DEP AGREEMENT NO. 22PLN68

ISLAMORADA, VILLAGE OF ISLANDS VULNERABILITY ASSESSMENT UPDATE & COMPLIANCE

Islamorada, Village of Islands

Final Project Report

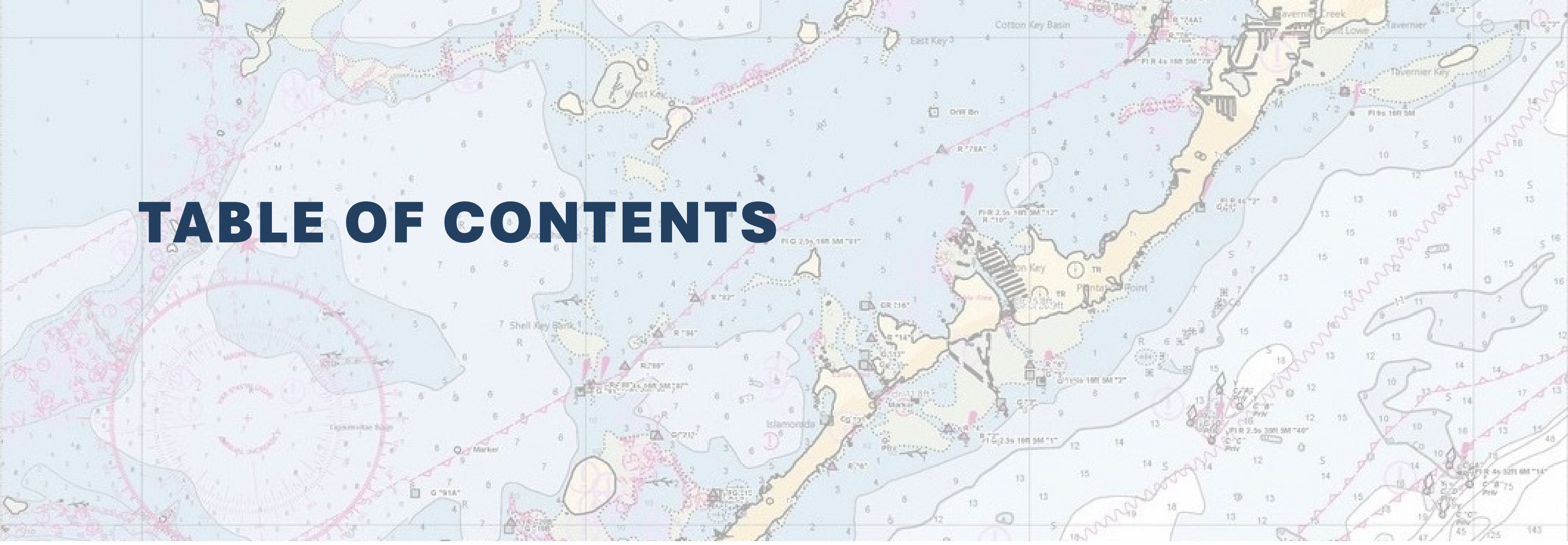
June 2024

This report is funded in part through a grant agreement from the Florida Department of Environmental Protection. The views, statements, findings, conclusions, and recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the State of Florida or any of its subagencies.

Islamorada, Village of Islands Vulnerability Assessment

Compliant with Resilient Florida Grant Program Requirements

June 2024



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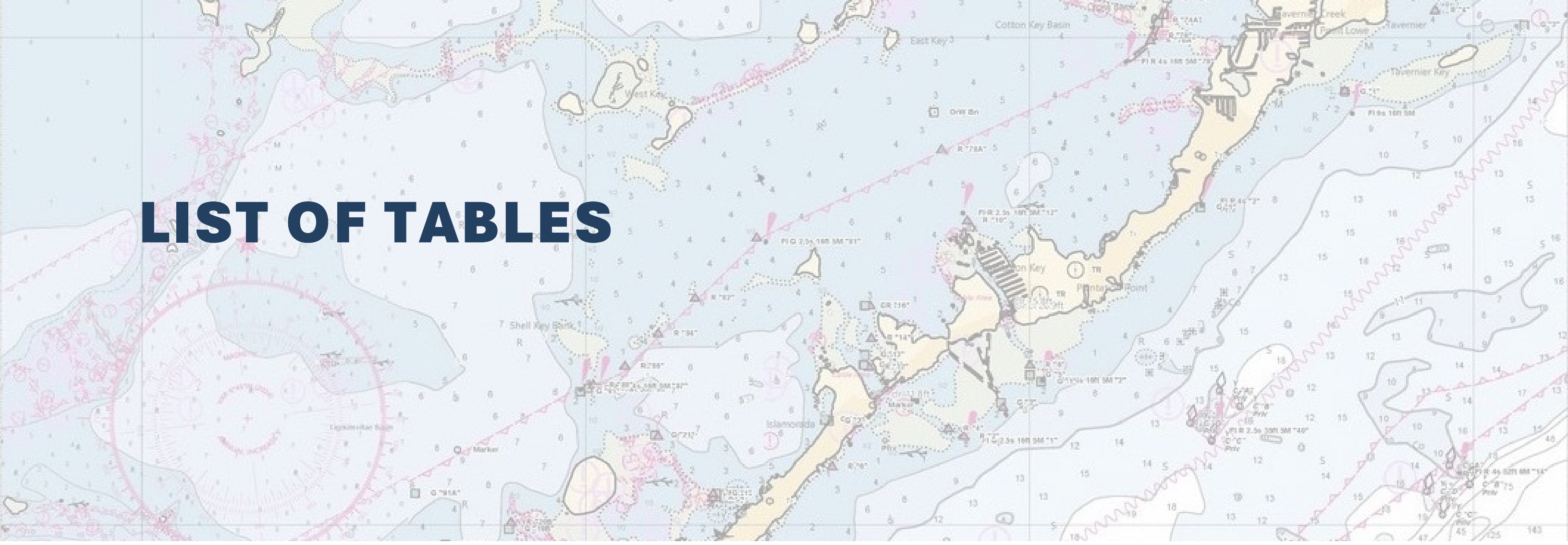

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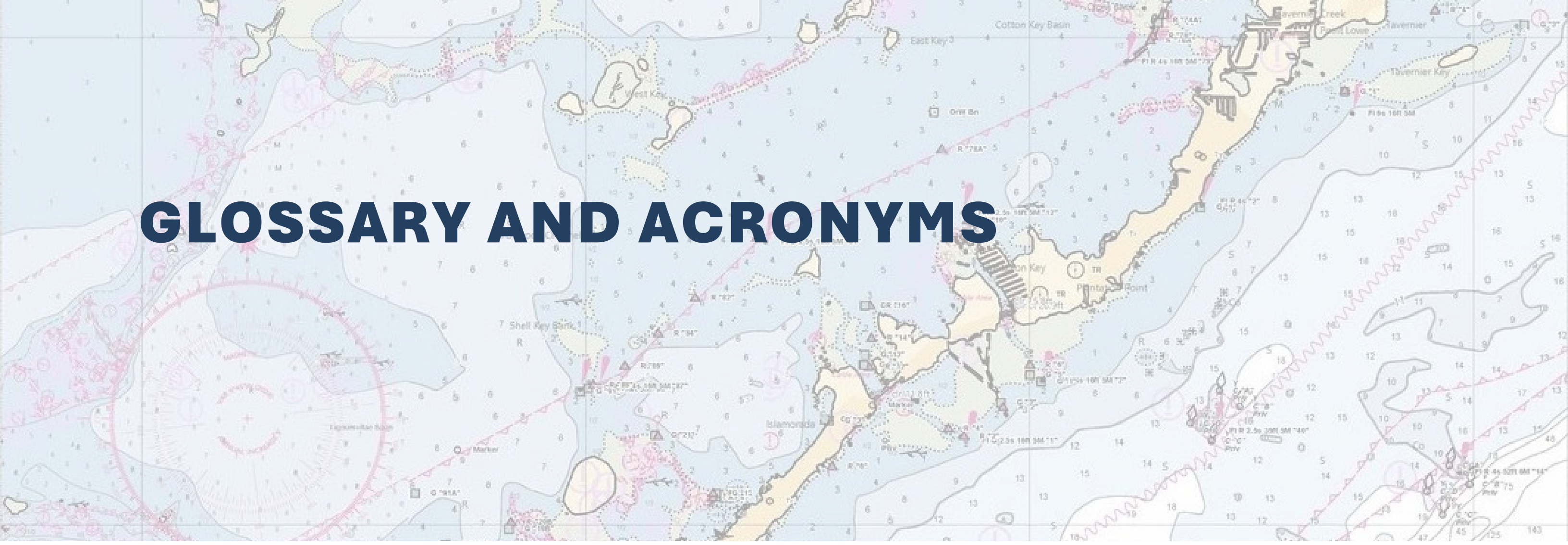


GLOSSARY AND ACRONYMS

Adaptation (to climate change) - The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. Adaptive capacity is the ability to make these adjustments.

Assets - People, resources, ecosystems, infrastructure, and the services they provide. Assets are the tangible and intangible things people or communities' value.

Bathtub Method / Model - The projected sea level rise at a point in time is added to the current water elevation and overlaid on the existing topography to identify inundated areas.

Climate Change - The increasing changes in the measures of climate over a long period of time - including precipitation, temperature, and wind patterns.

CRS - Community Rating System, a FEMA program that encourages communities to prepare for flooding events by awarding FEMA flood insurance premium discounts for completing floodplain management and other flood mitigation activities.

Exposure - The presence of people, assets, and ecosystems in places where they could be adversely affected by hazards.

FEMA - Federal Emergency Management Agency.

Global Warming - The rise in global temperatures due mainly to the increasing concentrations of greenhouse gases in the atmosphere.

Hazard - An event or condition that may cause injury, illness, or death to people or damage to assets.

Hazard Mitigation - When used by the Federal Emergency Management Agency (FEMA), the effort to reduce loss of life and property by lessening the impact of near future disasters.

IPCC AR5 RCP 8.5 Scenario - This condition is known as a representative concentration pathway for the concentration and trajectory of greenhouse gases was developed and intended by members of the Intergovernmental Panel on Climate Change (IPCC) to be a “very high baseline emission scenario” representing the 90th percentile of the volume of emissions that could occur in various future years if society does not make efforts to reduce greenhouse gas emissions. It is a “business as usual” scenario.

Impacts - Effects on natural and human systems that result from hazards. Evaluating potential impacts is a critical step in assessing vulnerability.

King Tide - A non-scientific term describing an especially high tide caused by alignment of the gravitational pull between the sun and moon. A King Tide usually occurs three to four times a year.

Mitigation (of climate change) - A human intervention to reduce emissions or enhance the sinks of greenhouse gases.

NIH - NOAA Intermediate-High Sea Level Projection.

NIL - NOAA Intermediate-Low Sea Level Projection.

NOAA - National Oceanographic and Atmospheric Administration.

Projections - The 2019 Unified Sea Level Rise Projections published by the Southeast Florida Regional Climate Change Compact. Potential future climate conditions calculated by computer-based models of the earth system. Projections are based on sets of assumptions about the future scenarios that may or may not be realized.

Relative Sea Level Rise - The way the height of the ocean rises or falls relative to the land at a particular location.

Resilience - The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption.

Risk - The potential total cost if something of value is damaged or lost, considered together with the likelihood of that loss occurring. Risk is often evaluated as the probability of a hazard occurring multiplied by the consequences that would result if it did happen.

Scenarios - A set of assumptions about the future regarding the level of mitigation efforts and other physical processes that have a level of uncertainty.

Sea Level Rise (Absolute Sea Level Rise) - The height of the ocean surface above the center of the earth, without regard whether nearby land is rising or falling.

Sensitivity - The degree to which a system, population, or resource is or might be affected by hazards.

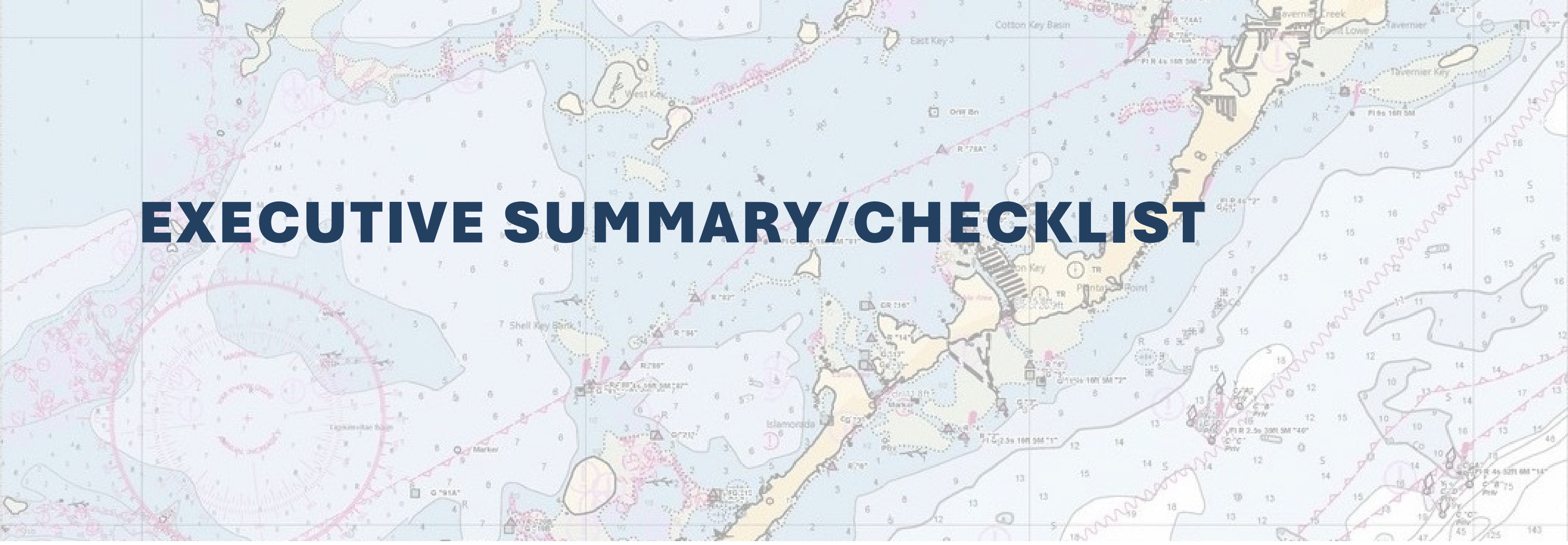
SLR - Sea level rise.

Uncertainty - A state of incomplete knowledge. Uncertainty about future climate arises from the complexity of the climate system and the ability of models to represent it, as well as the inability to predict the decisions that society will make.

Vulnerable populations - Vulnerable groups of people include those with low income, some communities of color, immigrant groups (including those with limited English proficiency), indigenous peoples, children and pregnant women, older adults, vulnerable occupational groups, persons with disabilities and persons with pre-existing or chronic medical conditions.

Vulnerability - The propensity or predisposition of assets to be adversely affected by hazards. Vulnerability encompasses the degree of exposure, sensitivity, potential impacts, and adaptive capacity.

Vulnerability Assessment - A process for identifying who or what is impacted by climate change. It is the combination of exposure, sensitivity, and adaptive capacity.



EXECUTIVE SUMMARY/CHECKLIST

This section serves as both an Executive Summary of the full Vulnerability Assessment Report, as well as an outline corresponding to the items in the Resilient Florida Grant Program Vulnerability Assessment Compliance Checklist Certification document distributed by the Florida Department of Environmental Protection (DEP). Headings and subheadings of sections in bold and / or italics with alphabetic letters in parentheses indicate the item identified in the DEP Checklist.

Final Vulnerability Assessment Report (a)

The complete Vulnerability Assessment Report can be found after this Executive Summary.

Results

The main takeaways of the Vulnerability Assessment:

- Flood risk is significantly elevated due to sea level rise, particularly in low-lying areas.
- The Village of Islamorada faces considerable disruption risks to critical assets, such as vital stormwater and transportation infrastructure.
- The local economy and vulnerable populations are at risk due to the significantly elevated flood risks now and in the future.
- Implementation of adaptation strategies are crucial for the Village of Islamorada to become a more resilient community.

Conclusions and Recommendations

In conjunction with this vulnerability assessment, the Village of Islamorada should consider the following recommendations to improve its climate resilience:

Electronic Mapping Data

Geospatial data (b)

Per FDEP requirements, a list of assets is included in the report. See Appendix C for a complete list of the data types/layers/sources.

GIS metadata (c)

GIS information supplied to FDEP contains the required metadata.

Critical assets impacted by flooding and sea level rise (d)

The GIS analysis underpinning this Vulnerability Assessment incorporates layers including critical municipal and regionally-significant assets found throughout Islamorada. Critical assets generally are those owned and maintained by the Village or are essential for the functioning of the Village. It should be noted that some critical assets may not be owned or maintained by the Village, for instance, health care or certain utility assets (such as water/wastewater and electric). Regionally significant assets are those that may not be owned by the Village but are no less critical to its functionality. These may be Federal, state or County assets.

Data summary for municipal assets

The following types of data were collected and evaluated for the project:

1. **Transportation Assets and Evacuation Routes**: airports, bridges, bus terminals, bus routes, boat ramps, major roadways, evacuation routes, port facilities, marinas, rail facilities, and railroad bridges.
2. **Critical Infrastructure:** wastewater conveyance structures and lift stations, potable water conveyance structures, stormwater drainage infrastructure and stormwater ponds, electric production and supply facilities, military installations, post offices, communications facilities, and disaster debris management sites.
3. **Critical Community and Emergency Facilities**: childcare facilities, schools, colleges, universities, assisted housing, community centers, emergency medical service facilities, fire stations, emergency management services, health care facilities, hospitals, law enforcement facilities, risk shelters, local government facilities, and state government facilities.

4. **Natural, Cultural, and Historical Resources**: This category is dedicated to preserving and protecting natural areas and cultural/historical sites, including historic buildings and cemeteries, places of worship, and other historical and cultural assets, Village and county parks, shorelines, surface waters, wetlands, and other terrestrial and aquatic natural areas.
5. **Supplementary Information**: This category includes additional data not explicitly required by Subsection 380.093, F.S., but valuable for a detailed vulnerability assessment. It encompasses FEMA's flood insurance study, flood zones, frequently flooded areas, soils, impervious surface areas, seawalls, land cover, land use, and property values.

Regionally-significant assets

Multiple asset types listed above would be considered regionally significant assets; they are due special attention. Given their specific mention in the statutory language which refers to critical assets that support the needs of communities spanning multiple geopolitical jurisdictions and, in this case, include:

- Commercial and Strategic Intermodal System (SIS) ports
- Airports (SIS)
- Bus terminals
- Evacuation routes
- Electric power transmission lines
- Drainage assets (including those maintained by water management district)
- Stormwater ponds
- Public water supply tanks
- Emergency medical services facilities
- Risk shelters

Asset layers were compiled initially in a comprehensive baseline asset inventory. This baseline asset inventory was reviewed multiple times throughout the data compilation process. During this exchange, the importance and relevance to resilience was discussed and a critical asset inventory was established. This serves as a foundational step for assets that are further analyzed in the vulnerability assessment. A more prioritized map series was produced which focused on the highest priority assets within the community and can be found in the Critical Asset Inventory.

Areas Prioritized in the Analysis

Figure 1 - Hot Spot Map

The project team generated these flooding "hot spots" based on the intensity of projected flooding caused by rainfall events and future sea level rise and the concentration of assets identified by the Village of Islamorada. An analysis of these hot spots was run to prioritize the assets within the hot spots based on level of flood impacts. Below are the results of this prioritization.

- Approx. 3,829 point assets within 9 geographic hot spots prioritized by:
  - Geographic area (Hot Spots 1-9)
- Immediate Need/Impact (Flood depth = inundation in modeled scenarios)
  - 540 assets were prioritized 1-3 (top 15% most vulnerable)

- 1,281 assets were prioritized 4-5 (4 – top 15 to 25% and 5 – top 25-50% most vulnerable)
- 2,006 assets were not prioritized (< 50%)

The "Hot Spot" Maps can be found in the Sensitivity Map Series.

Areas of Immediate Need

Based on the generated hot spots and collaboration with Village of Islamorada staff, the project team has prepared a prioritized list of assets that were identified as areas of immediate need and made recommendations for potential project improvements to alleviate impacts and increase the resiliency of each hot spot area. The selected locations are areas that are projected to be intensely impacted by future sea level rise. These located were compared to hurricane Irma impacts to ensure they reflected where flooding occurred during that event. Combining the two data sources provides insights into known and future areas of impact. Suggested improvements in Hot Spots should be further investigated at the engineering level for feasibility, design, cost and overall ability to alleviate current or future flooding risk.

Table 1 - Potential Improvements in Hot Spots

Hot Spot	Potential Improvements
Hot Spot 1: Coastal Utilities and Essential Service Area	• Elevate electrical and water management infrastructure • Implement sustainable landscaping around residential areas.
Hot Spot 2: Founder's Park Coastal Resilience Zone	• Reinforce sea walls and shorelines. • Elevate and secure critical infrastructure.
Hot Spot 3: East Ridge Resilience Sector	• Upgrade and elevate infrastructure for accessibility and safety. • Enhance electrical and wastewater systems. • Community preparedness and infrastructure hardening.
Hot Spot 4: Commerce and Resilience Quarter	• Elevate electrical and utility infrastructure. • Upgrade water and sewer infrastructure.

Hot Spot	Potential Improvements
Hot Spot 5: Historic Coastal Gateway	• Implement environmental and wetland enhancements. • Strengthen infrastructure resilience. • Protect historical structures.
Hot Spot 6: Southwind Resilience District	• Strengthen and protect sewer infrastructure. • Promote innovative building designs.
Hot Spot 7: Central Utility Lifeline Corridor	• Elevate and strengthen critical infrastructure. • Improve stormwater management.
Hot Spot 8: Coastal Corridor Protection Zone	• Protect electrical and wastewater infrastructure. • Preserve historical structures.
Hot Spot 9: Coastal Integration District	• Secure and elevate infrastructure. • Implement advanced stormwater management systems. • Enhance coastal and beach area protection.

Peril of Flood Compliance Plan amendments (e)

The Village of Islamorada Comprehensive Plan already complies with paragraph 163.3178(2)(f), Florida Statutes, pertaining to Peril of Flood; therefore, Peril of Flood amendments are not included within this Vulnerability Assessment.

Tidal Flooding

In the context of planning for future tidal flooding events, the Vulnerability Assessment Report for Islamorada incorporates detailed modeling techniques to predict how rising sea levels and high tide events will impact the area over several planning horizons (2040, 2070 and 2100). This modeling is particularly important given the Village's vulnerability to climate change-induced phenomena. The assessment uses the North American Vertical Datum of 1988 (NAVD 88) as a benchmark for all elevations, ensuring accuracy and consistency in projection data.

Key to the various flooding analyses (starting in this section with tidal flooding), is the complete map exposure series, included as Appendix D. A small sample of this map series is included in each of the sections detailing the various planning horizons, climate scenarios, and corresponding flood projections within this executive summary and complete Vulnerability Assessment. The first map included (Figure 2) shows the combination of sea level rise and high tide flooding (+2 feet MHHW[1]), alongside projections of the number of days tidal flooding is expected to occur. The climate scenarios represented within the model are based on NOAA's Intermediate-Low (NIL) and Intermediate-High (NIH) Sea Level Rise Projections from 2017, which were the required scenarios at the initiation of this Vulnerability Assessment. These projections provide a framework for understanding the range of possible future conditions, enabling the Village to prepare for a variety of outcomes.

The analysis employs geospatial temporal modeling techniques, leveraging tools like ArcGIS Pro and the VDATUM tool for datum conversion, to assist with simulating tidal flooding scenarios. This methodology employs the National Oceanic and Atmospheric Administration's (NOAA) mapping sea level rise inundation methodology, ensuring the assessment accurately captures the complexities of tidal flooding under various future scenarios.

Figure 2 - Sample Tidal Flooding Scenario Map

NIH 2070 SLR Projection and High Tide Flooding

[1] Two feet over MHHW is the FDEP-set threshold for high tide flooding.

Using this methodology, a representation of the analysis depicting a geographical display of the number of tidal flood days expected for each scenario and planning horizon is also included. This combination offers a nuanced view of the days each year that are expected to experience tidal flooding, contributing to a more comprehensive understanding of the temporal dynamics of flood risk.

Figure 3 - Approximate Number of Days of Tidal Flooding in 2070

Days of Tidal Flooding = SLR Projection and High Tide Flooding

This scenario utilizes the FDEP's recommendation to add two feet to the MHHW mark, enhancing predictions for future tidal flooding by accounting for increased sea levels and high tide events. This conservative approach aids in planning for more frequent and severe flooding, underscoring the need for robust coastal defenses like seawalls and natural barriers.

Building on the previous analysis, this section projects the number of days expected to experience tidal flooding, emphasizing its impact on daily life and the economy. It highlights the importance of comprehensive flood risk management strategies to mitigate these effects, aiming to ensure Islamorada's resilience and sustainable development amidst rising sea levels and changing climate conditions.

The scenarios of Sea Level Rise + High Tide Flooding and Days of Tidal Flooding together provide priority information to guide Islamorada's climate resilience strategy. They highlight expected changes along coastlines and low-lying areas, steering the conversation towards adapting urban plans, emergency readiness, and strengthening community resilience. Integrating these insights into Islamorada's long-term planning enables proactive responses to sea level rise and tidal flooding challenges, aiming for sustainable development and a resilient future for the community.

Storm Surge Flooding

This analysis leverages FEMA's storm surge data and the HAZUS-MH software, adjusting historical data monumented within the most recent effective Flood Insurance Study (FIS) from 2005 based on future sea level rise projections. It offers a detailed planning grade understanding of future storm surge impacts by integrating these projections with existing FEMA FIS data.

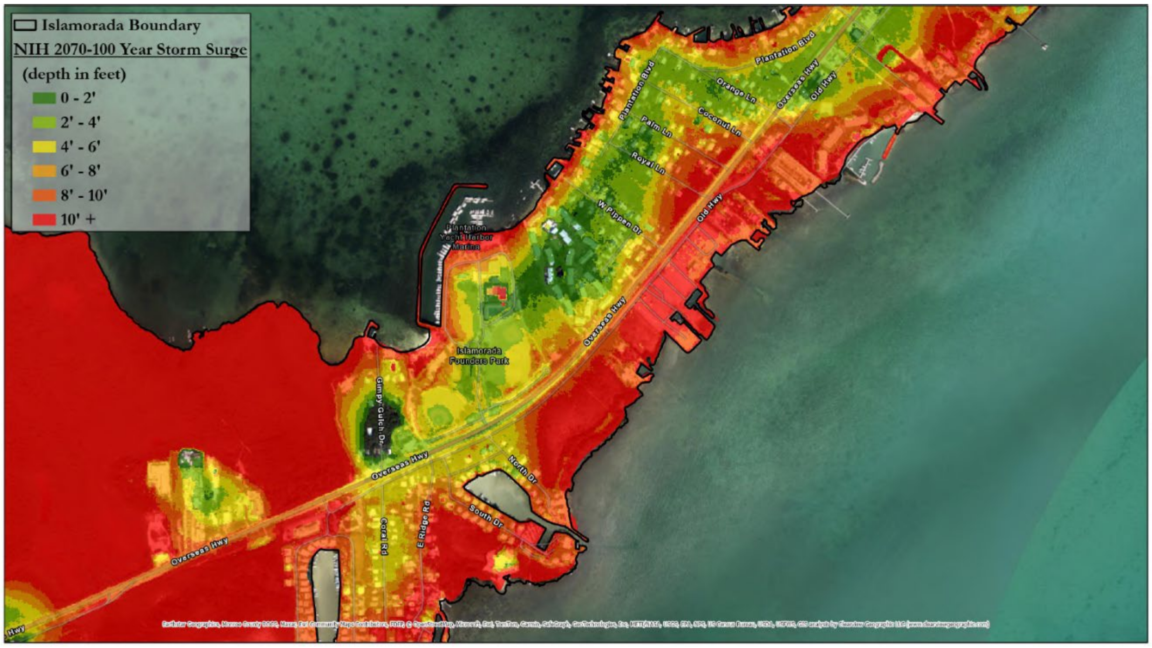
Depth of current and future storm surge flooding (h)

Using FEMA's comprehensive storm surge data in conjunction with HAZUS-MH software, historical storm surge events were adjusted to align with projected sea level increases for 2040, 2070, and 2100 planning horizons. This process enabled the prediction of storm surge depths across different timelines, providing a granular view of how storm surge flooding may evolve. The outcomes reveal significant increases in storm surge depths, underscoring the urgent need for adaptive infrastructure and planning measures to mitigate the impacts on vulnerable coastal communities.

Initial storm surge event equals or exceeds current 100-year flood event (i)

The initial storm surge event analyzed in this assessment equals or exceeds the magnitude of the current 100-year flood event as required by statute. This comparison highlights a stark increase in the severity and frequency of storm surge events, likely attributable to ongoing climatic changes and sea level rise. This implies that an event previously considered to be a once-in-a-century occurrence may now happen more frequently, requiring a reevaluation of flood risk assessments and flood zone designations. This finding is critical for updating building codes, insurance rates, and disaster preparedness plans to better reflect the heightened risk of significant storm surge flooding in the future. All storm surge maps can be found in the Exposure Map series.

Figure 4 - NIH 2070 SLR + 100-Year Storm Surge



The 100-year and 500-year storm surge scenarios are critical to understanding Islamorada's flood risks, with the former having a 1% annual chance of occurrence and the latter a 0.2% chance. These scenarios, crucial for urban and infrastructure resilience planning, consider the compounded impacts of climate change on storm surge risks using FEMA data and HAZUS-MH software, adjusted for future sea level rise. They provide a foundation for developing flood defenses, revising building codes, and crafting evacuation strategies. This comprehensive risk assessment aids Islamorada in proactive planning against storm surge flooding, ensuring a holistic approach by integrating with tidal flooding and sea level rise projections. It is a strategic effort to bolster the Village's resilience, protect its community, and maintain infrastructure integrity in the face of climate change.

Rainfall-induced Flooding (k)

Following the requirements of Section 380.093(3), F.S., this Vulnerability Assessment employs a spatiotemporal analysis, leveraging existing modeling results and developing new simulations to assess flood risk accurately. Use of the Hydrologic Engineering Center's River Analysis System (HEC-RAS) tool allows for detailed rainfall simulation and runoff computation. The integration of NOAA's Atlas 14 precipitation data and the South Florida Water Management District's (SFWMD) future rainfall change factors facilitates a comprehensive evaluation of potential future scenarios of rainfall-induced flooding. This methodological approach ensures that the assessment adheres to legislative requirements while providing a robust framework for predicting flood elevations under various conditions. All rainfall maps can be found in the Exposure Map series.

In the progression of the Vulnerability Assessment Report for Islamorada, attention shifts towards an equally pivotal domain: rainfall-induced flooding. This section meticulously outlines scenarios ranging from the more frequent 25-year events to the rare but devastating 1,000-year events, alongside adjusted projections that consider anticipated changes in climate patterns. Each scenario represents a distinct level of flood risk based on the probability and intensity of rainfall over a 24-hour period, thereby providing a comprehensive spectrum of potential flood hazards.

Future boundary conditions (l)

To account for the evolving nature of flood risk due to climate change, the future boundary conditions for this analysis have been carefully adjusted via overlays and change coefficient multipliers. These modifications incorporate elements of sea level rise and high tide conditions to the extent practicable, ensuring that the assessment reflects the most accurate and relevant scenarios for evaluating future flood risks. By doing so, the study aligns its predictions with the latest climate science, providing a more realistic projection of flood elevations and areas at risk.

The assessment adjusts the 25-year and 100-year 24-hour scenarios to reflect the impact of climate change on rainfall patterns, offering a forward-looking analysis of flood risks. By incorporating projections of increased rainfall intensity and frequency, these scenarios provide a clearer picture of potential future flood hazards. This comprehensive approach enables Islamorada to adapt its infrastructure and policies to the realities of a changing climate, ensuring informed decision-making in flood mitigation and resilience planning. This effort is vital for maintaining community well-being and sustainable development amidst the challenges posed by more frequent and intense rainfall events.

Depth of rainfall-induced flooding (m)

The analysis delves into the projected depths of rainfall-induced flooding for significant storm events, specifically the 25-year, 50-year, 100-year, 500-year, and 1,000-year storms. By examining these scenarios, the study identifies critical areas that are likely to experience substantial flooding, thus presenting a clear picture of the potential impact on infrastructure and communities. The depth of flooding is quantified through detailed maps and tables, offering valuable insights into the spatial distribution of flood risks.

The study presents its findings through a series of maps and tables that visualize the depth and extent of rainfall-induced flooding for all storm scenarios within the exposure series. These mapped visual aids facilitate a better understanding of the spatial distribution of flood risks, enabling stakeholders to identify high-risk areas and prioritize mitigation efforts accordingly.

100-year storm

This scenario predicts the extent and depth of flooding likely to occur with a 1% chance of occurring during any given year, providing a baseline for flood risk management and urban planning. This concept is widely used in flood risk management and planning to design standards for infrastructure resilience, such as levees, dams, and floodplains.

Figure 5 - Present Day - 100-Year 24-Hour Rainfall

The 100-year 24-hour scenario, modeling a severe storm with a 1% annual occurrence chance, is essential for guiding flood risk management and urban development strategies. It informs the creation of flood mitigation infrastructure, zoning laws, and insurance policies, pinpointing areas for strategic investments to lower flood risks and bolster community resilience.

500-year storm

An assessment of the more extreme but less frequent 500-year storm event gives insights into the potential for catastrophic flooding, informing long-term resilience strategies. It signifies a storm that has a 0.2% chance of occurring in any given year. This statistical measure is used to describe the severity and likelihood of extreme weather events, helping in the planning and construction of infrastructure designed to withstand such rare but potentially devastating storms.

Figure 6 - Present Day - 500-Year 24-Hour Rainfall

The 500-year 24-hour scenario, modeling an extreme rainfall event with a 0.2% annual chance, is vital for assessing the maximum flood risk potential, identifying areas and infrastructure at risk of severe flooding. This scenario underscores the need for extensive planning and advanced mitigation efforts to prepare for and reduce the impacts of such catastrophic events.

Higher frequency storm analyzed for exposure of a critical asset (j)

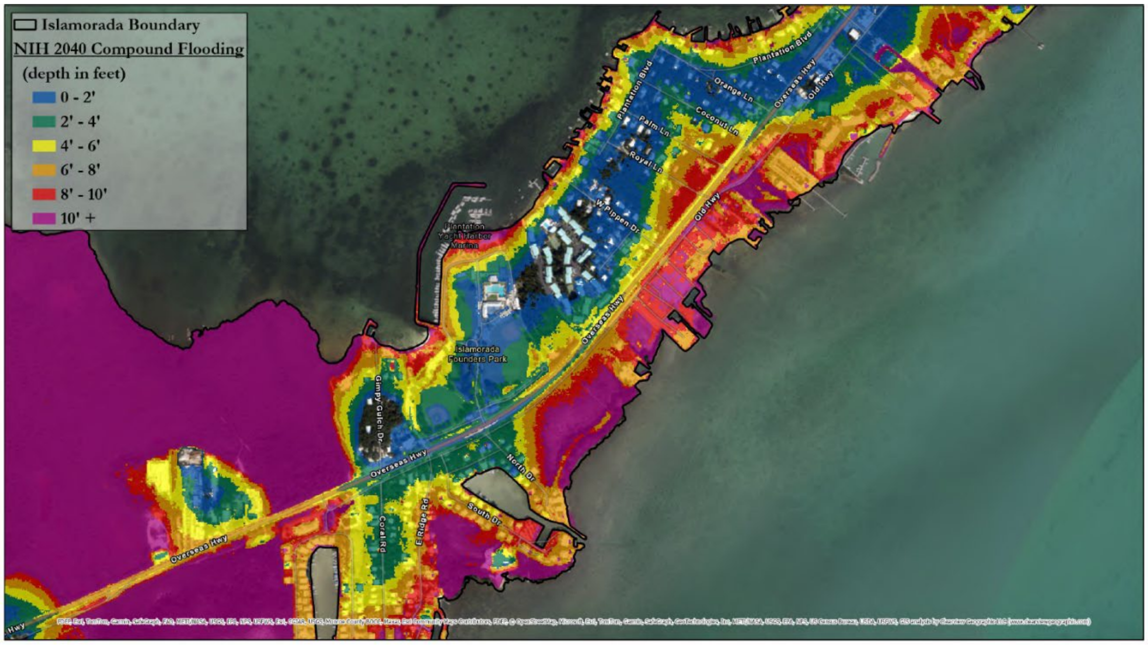
In addition to the standard 100-year and 500-year storm scenarios, the analysis also includes a detailed examination of higher frequency storms to assess the exposure of critical infrastructure and assets. This focused analysis helps in identifying vulnerabilities and planning for protective measures to safeguard essential services and facilities against the impact of more frequent, higher-intensity flooding events. Further exploring a range of storm events, including the 25-year, 50-year, 100-year, 500-year, 1,000-year storms, provides a more comprehensive overview of flood risks over a spectrum of probabilities meeting and exceeding the statutory requirements for Vulnerability Assessments. This detailed assessment, summarized in accompanying tables, aids in the development of a nuanced flood risk management strategy that addresses both common and severe flooding scenarios.

The rainfall scenarios ranging from 25-year to 1000-year events provide a comprehensive spectrum of flood risk assessments essential for Islamorada's flood management and urban planning. The 25-year scenario, with a 4% annual chance, highlights moderate flooding risks, emphasizing the need for improved drainage and community preparedness. Progressing in severity, the 50-year scenario (2% chance) evaluates the adequacy of flood defenses and critical infrastructure resilience. The 100-year scenario is a key benchmark in flood risk management, guiding urban development, flood mitigation, and zoning with a 1% occurrence chance. It calls for strategic investments to enhance community resilience. The 500-year scenario, reflecting a 0.2% chance of extreme rainfall, and the 1000-year scenario, with a 0.1% chance, both underscore the importance of comprehensive planning and robust mitigation to address the highest levels of flood risk and potential catastrophic impacts. Collectively, these scenarios underscore the necessity of a forward-looking approach to urban planning, emergency management, and resilience building against increasing flood risks.

Compound/Combined Flooding (n)

This segment addresses the compound effects of tidal, storm surge, and rainfall-induced flooding under various scenarios primarily focused on the 100-year and 500-year storm surge events plus 25-year and 100-year rainfall events with the compounding effect of sea level rise. It involves overlaying depth grids from various scenarios, acknowledging the resource and time constraints of the project. Combined flooding maps can be found in the Exposure Map series.

Figure 7 - NIH 2040 SLR + 100-Year Surge + 25-Year 24-Hour Rainfall



Through the comprehensive analysis of these compounded scenarios, the report underscores the importance of integrating multidimensional flood risk assessments into urban planning and infrastructure development. Such detailed projections facilitate the strategic implementation of adaptation and mitigation strategies, ensuring that communities are better prepared and more resilient to the increasingly complex and severe flooding challenges posed by climate change.

Scenario Development Specifications

North American Vertical Datum of 1988 (o)

All elevations referenced in and analyzed for this Vulnerability Assessment are expressed in North American Vertical Datum of 1988 (NAVD 88) values. Any exceptions are limited and are specifically noted in the Vulnerability Assessment and further appendices.

Local Sea Level Rise Scenarios (p)

The sea-level rise scenarios included in the Vulnerability Assessment include the 2017 NOAA Intermediate-Low (NIL) Sea Level Rise Projection and the 2017 NOAA Intermediate-High (NIH) Sea Level Rise Projection. These scenarios were the required scenarios when this Vulnerability Assessment was initiated prior to July 1, 2024. However, legislation adopted by the Florida Legislature and signed into law by the Governor in 2024[2] would shift these required scenarios to the 2022 NOAA Intermediate Low and Intermediate scenarios for Vulnerability Assessments initiated after July 1, 2024. The Village should consider this in future updates to this Vulnerability Assessment. The selected NOAA 2017 and 2022 projections align for 2040; however, the NOAA 2017 projections are higher for the 2070 and 2100 scenarios and thus more conservative for planning purposes.

The benefit of evaluating a range of conditions is that the Village can determine the tolerance for risk for any adaptation strategy decision and act upon data from this analysis that reflects a wider range of conditions. For assets, adaptation projects and policy decisions where there is a higher criticality for that decision, the higher end of the projections and output should be considered. Where there is a lower tolerance for flood impact, the lower end of the projections could be considered. The range provides options needed for more place-based and flood impact decision-making.

Planning horizons (q)

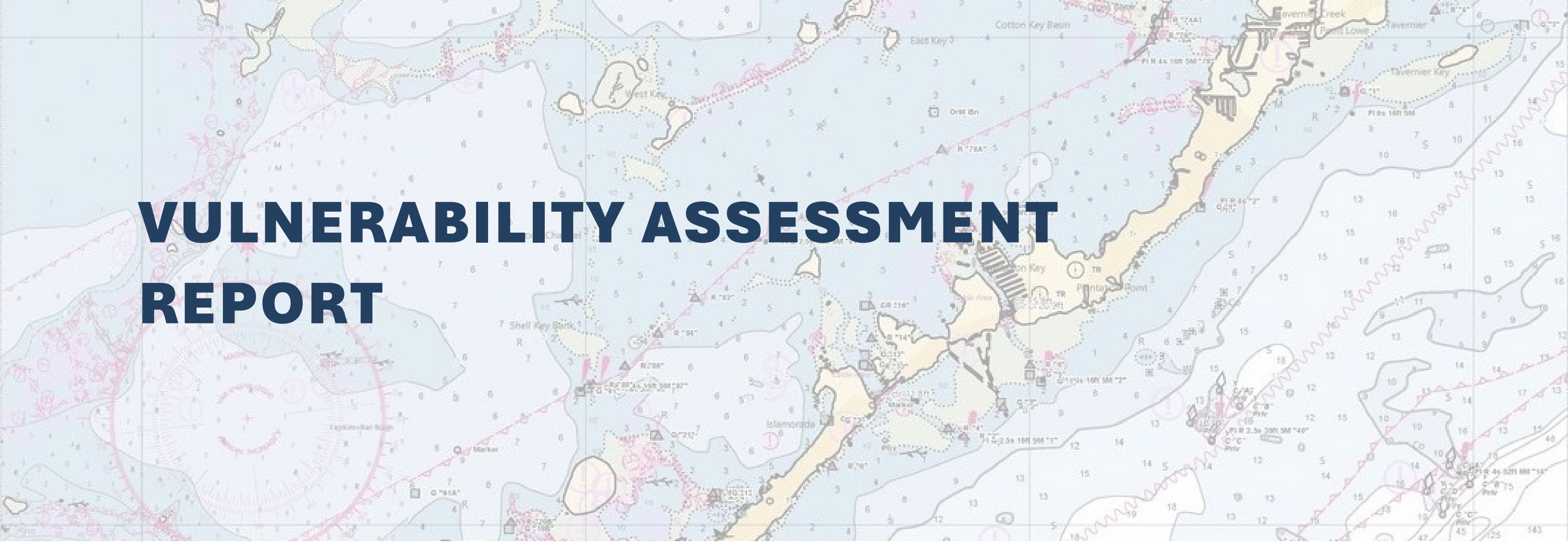
The planning horizons for this assessment coincide with NOAA's forecasting years: 2040, 2070 and 2100. While Section 380.093(3), F.S., only requires the 2040 and 2070 planning scenarios, this Vulnerability Assessment also includes the 2100 condition.

Sea level data selection (r)(s)

According to statute, vulnerability assessments must include local sea level data that has been interpolated between the two closest National Oceanic and Atmospheric Administration tide gauges or use the sea level data from whichever of those two nearest gauges reports a higher mean sea level.

For Islamorada, this Vulnerability Analysis uses NOAA's VDATUM software to interpolate between the two closest tide gauges, Vaca Key (8723970) and Key West (8724580). This interpolation is integrated directly into the exposure analysis methodology by converting the original North American Vertical Datum of 1988 (NAVD88) elevations from the Digital Elevation Model (DEM) to the localized vertical tidal datums. By aligning the DEM elevations with data from local tide gauges, this conversion ensures accurate and consistent comparisons, correctly reflecting local sea level elevations and allowing precise data manipulations.

[2] Signed into law by the Governor on May 13, 2024.



VULNERABILITY ASSESSMENT REPORT

Introduction

This Village of Islamorada Vulnerability Assessment (2024) represents the latest in a series of steps taken by the Village of Islamorada (Village) to build its resilience to the impacts of climate change, most notably sea level rise, precipitation, and combined flooding impacts. This document also complies with the criteria established by the State of Florida in 2021 for eligibility for resiliency infrastructure grants annually evaluated and ranked for appropriations in the Statewide Flooding and Sea Level Rise Resilience Plan. Those requirements, detailed in subsection 380.093(3), F.S., name the “components, scenarios, data, and information” that must be included for a vulnerability assessment to be considered complete.

Even more importantly, however, this Vulnerability Assessment assists the Village of Islamorada in protecting its residents, infrastructure, properties, natural landscapes, and way of life from the threats of sea level rise and extreme flooding.

Islamorada knows that the need for climate adaptation and mitigation planning does not exist in a vacuum, but rather stems from evidence of increasing sea levels and damaging rain and storm events, recognition of serious future risks, and the stark damage flooding is already causing in the region. Faced with these realities, the Village of Islamorada is pursuing an aggressive and overarching planning strategy to address underlying climate change threats.

Background

As a Village of Islands, connected to each other and mainland Florida by a single major road, and subjected to the unpredictable natural violence of tropical storms, Islamorada has grappled with issues of sustainability and resilience for as long as it has been settled by humans. Its modern history of engagement on these issues dates to at least 2007, when the Village adopted an Environmental Sustainability Plan. Resilience and climate preparedness issues were not central to this Plan, but it did place significant attention on stormwater management and land conservation. The Plan was updated and revised numerous times over subsequent years, including the addition of goals and objectives pertaining more directly to sea level rise, climate change impacts, and climate adaptation and resilience.

In 2016, the Village completed *Islamorada Matters: A Plan to Enhance, Preserve and Protect Our Quality of Life,* which focused heavily on sea level rise and flooding threats and the climate resilience measures needed to adapt to these risks. Indeed, four of the five focus areas named in the plan addressed some aspect of resilience – habitat conservation, protection of infrastructure/built environment, making Village facilities resilient, and general adaptation strategies – while the fifth, sustainability, focused on measures that lower the Village's own contributions to climate change.

More recently, Islamorada's resilience planning and implementation efforts have been supported by the State of Florida, through its Resilient Florida program. Among many other provisions, the Statewide Flooding and Sea Level Rise Resilience Act (SB 1954/HB 7019), approved by the Legislature in April 2021 and Governor DeSantis in May 2021, (now Section 380.093, F.S.) created the Resilient Florida Grant Program to provide funding to local governments for resilience planning grants and creation of the process to establish the annual Statewide Flooding and Sea Level Rise Resilience Plan appropriating annual funding for resilient infrastructure upgrades. State funding is predicated on local governments identifying assets at risk via vulnerability assessments conducted according to requirements detailed in the legislation and providing prioritized lists of proposed projects to the state. DEP is also charged with creating a statewide vulnerability assessment based on the local assessments.

Notably, Islamorada was one of the first communities to apply for and win funding through the Resilient Florida program. In the first year of funding, Fiscal Year 2021-22, the Village was awarded a Resilient Florida Planning Grant ($178,100) by the Florida Department of Environmental Protection (DEP) to create this Vulnerability Assessment. It also won two Resilient Florida implementation grants in that initial year: $1.9 million for Founders Park Breakwater Restoration and $17.5 million for Transmission Main Adaptation in partnership with FKAA.

Islamorada has also been an active participant in emergency management planning and programs which consider strategies for improving the long-term resilience of the community to natural hazards by reducing risk for people and property. These efforts include the Local Mitigation Strategy for Monroe County and its municipalities (the original 2010 strategy and subsequent updates in 2015 and 2021) and the 2012 Hurricane Evacuation Management Plan and Interlocal Agreement between Monroe County, its municipalities, and the State of Florida.

Public Participation and Engagement

Community resilience is the capacity of governments, individuals, organizations, institutions, and businesses to plan for, respond to, withstand, and bounce back from acute and chronic stressors related to climate change impacts, including sea level rise, flooding, and more intense storms. To successfully build long-term community resilience, stakeholders must be consulted and invited to shape planning processes and decisions about adaptation measures and infrastructure investments. Otherwise, these policies will lack the broad-based public support needed to sustain them over the long term and through political or economic challenges.

Resilience Initiatives in Islamorada

2016 Islamorada Matters Plan Recommendations

The Village's 2016 Islamorada Matters Plan evaluated the Village's level of climate preparedness and investigated the potential impacts of sea level rise, exceptionally high tides, storm surge, and other sea level rise and flooding issues. As vulnerability and sea level rise modeling data were developed for the project, candidate adaptation strategies were developed and publicly discussed, and a series of public meetings were held to help the community understand what Islamorada will face and what can be done to manage the challenges.

Each of the Plan's five focus areas put forward three top recommendations, and many have been advanced in part or in full since 2016:

Habitat

- ***Update Stormwater Master Plan to include sea level rise assumptions and incorporate green infrastructure feature as a priority.*** This effort is currently underway.

- ***Conduct a habitat analysis to document species, condition, size and location of trees within the Village.*** The Village has performed these analyses in certain parks and conservation areas, but not Village-wide. Furthermore, proposals for development in areas containing mapped habitat are required to conduct a habitat analysis, including a vegetation survey and mitigation plan.

- ***Identify areas where living shorelines are most appropriate and develop guidance for implementation, monitoring, and evaluation.*** The Village has identified these areas but has not yet developed guidance documents.

Infrastructure and Built Environment

- ***Improve data related to properties and infrastructure facilities including digitizing all building footprints.*** The Monroe County Property Appraiser has digitized building footprints for some condominium buildings, but not all buildings.

- ***Identify key road segments for retrofits with coordinating agencies. Develop a database of real-time flood impacts.*** This effort is currently underway.

- ***Establish adaptation action areas or zoning overlays where enhanced design criteria will be developed.*** The Village is expected to consider these options as an outcome of the current projects related to roads and stormwater master planning.

Village Buildings and Key Facilities

- ***Consider sea level rise impacts in capital planning by identifying critical assets (habitat and infrastructure) over time.*** Identification of critical assets is a part of this Vulnerability Analysis.

- ***Conduct detailed site-level flood exposure audits for the wastewater pump station (142 Sunshine Boulevard) and Islamorada Master Repump Station, and access to wastewater infrastructure.***

- ***Develop long-term flood resilience alternatives for Fire Station #19, located at 74070 U.S. Highway 1.*** The fire station is currently undergoing dry flood proofing upgrades, using Hazard Mitigation Grant Program funding.

Adaptation Strategies

- ***Continue discussing sea level rise vulnerability with residents and stakeholders.*** Conversations linked to this Vulnerability Assessment represent the latest stage in this ongoing effort.

- ***Develop and implement a GIS database for Village employees/interested residents to document nuisance floods.*** Although this specific idea has not been implement, the Village's Building Department has adopted Forerunner floodplain management software, which might support any future efforts to document nuisance flooding.

- ***Ensure that future flood vulnerability assessments build upon the work in the Islamorada Matters project.*** This Vulnerability Assessment considers Islamorada Matters a foundational effort supporting the current work.

Sustainability

- ***Promote a cultural shift aimed at saving money and reducing carbon emissions.*** Discussions continue within the Village regarding potential advancements of this recommendation. Closer collaboration with the Southeast Florida Regional Climate Change Compact, most notably adoption of the Southeast Florida Climate Action Pledge in July 2023.

- ***Consistently highlight available/pending incentives for residents desiring to perform energy retrofits or renewable energy deployment.*** The Village is linking its website to the Florida Keys Electric Cooperative, to inform residents about its rebate programs.

- ***Adopt more energy efficiency for buildings within the jurisdiction.*** Discussions continue to determine a path forward for this recommendation, including conversations with other sustainability coordinators and the City of Key West on potential energy auditing platforms.

Stormwater Improvements

Stormwater Master Planning

In 2000, the Village of Islamorada developed a Stormwater Master Plan to address water quality improvements to the stormwater discharges into Village canals and nearshore waters of Florida Bay and the Atlantic Ocean. Initial funding for the implementation of the Master Plan for fiscal years 1999 –2001 was obtained from various agencies, including the South Florida Water Management District (SFWMD), the Florida Department of Transportation (FDOT), and the Florida Department of Environmental Protection (DEP). This was driven by numerous studies, identifying the concerns of pollutants on the declining nearshore water quality. The Master Plan allowed the Village to implement corrective actions and preventative measures to minimize stormwater pollutant loading to canals, near shore waters, and provide solutions that account for natural and ecological resources. Additionally, the Master Plan identified management initiatives such as regulatory ordinances and Best Management Practices (BMPs) to protect the health and safety of the ecosystem and public and private property.

The Village's Master Plan included identification of drainage basin boundaries, on-site evaluation of existing drainage structures, assessment of natural areas, and assembly of the data into the stormwater Geographical Information System (GIS) Management System. Results of the Master Plan include Event Mean Concentration (EMC) of the four separate islands within the Village including Plantation Key, Windley Key, Upper Matecumbe Key, and Lower Matecumbe Key. These areas were individually evaluated based on their respective EMC parameters, individually ranked per their priority, provided proposed BMPs, and estimated for cost of future implementation.

However, among the requirements for the Five-Year Work Program was the establishment of financial mechanisms to generate sufficient revenue for a long-term stormwater management program. At the time of the 2000 Stormwater Master Plan, the Village did not have a source of future funding for implementing stormwater improvements. In response to supplemental financial support of the Village Master Plan, a few opportunities were identified. These included Federal, state, and coastal programs as well as low interest loans, development of Village ordinances, stormwater utility, and private endowments.

Islamorada's Stormwater Design Criteria Technical Manual (2016) was created as a supplementary and illustrative guide to the Stormwater Management Master Plan. This Technical Manual contains forms and procedures, minimum design standards, other details, and maintenance requirements for stormwater management to provide technical assistance to those submitting a stormwater management plan for development and to aid and accompany the stormwater regulations. This Manual superseded the previous Manual, dated February 2002.

Islamorada will be updating its Stormwater Master Plan over the course of the coming year, following the completion of the Mobile LiDAR data discussed in following section.

Stormwater Assessments

On August 23, 2005, the Village Council adopted Ordinance No. 05-15 (the "Assessment Ordinance"), thereby authorizing the imposition of Stormwater Service Assessments against real property benefited by the Village's provision of Stormwater Management Services. Pursuant to this Assessment Ordinance, the Village imposed Stormwater Service assessments for the first time beginning in November 2005. The funds generated by this assessment are used to fund stormwater service costs within the Village's Stormwater Utility Enterprise Fund. The Assessment Ordinance requires that the Village annually adopt a final rate resolution for each subsequent fiscal year.

Mobile LiDAR

Islamorada is currently securing mobile LiDAR data across its territory to better understand the elevation changes along owned and maintained roadways and critical infrastructure within the Village. The mobile LiDAR survey will be executed in accordance with the FDOT terrestrial mobile LiDAR (TML) Type A Survey standards to achieve the required accuracies. This includes specific target and validation point spacing, point density requirements and redundant / multiple pass measurements. The dataset is expected to be completed February 2024.

Other Regional Efforts

Monroe County

Monroe County has been engaged in resiliency, climate, and sustainability planning since 2010 when it first hired a staff person to head the County's sustainability and climate initiatives. That effort was concurrent with the award of American Reinvestment and Recovery Act (ARRA) funds and was one catalyst in undertaking these broader planning and infrastructure initiatives. This led to the County's first sustainability and resiliency planning document known as GreenKeys. Concurrent with the development of GreenKeys, the Village of Islamorada produced its first previously referenced climate planning document known as Islamorada Matters.

The County has continued its resiliency planning initiatives and coordination between the County and the Village on these initiatives has increased. The County has amended provisions of its Comprehensive Plan and integrated sea level rise policy initiatives into the Plan and its Code of Ordinances. The County also produced its first Vulnerability Assessment in 2015 in conjunction with the GreenKeys Planning process. The County also produced a credited CRS Watershed Management Plan in 2019 and was awarded 120 points for that effort. This WMP was one of the first in the Country to incorporate the new guidance related to sea level rise into the effort evaluating the NOAA Intermediate High 2100 condition. The County undertook numerous other policy initiatives, such as a specific state-mandated update of its Coastal and Conservation Element of the Comprehensive Plan to comply with new state guidelines. The County updated its Vulnerability Assessment work in 2021 and is currently proceeding with a further Vulnerability Assessment update to ensure it meets the requirements of the state's Resilient Florida program guidelines, enacting into law in 2021.

The County also initiated a planning effort in 2020 to conduct a Roads Vulnerability Analysis and Capital Plan. This extensive engineering-based effort has been based on updated and highly accurate mobile LiDAR previously collected by the County and evaluates the vulnerability and criticality of the County's roadways. The Plan includes conceptual engineering design, cost estimates, and a timetable in five-year increments to undertake road elevation, stormwater, and tidewater adaptation projects. The County and municipalities have engaged in extensive coordination to expand that planning process across the entirety of the Keys including the municipalities. The County has recently launched a Natural Resources Adaptation planning process to determine the cost-benefit and natural resources adaptation priorities in the County. Finally, the County has begun implementing several road elevation/adaptation and shoreline projects according to state and federal grants and appropriations received.

Florida Department of Transportation (FDOT)

FDOT has developed a statewide Resilience Action Plan (RAP), as required by Section 339.157, F.S. As a major state roadway, the Overseas Highway, US-1, is included within the plan's purview. The plan seeks to enhance infrastructure and operational resilience, design retrofits and construction of highway facilities, and strengthen partnerships to address multijurisdictional needs. The RAP assesses potential impacts of storms, flooding, and sea level rise on the State Highway System, and identifies strategies to improve the resiliency of Transportation facilities. FDOT recently initiated development of the Statewide Resilience Improvement Plan (RIP), which will build on the prior statewide RAP analysis and could potentially secure additional federal funding identified by the plan.

The current RAP includes a priority project list, which categorizes short term projects in line with FDOT's five-year work program and long-term projects based on their respective needs and cost-feasible long-range plans. The priority project list also identifies geographic areas that may be subject to water-related hazards. According to the RAP Project List (Appendix A of the RAP), Islamorada falls under the medium tier project category.

Florida Keys Aqueduct Authority

The Florida Keys Aqueduct Authority (FKAA) has provided data to both the Village of Islamorada and Monroe County in their efforts to conduct Vulnerability Assessments and the Village's Watershed Management Plan. Data regarding critical facilities has been incorporated into baseline asset maps referenced later within this document. Although the Village does not own or manage FKAA assets, they are still considered "regionally significant" and will be evaluated under the scenarios required by Section 380.093, F.S. and incorporated into the Critical Asset Inventory.

FEMA Community Rating System

Since its creation in 1968, the National Flood Insurance Program (NFIP) has provided federally-backed flood insurance in communities that enact and enforce floodplain regulations. By requiring communities to plan for and protect against a 1%-average-annual-chance flood event (also known as a 100-year flood event), the NFIP encourages the regulation of development in flood areas.

The Federal Emergency Management Agency (FEMA) oversees the NFIP and administers its Community Rating System, a voluntary program that offers NFIP insurance rate reductions for property owners in communities that exceed the minimum NFIP participation requirements through certain additional floodplain management and conservation activities. Local governments are classified according to their total CRS scores.

Islamorada joined CRS in October 2015 and has continually advanced in the CRS program. In 2021, Islamorada was awarded a CRS Class 5, scoring 2,879 CRS credit points. The Class 5 designation affords most NFIP policy holders a 25% percent discount annual discount on flood insurance. Table 2 below shows CRS participation in Florida and the percentage reduction in flood insurance rates associated with each rating class.

Table 2 - CRS Participation in Florida

CRS Class	Number of Florida Communities	NFIP Discount
9	17	5%
8	40	10%
7	53	15%
6	72	20%
5	58	25%
4	1	30%
3	4	35%

Discounted flood insurance provides a powerful incentive for communities to take steps that will reduce flood damage to existing buildings and manage development in certain unmapped areas, encouraging the restoration and preservation of the natural functions of floodplains.

CRS provides both incentives and tools to further the goals of providing flood insurance to property owners, reducing flood loss, and saving taxpayers' money. With the Village participating in the program, property owners can receive discounted flood insurance premium rates; with effective floodplain management, the community becomes more resilient.

These rate reductions are due, in part, to the Village's initiatives that help to implement three basic CRS goals:

1. Reduce flood damage to insurable property. The CRS program encourages communities to reduce the exposure of existing buildings (and their contents) to flood damage, especially properties that have flooded multiple times. Standards exceeding the minimum criteria of the NFIP may be needed to protect buildings and contents from flood hazards. The CRS encourages communities to map and provide data on their flood hazards and employ such data in their regulatory programs.

2. Strengthen and support the insurance aspects of the NFIP. Communities are awarded CRS points for activities that support accurate risk rating of flood insurance premiums, through mapping and information programs that help assess individual property risk and reduce repetitive flood losses. Local governments can receive additional points for informing residents of their flood risk and inducing them to purchase and maintain flood insurance policies.

3. Encourage a comprehensive approach to floodplain management. The CRS program encourages communities to use all available tools to implement comprehensive local floodplain management programs, which can address concerns beyond the protection of insurable property. The CRS program recognizes local efforts that protect lives; advance public health, safety, and welfare; minimize damage and disruption to infrastructure and critical facilities; preserve and restore the natural functions and resources of floodplains and coastal areas; and ensure that new development does not shift adverse impacts to other parts of the watershed or other properties. Understanding the physical and biological processes that form and alter floodplains and watersheds allows communities to appropriately address flooding, erosion, habitat loss, water quality, and special flood-related hazards. The "comprehensive approach" envisioned by the CRS program includes planning, public information, regulations, financial support, open space protection, public works activities, emergency management, and other appropriate techniques.

CRS Requirements and Creditable Activities

In recognition of the fact that "floodplains and watersheds change over time" due to "many natural and manmade changes," the CRS Manual introduced a series of credit options for "community efforts to anticipate" future flood risk in relation to climate change. Because sea level rise is expected to be an increasingly critical issue for floodplain management, many of the credit options and assessment criteria for coastal communities specifically refer to studies of sea level rise impacts on future hydrologic conditions and local drainage systems.

These options are summarized in section 116.c of the CRS Manual as:

1. Credit is provided in Section 322.c for communities that provide information about areas (not mapped on the Flood Insurance Rate Map (FIRM) that are predicted to be susceptible to flooding in the future because of climate change or sea level rise.

2. To achieve CRS Class 1, a community must receive credit for using regulatory flood elevations in the V and coastal A Zones that reflect future conditions, including sea level rise.

3. Credit is provided in Section 342.d when prospective buyers of a property are advised of the potential for flooding due to climate changes and/or sea level rise.

4. Credit is provided in Section 412.d when the community's regulatory map is based on future-conditions hydrology, including sea level rise.

5. Credit is provided in Section 432.k when a community accounts for sea level rise in managing its coastal A Zones.

6. Credit is provided in Section 452.b for a coastal community whose watershed master plan addresses the impact of sea level rise.

7. Credit is provided in Section 512.a, Steps 4 and 5, for flood hazard assessment and problem analyses that address areas likely to flood and flood problems that are likely to get worse in the future, including (1) changes in floodplain development and demographics, (2) development in the watershed, and (3) climate change or sea level rise.

There are 19 creditable CRS activities organized under four categories as reflected in Table 3. Each of the 19 activities has one or more elements. The CRS Manual assigns credit points based on the extent to which each activity advances the goals of the CRS, which are 1) to reduce and avoid flood damage to insurable property, 2) to strengthen and support the insurance aspects of the NFIP, and 3) to foster comprehensive floodplain management.

The table below outlines the CRS Activities and the current scores in each of the CRS Activities.

Table 3 - Islamorada CRS Activities

CRS Activity Number	Activity	Current Points Scored
310	Elevation Certificates	29
320	Map Information Service	90
330	Outreach Projects	350
340	Hazard Disclosure	10
350	Flood Protection Information	76
360	Flood Protection Assistance	90
370	Flood Insurance Promotion	90
420	Open Space Preservation	992
430	Higher Regulatory Standards	197
440	Flood Data Maintenance	174
450	Stormwater Management	33
510	Floodplain Mgmt. Planning	357
530	Flood Protection	29
540	Drainage System Maintenance	80
610	Flood Warning and Response	282
	TOTAL	**2,879**

Islamorada's CRS program is currently under review, with a new score to be released within the next calendar year. The new score will be used to determine future Class 4 eligibility, which would require reaching 3,000 points and meeting other requirements. Historically, one of the major hurdles for Florida communities reaching Class 4 is adopting a Watershed Master Plan that meets the rigorous CRS standards. This Watershed Master Plan is currently scheduled for completion by September 2024.

Good floodplain management acknowledges and thinks about how floodplains might look over time. This includes many factors such as rising sea levels. The CRS Manual incorporates acknowledgement of—and credit for—community efforts to anticipate future flood risk and climate resilience and to take actions to mitigate adverse impacts. The Village of Islamorada will be well situated to earn CRS points related to sea level rise, not only by completing this Vulnerability Assessment, but also undertaking other efforts, such as the Village's current work on its FDEM-funded Watershed Management Plan.

Current Context of Vulnerability

Climate Change and Sea Level Rise

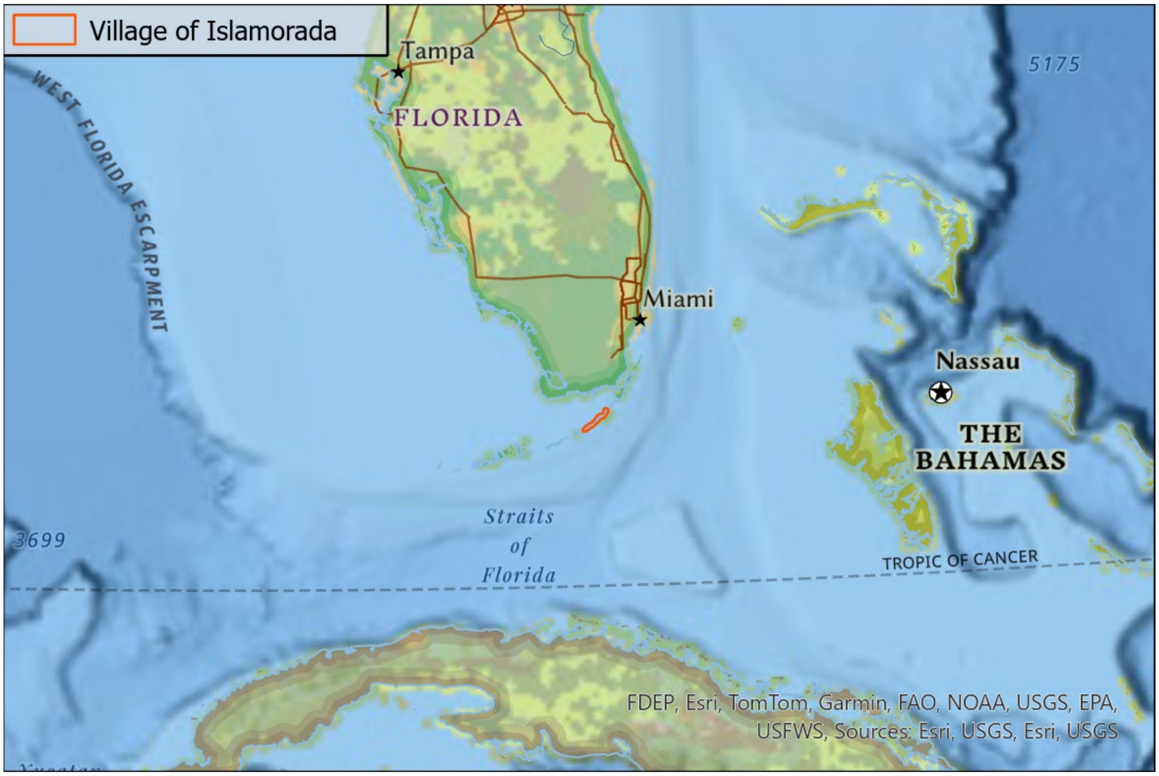
Globally, climate change presents a monumental challenge, characterized by rising temperatures, shifting weather patterns, and increased frequency of extreme weather events. In the context of Islamorada, these global trends manifest in specific regional impacts that directly affect the Village's environmental and socioeconomic fabric. Islamorada faces unique challenges due to its geographical character and location, with climate change exacerbating existing environmental vulnerabilities. The assessment specifically focuses on understanding these local implications, including how shifts in climate patterns are influencing the Village's natural ecosystems, urban infrastructure, and socio-economic dynamics.

In the case of Islamorada, climate change presents a multifaceted set of challenges that demand careful examination and proactive response. Characterized by rising global temperatures, altered weather patterns, and a heightened frequency of extreme events, these changes have direct and indirect effects on the Village and other parts of Monroe County, impacting various aspects of the region's environment, economy, and society.

One notable consequence is the increase in sea levels, which is primarily driven by the thermal expansion of seawater and the melting of polar ice caps and glaciers. As sea levels continue to rise, Islamorada's shorelines face escalating risks, including coastal erosion, more frequent and severe flooding, and compromised infrastructure. These impacts are compounded by the Village's low-lying topography and its reliance on a robust coastal economy, making it particularly vulnerable to sea-level rise.

Sea-level rise is a critical concern for island communities like Islamorada, posing significant risks to their infrastructure, ecosystems, and communities. The Village's coastline, characterized by its shorelines and vital economic assets, is under threat as sea levels encroach further inland. Shoreline erosion and compromised drainage system operations are two consequences of these impacts likely to increase in the future.

Figure 8 - Regional Context of Islamorada



Furthermore, the increased frequency and intensity of storms, including hurricanes and tropical cyclones, pose a substantial risk to Islamorada. Rising sea levels exacerbate the storm surge effect, magnifying the potential for devastating inundation during these events.

Additionally, the economic vitality of Islamorada, with its reliance on tourism, fisheries, and maritime industries, is intricately linked to its coastal assets. As sea levels rise and coastal vulnerabilities grow, these sectors face increasing uncertainty and disruption.

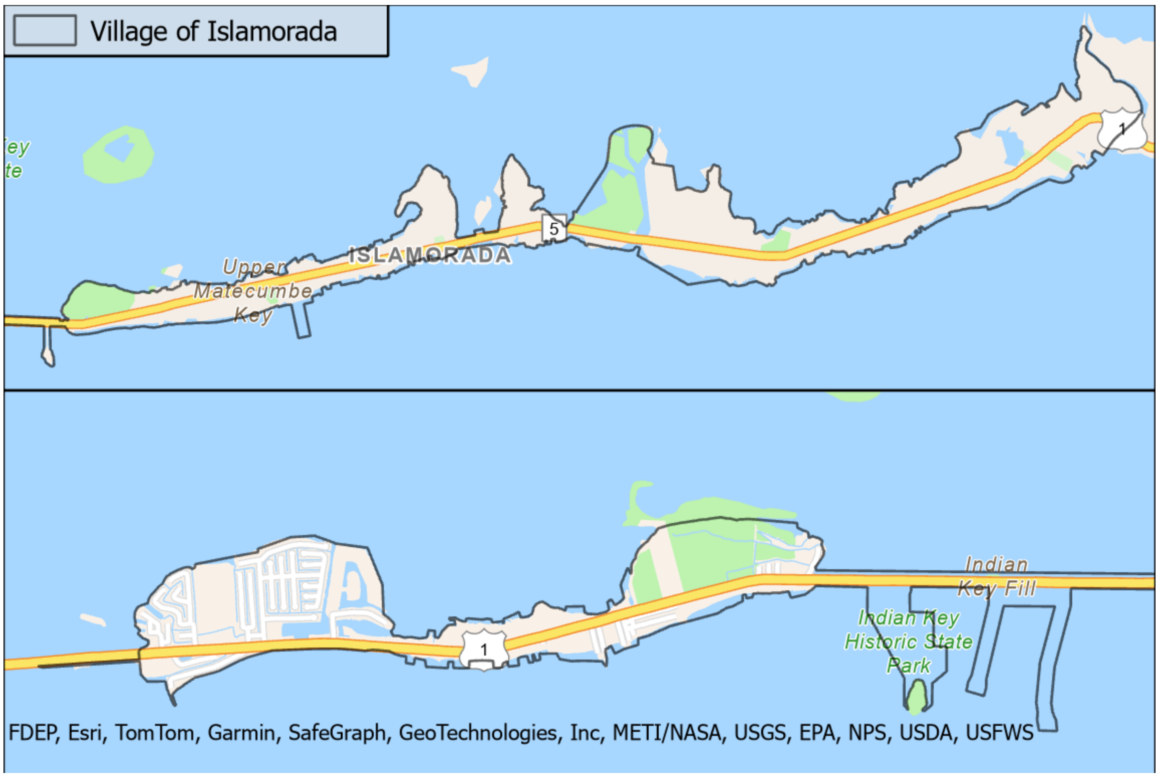
Physical Descriptors of Area

Geographical Setting and Characteristics

Islamorada's geographical characteristics render it particularly susceptible to climate change impacts. These characteristics include:

Island Setting and Coastal Location: As a series of low-lying Islands located on the border between the Gulf of Mexico and the Atlantic Ocean, Islamorada is highly susceptible to a range of coastal hazards. This includes the threat of sea-level rise, which can lead to temporary or permanent inundation of shorelines and land, and storm surges from tropical storms and hurricanes, which are capable of overtopping and sweeping across the entire island landscape. Additionally, by increasing the base water level, sea level rise elevates the risk of flooding during daily and seasonal high tides.

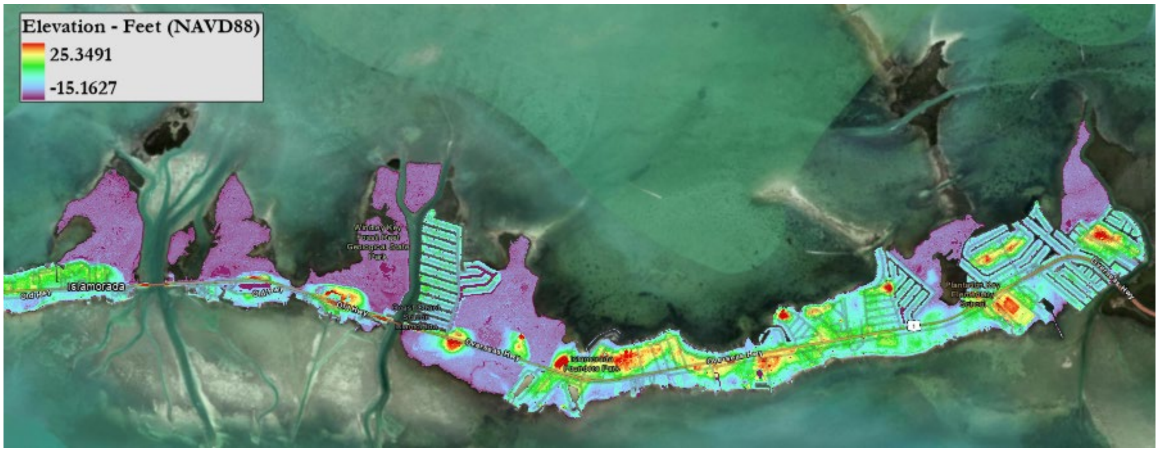
Figure 9 - Map of Islamorada

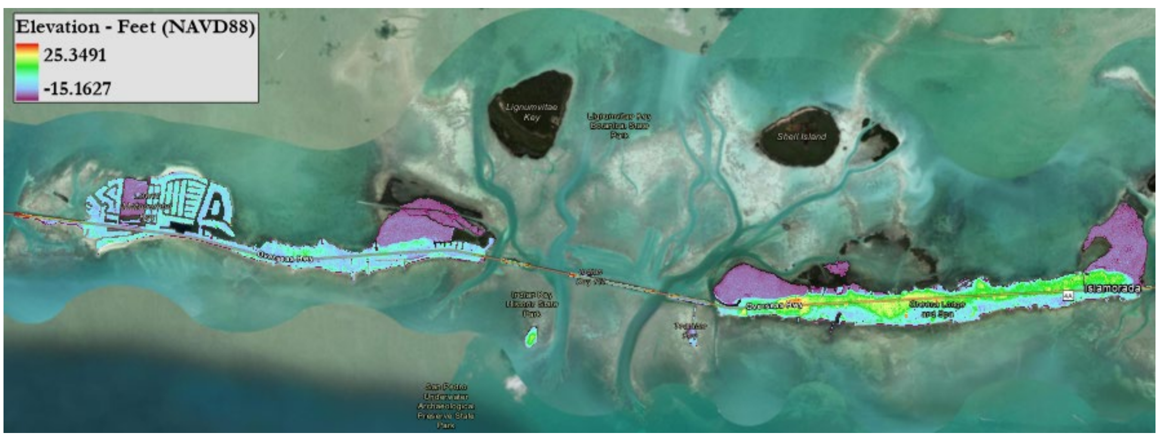


Elevation and Topography: While some parts of the Village feature relatively flat terrain, others exhibit slightly elevated landscapes. These topographical differences greatly influence flood risk and drainage patterns. Low-lying areas with minimal elevation are at greater risk of flooding, while elevated regions may experience comparatively lower flood risk. Due to the Village's low overall elevation, the entire municipality faces a heightened risk of inundation during extreme weather events.

Figure 10 - Elevation

Lower elevations in purple, higher in red and yellow





Demographic Overview

Understanding the demographic characteristics of Islamorada is crucial for evaluating the residents' vulnerability in the face of climate change. This comprehensive analysis provides insights into the population dynamics, growth trends, socioeconomic factors, and the application of tools like the Social Vulnerability Index and the Location Affordability Index. Evaluating these indicators offers a multifaceted understanding of the challenges and potential solutions for climate resilience.

Population Dynamics and Distribution

Population concentrations in different areas of the Village vary between day and night, influencing the risk exposure during flood-related events. During the day, as people converge on workplaces, schools, and government facilities, areas with commercial and civic uses experience higher population densities. At night, the population disperses into residential neighborhoods, which are less concentrated. These patterns are depicted in Figures 11 and 12, using color coding (red for high concentration, yellow for medium, and green for low) to indicate population density at different times of the day.

- **Daytime Activities:** Include daily commercial traffic, busy workplaces, shopping, and dining.

- **Nighttime Quietude:** Characterized by reduced traffic, closed businesses, and a population retreating to homes and tourist accommodations.

Figure 11 - Daytime Population Concentration

Red indicates high concentration, yellow medium, and green low

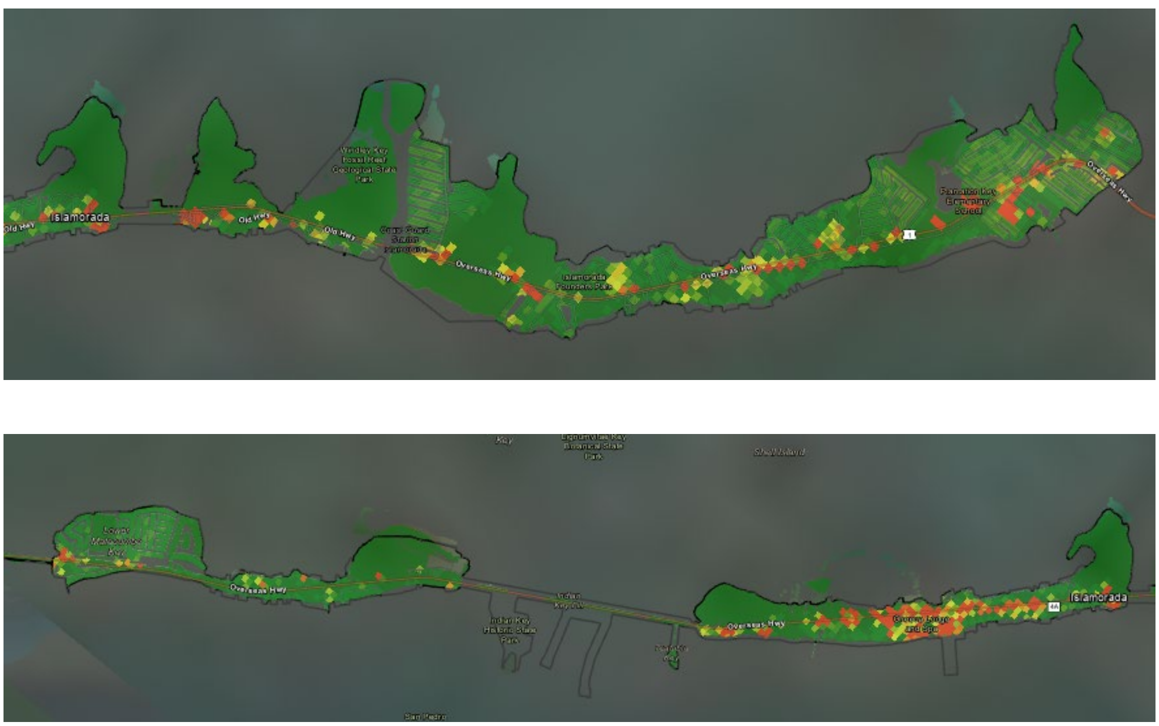
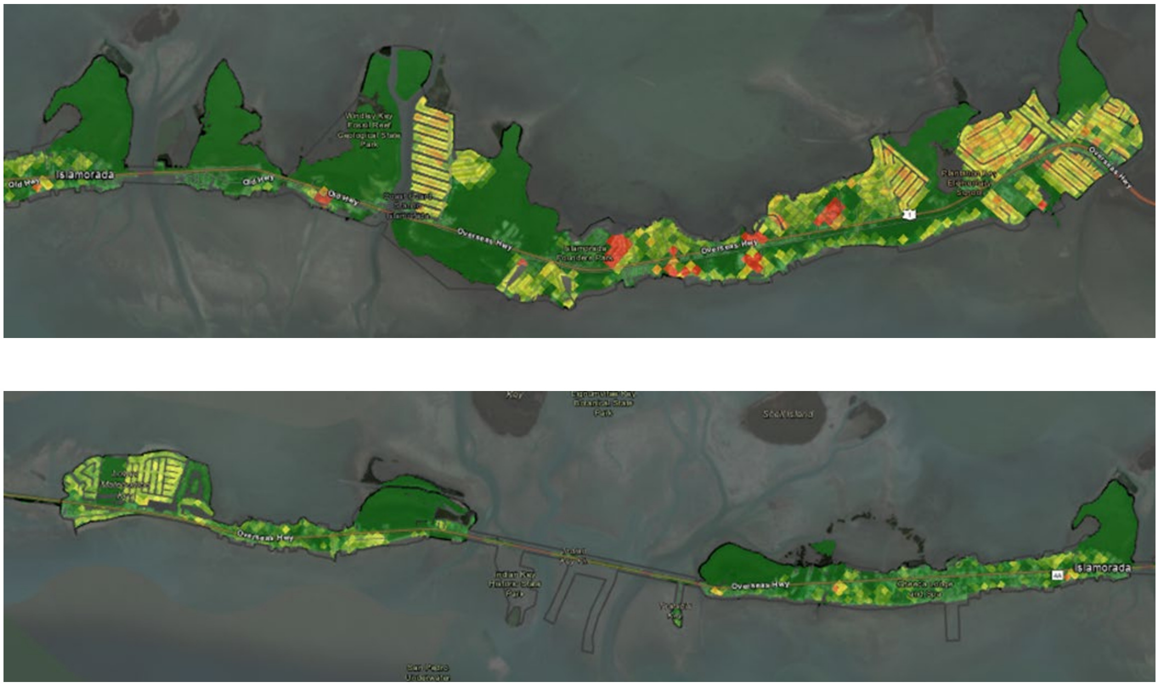


Figure 12 - Nighttime Population Concentration

Red indicates high concentration, yellow medium, and green low



These insights underscore the importance of considering the dynamic nature of population distribution in climate vulnerability assessments. The difference between daytime and nighttime population density shows a reliance on assets and infrastructure that could be subject to significant flooding impact.

Population Growth Trends

Examining Islamorada's population growth trends is crucial for gauging its future vulnerability. With a relatively stable population of approximately 7,400 and a modest growth rate of 0.35% by 2028, the Village is a mature community with limited expansion potential. Therefore, unlike some other communities in Florida, Islamorada is unlikely to see any significant revenue windfalls from increased development. Derived from data gathered by the American Community Survey (ACS) and the U.S. Census Bureau, this insight underscores the necessity for targeted infrastructure development and resilience planning. Appendix H contains demographic information extracted from the American Community Survey and US Census Bureau.

Figure 13 - Islamorada Population Trends, 2020-2023

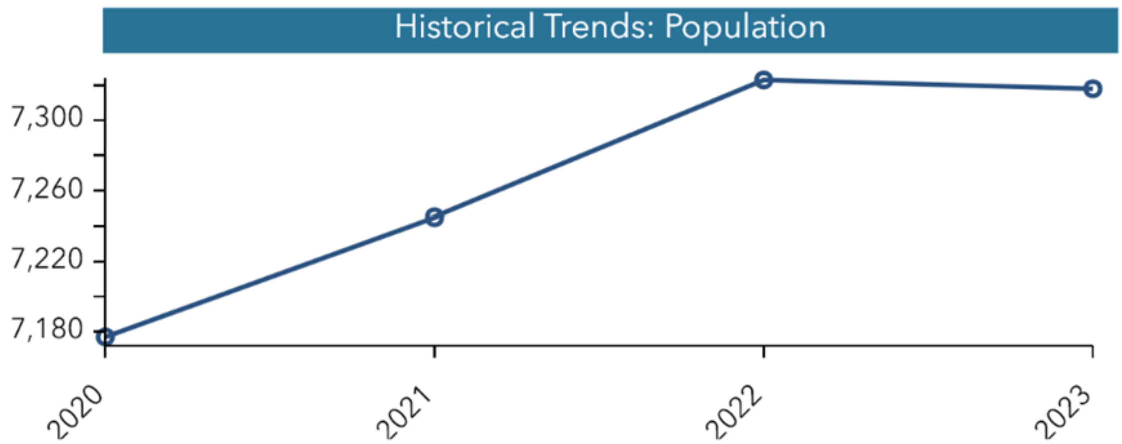
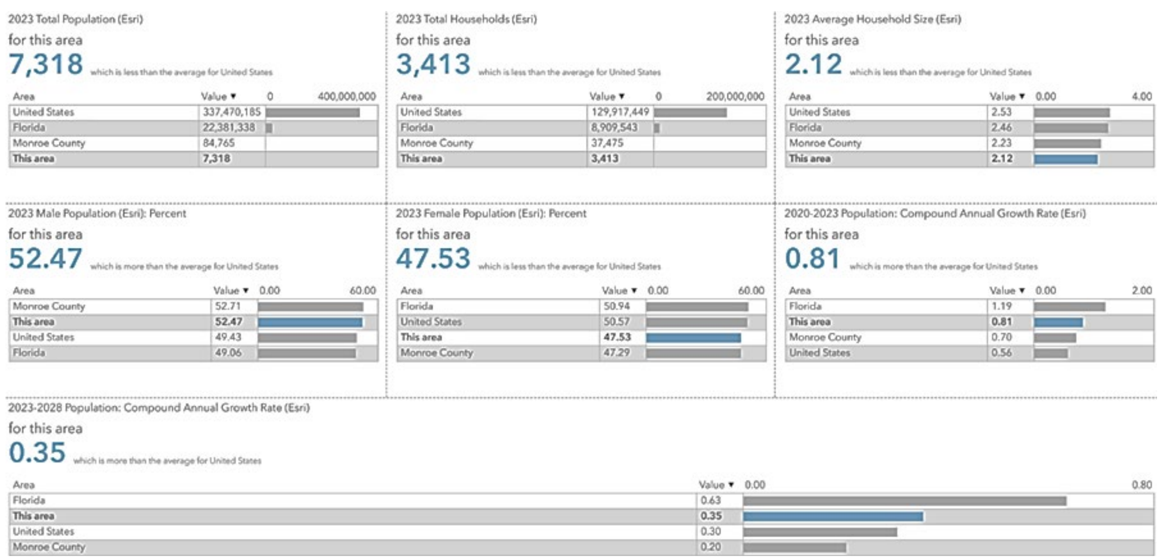


Figure 14 - Population and Growth Rate Infographic



2023 Total Population (Esri)
for this area
7,318 which is less than the average for United States

Area	Value ▾
United States	337,470,185
Florida	22,381,338
Monroe County	84,765
This area	**7,318**

2023 Total Households (Esri)
for this area
3,413 which is less than the average for United States

Area	Value ▾
United States	129,917,449
Florida	8,909,543
Monroe County	37,475
This area	**3,413**

2023 Average Household Size (Esri)
for this area
2.12 which is less than the average for United States

Area	Value ▾
United States	2.53
Florida	2.46
Monroe County	2.23
This area	**2.12**

2023 Male Population (Esri): Percent
for this area
52.47 which is more than the average for United States

Area	Value ▾
Monroe County	52.71
This area	**52.47**
United States	49.43
Florida	49.06

2023 Female Population (Esri): Percent
for this area
47.53 which is less than the average for United States

Area	Value ▾
Florida	50.94
United States	50.57
This area	**47.53**
Monroe County	47.29

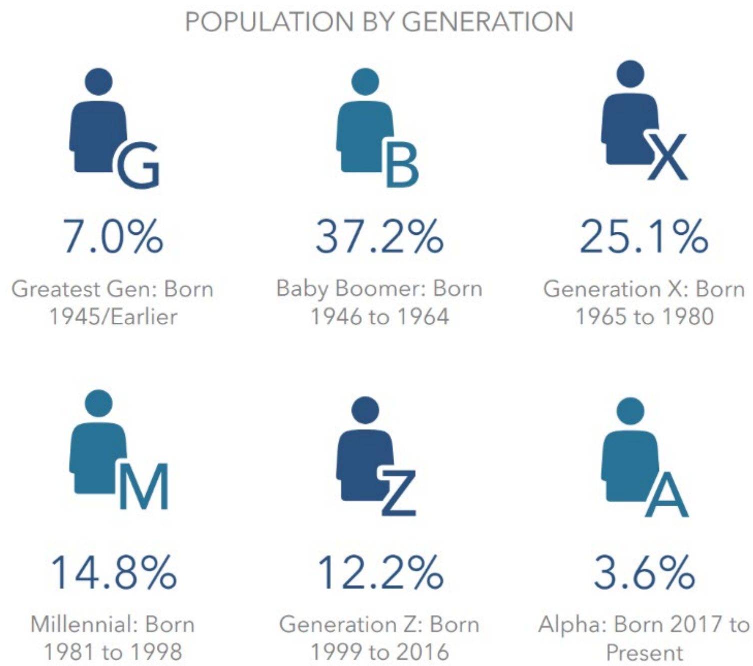
2020-2023 Population: Compound Annual Growth Rate (Esri)
for this area
0.81 which is more than the average for United States

Area	Value ▾
Florida	1.19
This area	**0.81**
Monroe County	0.70
United States	0.56

2023-2028 Population: Compound Annual Growth Rate (Esri)
for this area
0.35 which is more than the average for United States

Area	Value ▾
Florida	0.63
This area	**0.35**
United States	0.30
Monroe County	0.20

Figure 15 - Percent of Population By Generation

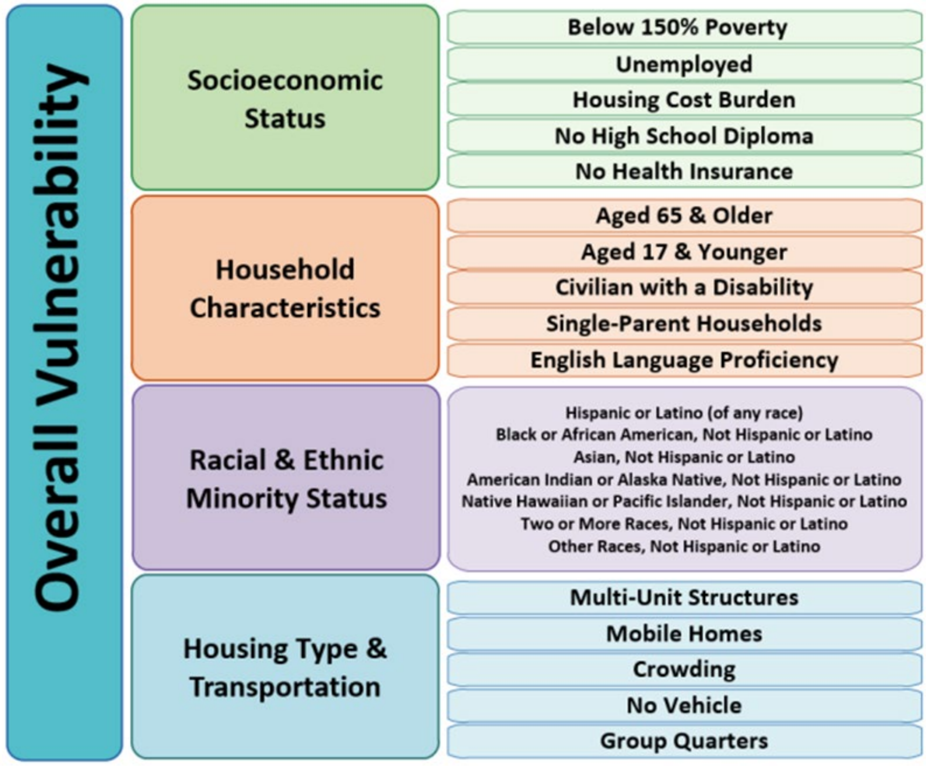


Socioeconomic Vulnerability

Socioeconomic disparities significantly influence community resilience to flood risk. Vulnerable populations may face disproportionate impacts from flooding and climate change due to limited resources and resilience. It is essential to identify and address socioeconomic disparities to ensure an equitable response to climate-related and increased flood-risk related challenges.

Socioeconomic disparities play a crucial role in determining a community's resilience to climate change. Vulnerable populations, identified through the most recent Centers for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI), are at increased risk due to factors such as poverty, lack of vehicle access, and crowded housing conditions. The SVI provides a comprehensive assessment across four key themes—socioeconomic status, minority status and language, housing composition and disability, and housing and transportation—offering valuable insights for emergency preparedness, supply estimation, shelter identification, and evacuation planning in the face of sea-level rise and potential flooding scenarios. See Figure 16. The latest SVI data highlights Islamorada's at-risk communities, emphasizing the need for targeted support and intervention.

Figure 16 - Components of Social Vulnerability Index



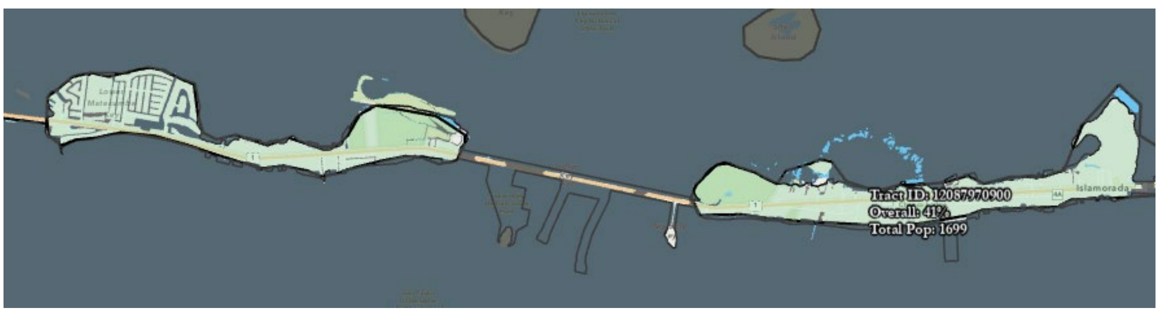
The SVI was utilized to identify vulnerable populations and serve as a framework to discuss population characteristics that are exacerbated by flooding under future flooding conditions.

The CDC's SVI database and mapping tools can assist with emergency preparedness in several ways. It can be used to estimate the amount of necessary supplies, such as food, water, medicine, and bedding, as well as how many emergency personnel are needed to assist at specific sites. The tool can also identify areas in need of emergency shelters and generically, in the preparation of evacuation plans, accounting for those with special needs, and highlighting those communities that may need continued support to recover from a natural disaster.

As reflected in Figure 17, the analysis of the Village's social vulnerability using the latest CDC's SVI utilizes U.S. Census data to analyze the social vulnerability of every census tract. Each census tract is ranked on 15 social factors, including poverty, lack of vehicle access, and crowded housing, and groups them info four related themes to create an average score between 0% - 100%.

Figure 17 - CDC Social Vulnerability Index Map

Most vulnerable populations highlighted w/hatching and labeling (<50% overall percentile ranking)



The U.S. Department and of Housing and Urban Development (HUD) with the help of the Department of Transportation launched the Location Affordability Index (LAI) which identifies areas based on cost estimates of housing and transportation for eight different household profiles (see Table 4). Furthermore, the LAI presents advanced insights into housing and transportation costs, which are critical for flood risk planning and enhancing climate resilience. By leveraging simultaneous equation modeling and an extensive dataset, the LAI accurately estimates costs for a variety of household profiles. This includes considerations of auto ownership, housing expenses, and transit usage, providing a nuanced understanding of affordability challenges faced by residents.

Table 4 - Location Affordability Index Household Income Profiles

Household Profile	Median Household Income for a Given Area (MHHI)
1. Median-Income Family	MHHI
2. Very Low-Income Individual	National Poverty Line
3. Working Individual	50% of MHHI
4. Single Professional	135% of MHHI
5. Retired Couple	80% of MHHI
6. Single-Parent Family	50% of MHHI
7. Moderate-Income Family	80% of MHHI
8. Dual-Professional Family	150% of MHHI

The term "Working Individual - 50% of MHHI" and others like it refer to metrics used to describe the income level of a working individual in relation to the Median Household Income (MHHI) of a given area. Here is a breakdown of what this means and its significance:

- MHHI (Median Household Income): This is the median income of all households in a specific area. The median is the middle value when you line up all the households by income, meaning half the households earn more than the MHHI and half earn less. It is a commonly used measure to understand the average income level of an area.

- 50% of MHHI: When an individual's income is described as "50% of MHHI," it means their income is half the median household income for their area. This is a relative measure indicating the individual's earnings compared to the average household in the community.

These metrics have significance in the context of flooding and vulnerability assessments:

- Economic Vulnerability: Individuals earning a low percentage of the MHHI may have less financial flexibility to recover from flood damage or to invest in preventative measures such as insurance or home improvements that reduce flood risk.

- Resource Allocation: Understanding the income levels of affected individuals or households in relation to the MHHI helps in tailoring flood resilience and recovery programs. It highlights populations that may need more support in terms of subsidies, grants, or other assistance.

- Planning and Preparedness: Identifying areas where a significant portion of the population earns a lower percentage of MHHI can inform emergency management agencies and local governments about potential needs for evacuation assistance, shelters, and other support services during and after a flooding event.

The incorporation of income levels as a percentage of MHHI in vulnerability assessments helps to paint a more detailed picture of risk and resilience within a community. It underscores the interconnectedness of socioeconomic status and disaster vulnerability, emphasizing the need for targeted approaches in resilience planning and support. The LAI scores across Islamorada identify areas of varying affordability and detail the distribution of owner-occupied versus renter-occupied housing (see Figure 18 below), illustrating the intersections of affordability, vulnerability, and climate risk. Higher renter areas are generally associated with more social vulnerability or where certain populations may be exponentially impacted by flooding. This comprehensive approach informs strategic planning and interventions, aiming to mitigate the impacts of climate change on the most vulnerable segments of the population. These enhancements, along with a broader dataset, make the LAI a robust tool for understanding and planning around housing and transportation affordability, potentially aiding in flood risk planning by highlighting areas where affordability and risk intersect.

In the context of flood risk, the correlation between higher rates of renters in a community and increased social vulnerability takes on an even more critical dimension. Renters often reside in areas more susceptible to flooding, either due to the lower cost of housing in such locations or due to limited availability of affordable options in safer areas. This situation places them at a disproportionate risk during flood events, not only in terms of immediate physical danger but also regarding the longer-term repercussions on their stability and well-being.

The transient nature of rental housing means that renters may have less knowledge about local flood risks and less incentive to invest in long-term flood preparedness measures. Furthermore, the financial instability associated with renting can exacerbate the challenges of recovering from flood damage. Renters may lack the insurance coverage, savings, or resources to quickly rebound from the loss of property or displacement caused by flooding. This can lead to significant disruptions in their lives, including the loss of employment, educational discontinuity, and mental health stresses.

Moreover, the areas with high concentrations of rental properties may receive less attention in terms of flood mitigation infrastructure and services. Investment in flood defenses, such as levees, floodwalls, and green infrastructure, is often prioritized in areas with higher property values and stronger political influence, which can leave renter-dominated neighborhoods more exposed and vulnerable.

Given these dynamics, addressing the flood risk in communities with a high proportion of renters requires targeted policies and interventions. This includes not only enhancing the physical infrastructure to withstand flooding but also improving the resilience of the rental population through education on flood risks, access to affordable flood insurance, and the establishment of support systems for post-disaster recovery. Policies aimed at ensuring the availability of affordable, flood-resilient housing in safer areas are also crucial. Such comprehensive approaches can help mitigate the impact of floods on socially vulnerable populations, thereby reducing the overall risk and enhancing community resilience against climate change and natural disasters.

Figure 18 - HUD LAI Scores across Islamorada

Relatively more affordable areas within Islamorada are green, less affordable are orange, with yellow in between. Pie chart overlays represent the ratio of total owner-occupied housing in blue and renter occupied housing in purple.

Key Infrastructure and Assets

Islamorada's critical infrastructure and assets are the backbone of the Village's functionality and are integral to the vulnerability assessment. They are also required components of the analysis pursuant to statute divided out into four major “asset classes.” These major asset classes are:

- Transportation assets and evacuation routes

- Critical infrastructure

- Critical community and emergency facilities

- Natural, cultural, and historical resources

These assets encompass a wide range of essential components:

Transportation Infrastructure: Islamorada includes a network of vital transportation assets, including bridges, an airport, and a series of roadways linked to one major evacuation route. Tavernier Airport makes up the Village’s air transport infrastructure, with marinas and boat ramps comprising the primary water transportation facilities.

Figure 19 - Map of Transportation Infrastructure

Critical Infrastructure: The Village relies on a robust network of utilities that includes stormwater components, wastewater treatment facilities, water supply systems, and electrical infrastructure. These utilities are indispensable for maintaining essential services, and their vulnerability to climate-related disruptions can have cascading effects on the community. Some are owned by the Village and some are owned by other entities. These assets are included in Figures 20-23.

Figure 20 - Map of Stormwater Infrastructure

Figure 21 - Map of Sanitary Sewer Infrastructure

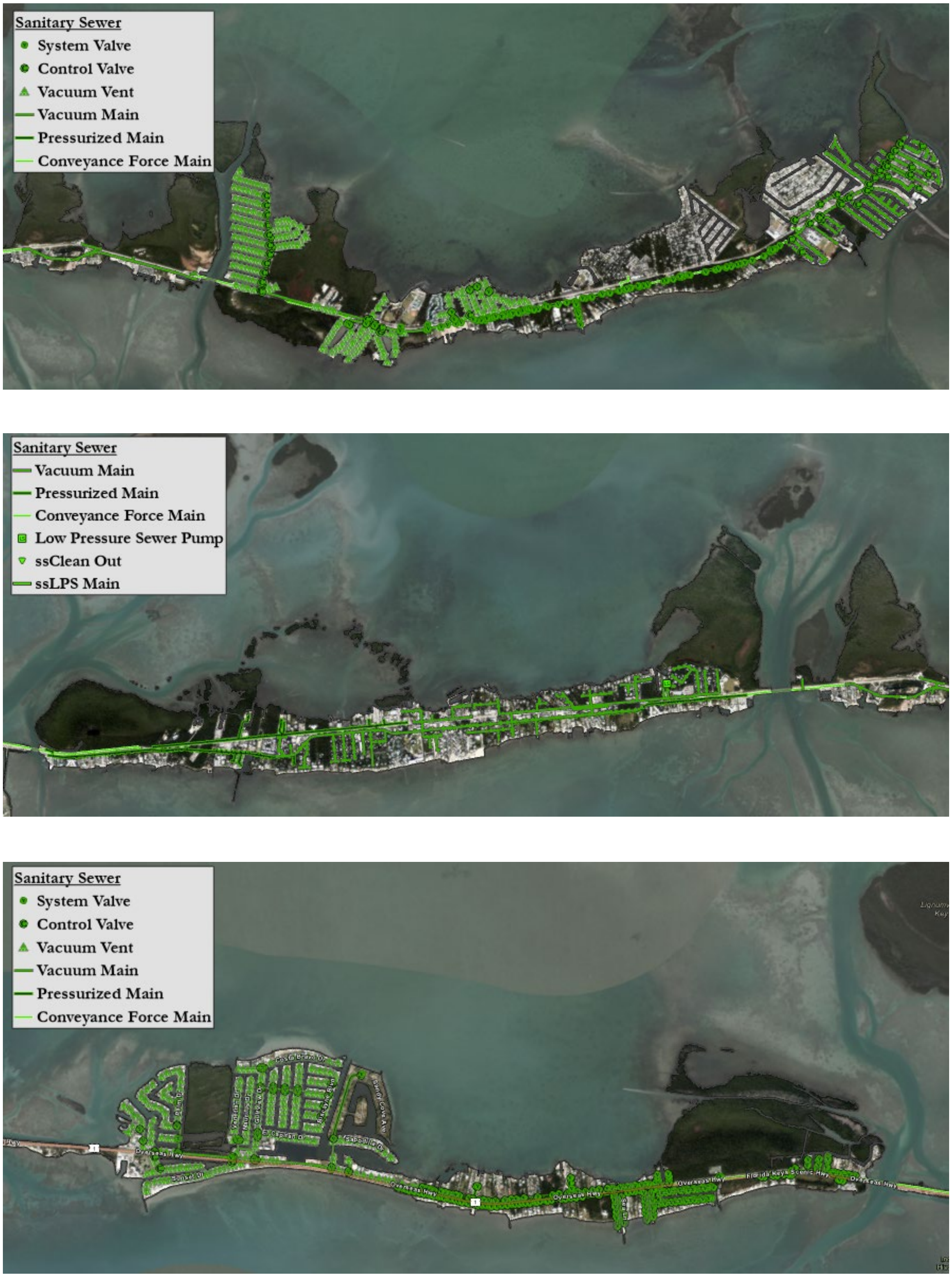


Figure 22 - Map of Potable Water Infrastructure

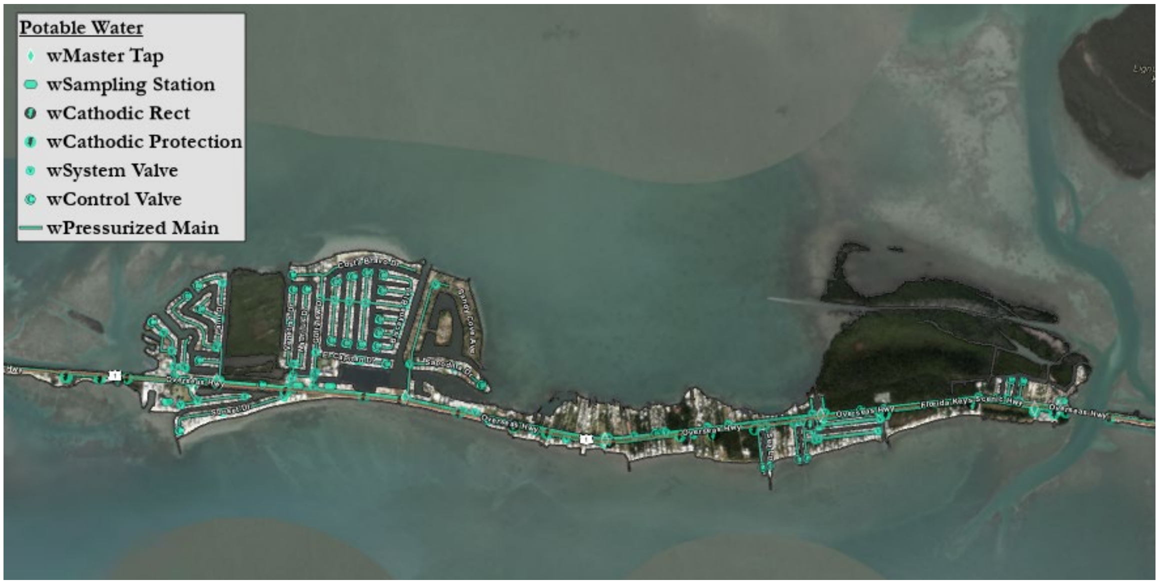
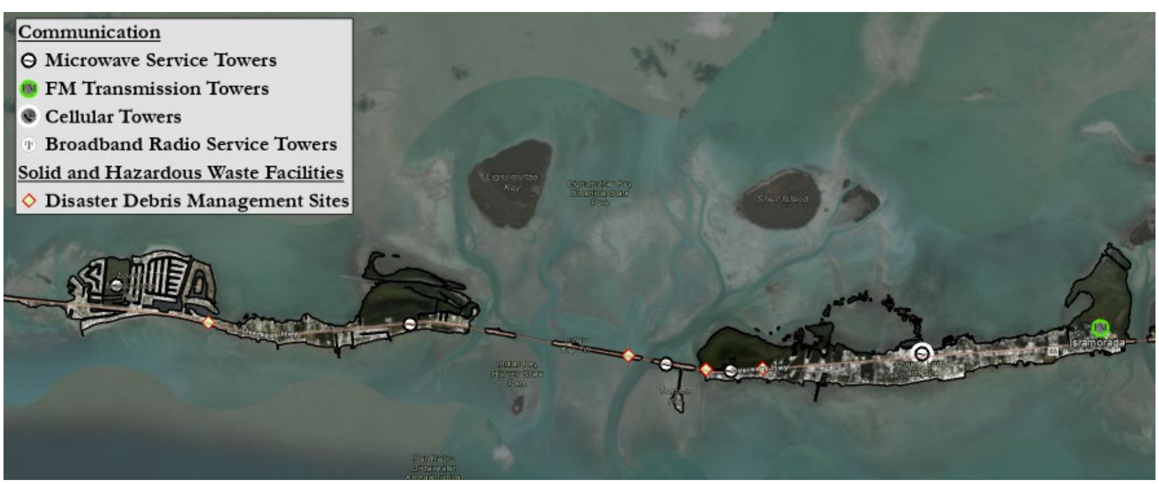
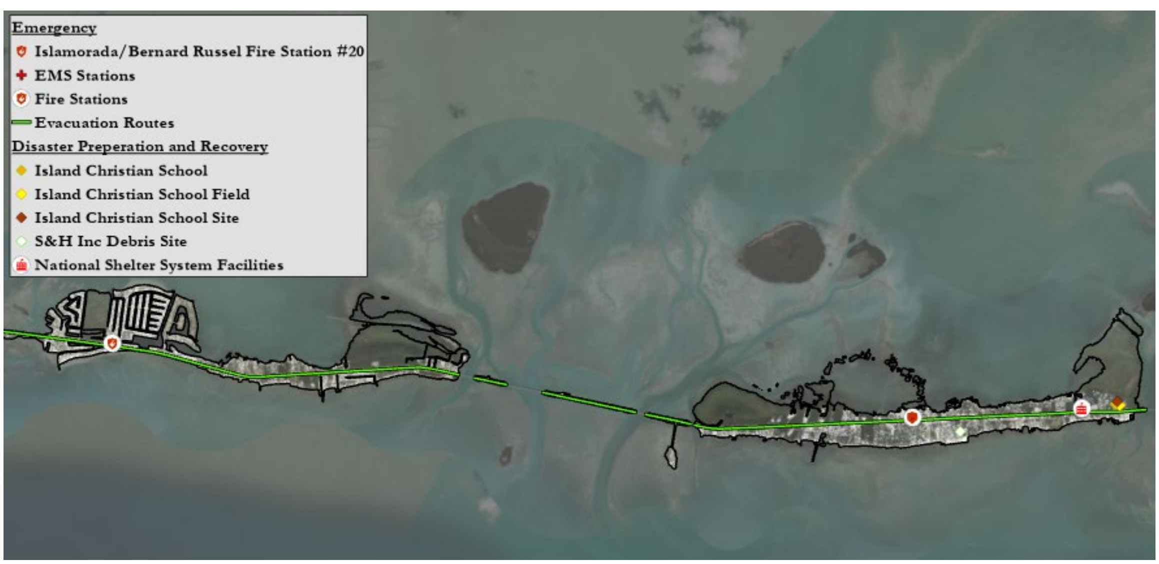


Figure 23 - Map of Other Critical Infrastructure Assets



Critical Emergency and Community Facilities: Hospitals and healthcare facilities, while generally not owned and maintained by the Village, are lifelines during disaster response and recovery, especially in the face of extreme weather events. Its important to note that there were no hospitals or healthcare facilities captured within the asset inventory within Islamorada's municipal boundaries. Nearby, regional healthcare facilities, and their ability to function without interruption is vital for the well-being of the community. Emergency response centers serve as command hubs for coordinating emergency response efforts. They are pivotal in disaster management and require robust infrastructure and connectivity to ensure effective response during climate-related emergencies.

Figure 24 - Map of Emergency Management Infrastructure



Natural and Cultural Resources: Islamorada's natural areas, cultural assets, and historical sites contribute significantly to its identity and quality of life. These resources are not only important for the well-being of the community but also need protection against climate change impacts to preserve the Village's heritage.

Figure 25 - Map of Park Systems and Natural Areas

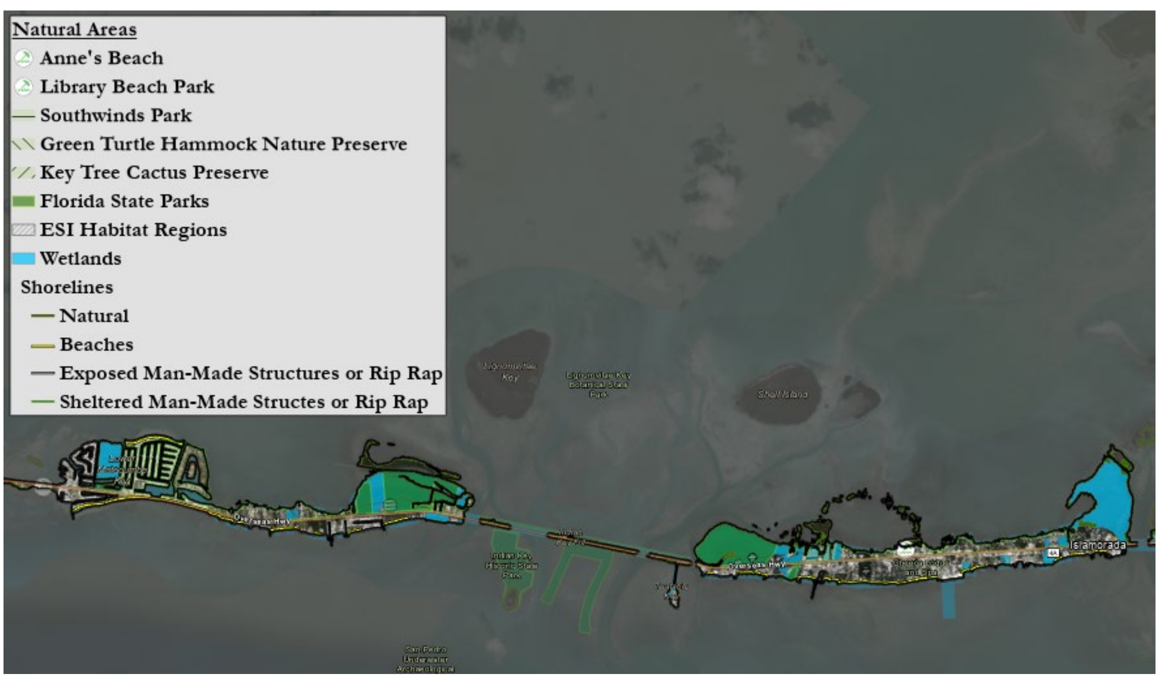


Figure 26 - Map of Cultural and Historic Assets

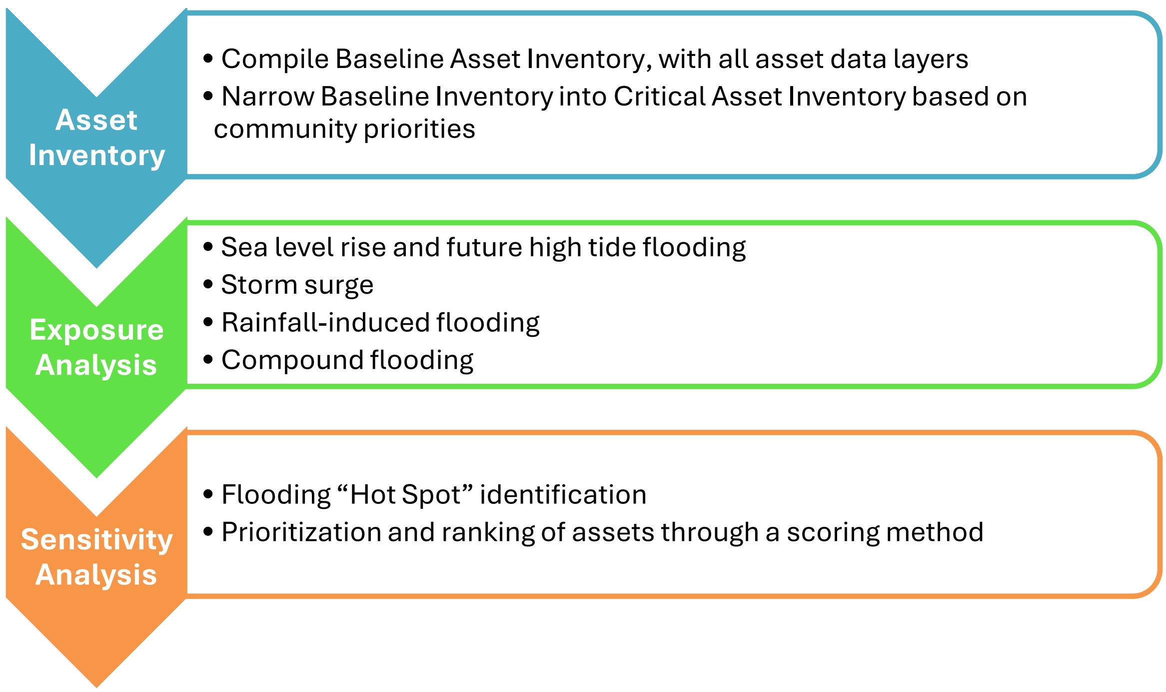
Regionally Significant Assets: As defined in Subsection 380.093, F.S., regionally significant assets are critical facilities that serve a broader geographic area, including neighboring communities, and are not necessarily owned and maintained by the Village. These assets may encompass water resource facilities, regional medical centers, emergency operation centers, regional utilities, major transportation hubs, airports, and seaports. Identifying and safeguarding these assets is crucial for regional resilience and response coordination.

Assessment Methodology

Approach to Vulnerability Assessment

The methodology employed in this Vulnerability Assessment adheres to Subsection 380.093, F.S., and uses a comprehensive set of data sources and modeling techniques. This approach is designed to provide a detailed analysis of the Village's vulnerability to climate change and sea-level rise. The primary components of this methodology are described in Figure 27.

Figure 27 - Vulnerability Assessment Process Steps



It is important to acknowledge the limitations of this methodology. While it provides a valuable foundational assessment, it is not a substitute for detailed, site-specific studies. Future studies involving engineering-grade hydrologic and hydraulic modeling are recommended for more localized flood risk understanding.

Data Collection & Asset Inventory Evaluation Process

To ensure accuracy and comprehensiveness, this Vulnerability Assessment employed an exhaustive data collection strategy. Data was gathered from various authoritative sources, including federal agencies such as the Department of Homeland Security (DHS), National Oceanic and Atmospheric Administration (NOAA), and the Federal Emergency Management Agency (FEMA); state authorities such as the Florida Department of Environmental Protection (FDEP), Department of Transportation (FDOT) and the Fish and Wildlife Conservation Commission (FWC); and local authorities, including Village of Islamorada staff. The collected data was categorized as follows:

1. **Transportation Assets and Evacuation Routes**: airports, bridges, bus routes, major roadways, evacuation routes, port facilities, marinas, boat ramps and waterways.
2. **Critical Infrastructure:** wastewater treatment facilities and lift stations, pump stations, drinking water facilities, water utility conveyance systems, drainage infrastructure and stormwater ponds, electric supply facilities, solid waste facilities, military installations, post offices, communications facilities, and disaster debris management sites.
3. **Critical Community and Emergency Facilities**: schools, assisted housing, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, fire stations, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelters, and state government facilities.
4. **Natural, Cultural, Historical Resources**: This category is dedicated to preserving and protecting natural areas and cultural/historical sites, including conservation lands, historic buildings and cemeteries, national and state parks, shorelines, surface waters, wetlands, and historical and cultural assets.
5. **Supplementary Information**: This category includes additional data not explicitly required by Subsection 380.093, F.S., but valuable for a detailed vulnerability assessment. It encompasses FEMA's flood insurance study, flood zones, photos of flooding, impervious surface areas, seawalls, and more. Geomorphological features and socioeconomic environment data are also included.

Additionally, multiple asset types listed above would be considered regionally significant assets; they are due special attention, given their specific mention in the statutory language which refers to critical assets that support the needs of communities spanning multiple geopolitical jurisdictions. These assets include Commercial and Strategic Intermodal System (SIS) ports, spaceports, waterways, railroad crossings, railroads, rail terminals, rail bridges, bus terminals, evacuation routes, electric power plants, electric power transmission lines, dams, and drainage assets maintained by water management districts. Additionally, stormwater ponds, wastewater facilities, public water supply tanks, public water supply plants (non-federal), emergency medical services facilities, emergency operations centers, risk shelters for the general population, and risk shelters for those with special needs are considered crucial in supporting the infrastructure and safety requirements of multiple regions.

Supplemental information is included to augment resilience planning, capturing assets not explicitly identified in the statutory framework. This structured approach facilitates a comprehensive understanding and effective addressal of climate change adaptation and resilience challenges.

Data Request

The data collection and evaluation process for Islamorada's Vulnerability Assessment was methodical and robust, involving a variety of authoritative sources. The effort gathered topographical, hydrological, climatic, and tidal data via a standardized data request document directed to agencies including DHS, NOAA, FEMA, local authorities, and research institutions. The collected data was categorized into four primary categories, tracking the State's defined asset classes, with a fifth supplementary category to enhance resilience planning efforts.

Data Gap Analysis

The Gap Analysis conducted for the Islamorada Vulnerability Assessment identified key areas of data insufficiency and proposed strategic solutions and pathways to obtain more information. These included enhancing geospatial data through mapping and system integration, improving infrastructure data with departmental reviews and responsible data management, and updating information on natural, cultural, and historic resources through community involvement. The analysis also recommended standardizing terminologies and developing comprehensive metadata to address inconsistencies and unclear data coverage. Employing a range of methods such as satellite imagery, government record analysis, and statistical modeling, the approach aims to achieve a thorough and dependable assessment to close gaps described in the Gap Analysis now and into the future.

Exposure Analyses: Tools and Models Used

The methodology of the Vulnerability Assessment Report encompasses a detailed analysis of the 2040, 2070 and 2100 planning horizons using advanced tools and models, meticulously aligned with compliance requirements. This section delves into four key aspects:

Future High Tide Modeling: This involves sophisticated modeling techniques using ArcGIS Pro and NOAA's methodology. The process includes creating VDATUM conversion surfaces and utilizing algorithms for tidal variability interpolation, ensuring accurate future high tide flood mapping accounting for the tidal flooding threshold of 2’ above mean higher high water. This Analysis also includes a representation of the number of tidal flood days that is expected for each scenario as well as planning horizon in the map series titled “Days of Tidal Flooding” in the Exposure Map series, which is supplemental to the 2’ mean higher high-water threshold established by DEP.

Storm Surge Analysis: Utilizing FEMA's storm surge data and HAZUS-MH software, this analysis adjusts the historical storm surge data by the future sea level rise projections discussed in the report. The approach integrates these projections with the community's existing FEMA Flood Insurance Study data, offering a nuanced understanding of future storm surge impacts.

Rainfall-Induced Flooding Evaluation: Adhering to specific legislative requirements, this part employs the Hydrologic Engineering Center's River Analysis System (HEC-RAS) for rainfall simulation and runoff computation. It incorporates NOAA’s Atlas 14 data, enriched with SFWMD change factors[3], to create baseline rainfall depth grids essential for a comprehensive evaluation of potential future rainfall-induced flooding.

Compound Flooding Assessment: This segment addresses the compound effects of tidal, storm surge, and rainfall-induced flooding. It involves overlaying depth grids from various scenarios, acknowledging the resource and time constraints of the project.

Each of these components is detailed over multiple pages in the report, providing an exhaustive, data-driven approach to assess Islamorada's vulnerability to climate-induced changes. The methodology is crafted to not only meet compliance standards but also to provide a deep, actionable insight into the Village’s potential future flooding scenarios.

Scenario Development and Assumptions for Evaluations/Modeling

North American Vertical Datum of 1988

All elevations referenced in and analyzed for this Vulnerability Assessment are expressed in North American Vertical Datum of 1988 (NAVD 88) values.

[3] https://sfwmd-district-resiliency-fsfwmd.hub.arcgis.com/apps/0616cf4890424ec8bd8a0f901dee7cf0

Local sea level rise scenarios

The sea-level rise scenarios included in the Vulnerability Assessment include the 2017 NOAA Intermediate-Low Sea Level Rise Projection and the 2017 NOAA Intermediate-High Sea Level Rise Projection. These scenarios were the required scenarios when this Vulnerability Assessment was initiated prior to July 1, 2024. Legislation adopted by the Florida Legislature and signed into law by the Governor in 2024[4] will shift these required scenarios to the 2022 NOAA Intermediate Low and Intermediate scenarios. These new scenarios will apply to Vulnerability Assessments initiated after July 1, 2024.

The benefit of evaluating a range of conditions is that the Village can determine the tolerance for risk for any adaptation strategy decision and act upon data from this analysis that reflects a wider range of conditions. For assets, adaptation projects, and policy decisions which are considered more critical, the higher end of the projections and output should be considered. Where flood impacts would be less critical, the lower end of the projections could be considered. The range provides options needed to make decisions based on the characteristics of specific places and flood impacts at those locations.

In the context of flood risk planning, the significance of assessing and preparing for risks varies widely across different types of assets, reflecting the underlying concept of risk tolerance. This differentiation becomes particularly evident when contrasting the planning requirements for infrastructure with divergent risk profiles and societal impacts, such as recreational facilities versus nuclear power plants.

Recreational facilities, for example, though valuable for community well-being and local economies, generally represent assets with a relatively lower criticality in the broader scope of Village-wide emergency preparedness and long-term resilience planning. The risk tolerance for such facilities is comparatively higher, meaning that while flood impacts are undesirable, they are less likely to cause widespread or long-lasting harm. Therefore, in the adaptation strategy for these assets, a balanced approach may be adopted, potentially aligning with the lower end of sea-level rise projections. This approach prioritizes cost-effectiveness and practicality, acknowledging the lower relative impact of flooding on these facilities.

Conversely, the planning and risk assessment for nuclear facilities demand an exceptionally low tolerance for risk due to the potential for catastrophic consequences in the event of flooding. The critical nature of such infrastructure—not only in terms of energy supply but also considering the immense implications for public health, safety, and environmental protection—necessitates that adaptation

[4] Signed into law by the Governor on May 13, 2024.

strategies are aligned with the most conservative projections and models available. In this case, the higher end of sea-level rise scenarios would be a prudent basis for planning, reflecting a commitment to safeguarding against even the most unlikely events. The imperative to ensure the utmost level of resilience against flooding underscores the non-negotiable demand for stringent precautionary measures in the context of nuclear planning.

Planning horizons

The planning horizons for this assessment coincide with NOAA's forecasting years: 2040, 2070 and 2100. While Section 380.093(3), F.S only requires the 2040 and 2070 planning scenarios, currently, this Vulnerability Assessment also includes the 2100 condition.

Sea level data selection

According to statute, vulnerability assessments must include local sea level data that has been interpolated between the two closest National Oceanic and Atmospheric Administration tide gauges or use the sea level data from whichever of those two nearest gauges reports a higher mean sea level.

For Islamorada, this Vulnerability Analysis uses NOAA's VDATUM software to interpolate between the two closest tide gauges, Vaca Key (8723970) and Key West (8724580). This interpolation is integrated directly into the exposure analysis methodology by converting the original North American Vertical Datum of 1988 (NAVD88) elevations from the Digital Elevation Model (DEM) to the localized vertical tidal datums. By aligning the DEM elevations with data from local tide gauges, this conversion ensures accurate and consistent comparisons, correctly reflecting local sea level elevations and allowing precise data manipulations.

The datum chart below (Figure 28) is a visual representation of various reference levels (datums) related to the Key West tide gauge. These datums are standardized elevations used to serve as reference points for measuring water levels. Each datum is related to specific tidal conditions and is used to predict tidal flooding, navigate ships, and for coastal and marine engineering. Here is a brief explanation of common datums on Figure 28:

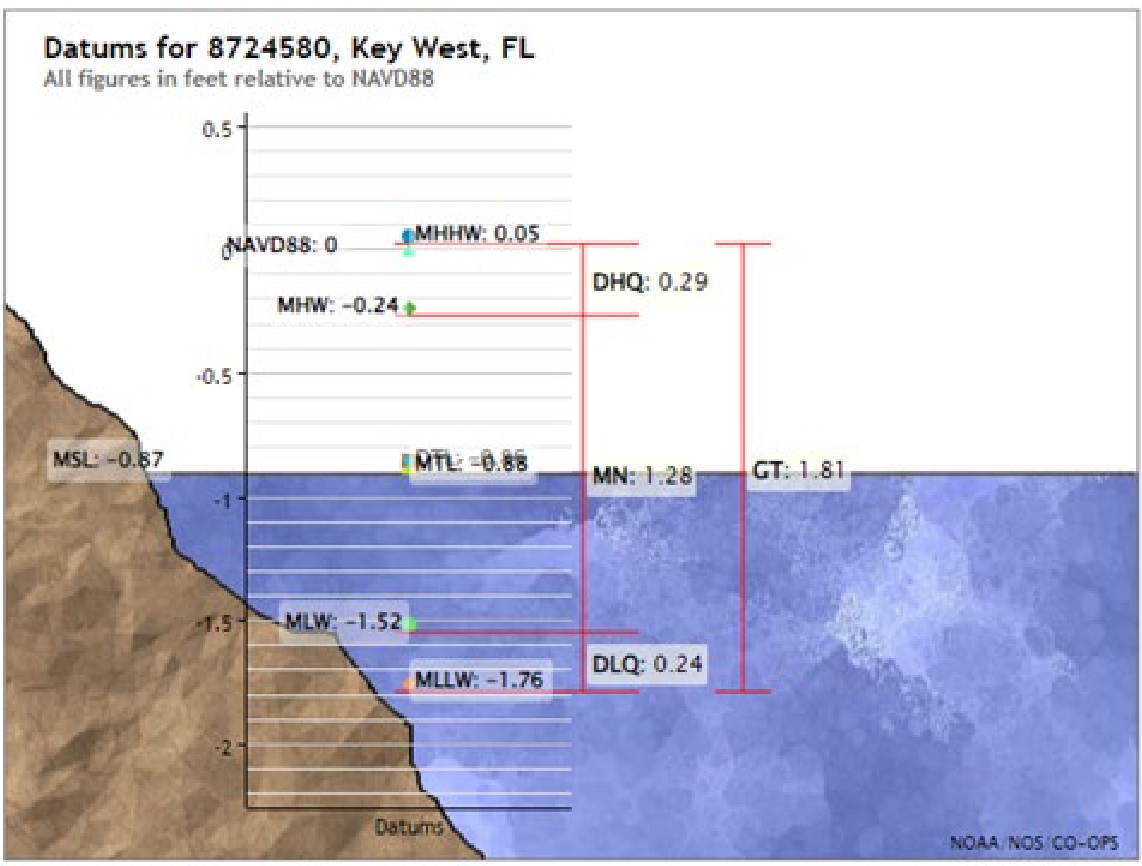
- **Mean Higher High Water (MHHW):** This is the average elevation of the higher high tides over a specific period. It is important for construction and development in coastal zones as it indicates the highest average water level that can be expected.
- **Mean High Water (MHW):** This is the average of all the high-water heights observed over the National Tidal Datum Epoch (usually a period of 19 years).

- **Mean Sea Level (MSL):** This is the average sea level. The mean level of the ocean's surface, calculated from hourly tidal heights measured over extended periods.
- **Mean Low Water (MLW) and Mean Lower Low Water (MLLW):** These represent the average of the lowest tides and the lowest average tide recorded, respectively, and are often used for navigational purposes to ensure boats and ships don't run aground.

The specific values and their vertical relationship to each other provide critical information for a range of activities, including coastal planning, construction, and navigation. The chart is typically set against the North American Vertical Datum of 1988 (NAVD88), which is a standard geodetic datum for elevations used in the United States for mapping and construction.

The exact purpose and usage of these datums can vary depending on the context, such as flood risk assessment, where knowing the heights of various tide conditions is essential for preparing for potential flooding events.

Figure 28 - Datums for Key West Tide Gauge



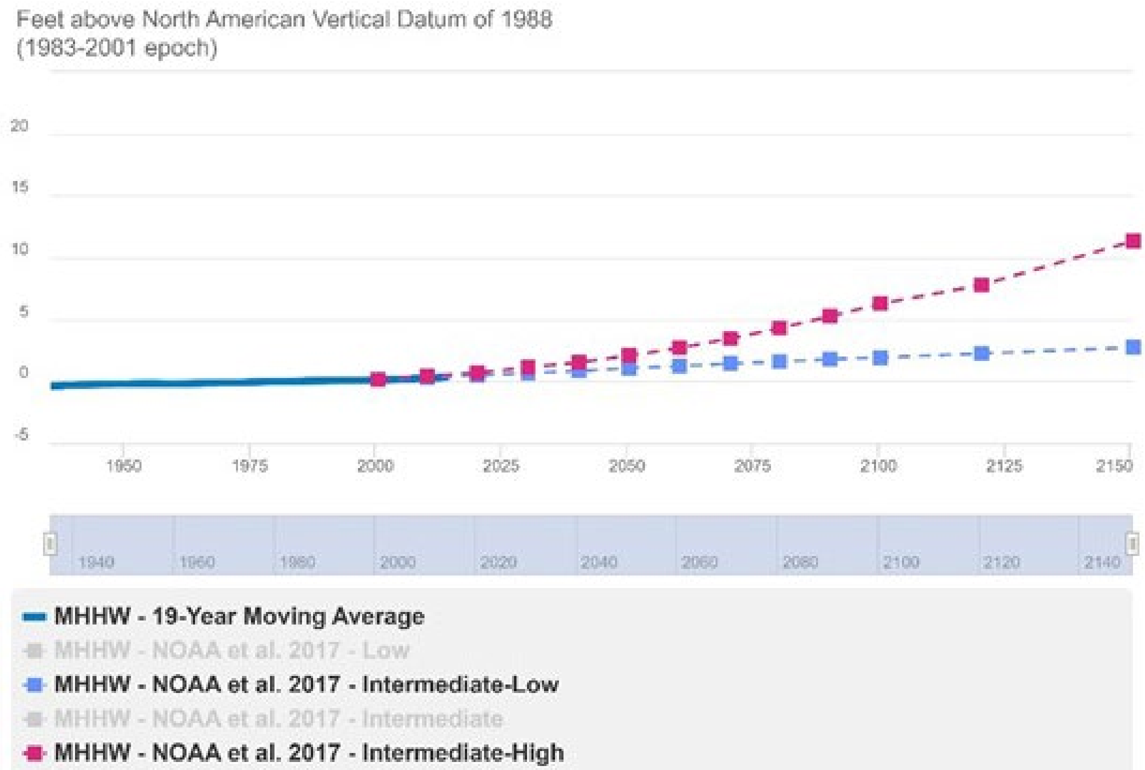
Datum charts in the context of water levels and elevations serve as a reference for understanding both current and future conditions. The following explains their usage and significance:

- **Current Water Levels (Datum Charts and Tide Gauge Record):** Datum charts represent the baseline or reference points from which water levels and land elevations are measured. These charts are crucial for a wide range of activities, including navigation, construction, and environmental management. They provide a snapshot of existing conditions, serving as a benchmark for comparing changes over time.
- **Projections in the Charts (Future Water Levels for NIL and NIH):** The projections found within these charts are predictive models that estimate future changes in water levels due to various factors, most notably climate change and sea-level rise. These projections are based on data analysis and simulation models that account for different scenarios, including greenhouse gas emission trajectories, polar ice melt rates, and ocean temperature changes.

In essence, datum charts provide a "ground truth" of current conditions against which future changes can be measured and predicted. These future projections are essential for planning and preparing for impacts related to rising sea levels, such as coastal flooding, habitat loss, and infrastructure vulnerability. They help policymakers, urban planners, and communities make informed decisions to mitigate risks and adapt to changing environmental conditions.

Understanding the difference between current conditions and future projections is crucial for effective environmental management and resilience planning. It allows for proactive measures to be put in place, reducing the potential damage and disruption caused by natural phenomena and climate change.

Figure 29 – Key West Tide Gauge Sea Level Data and Projections



The USACE Sea Level Change Curve Calculator[5] and Sea Level Analysis Tool[6] were utilized to calculate the sea level rise values required for NOAAs method for mapping sea level rise[7] with the most recent digital elevation model and VDATUM[8] derived tidal surfaces. After reviewing the closest tide gauges available within the USACE Sea Level Change Curve Calculator, the NOAA tide gauge, referenced as "Key West, FL" (NOAA Gauge Station ID: 8724580, 2024) was selected for its proximity to the study area. The Key West tide gauge indicates a relative sea-level trend of 2.61 millimeters/year with a 95% confidence interval of +/- 0.15 mm/year based on data from 1913 to 2023 (Figure 30).

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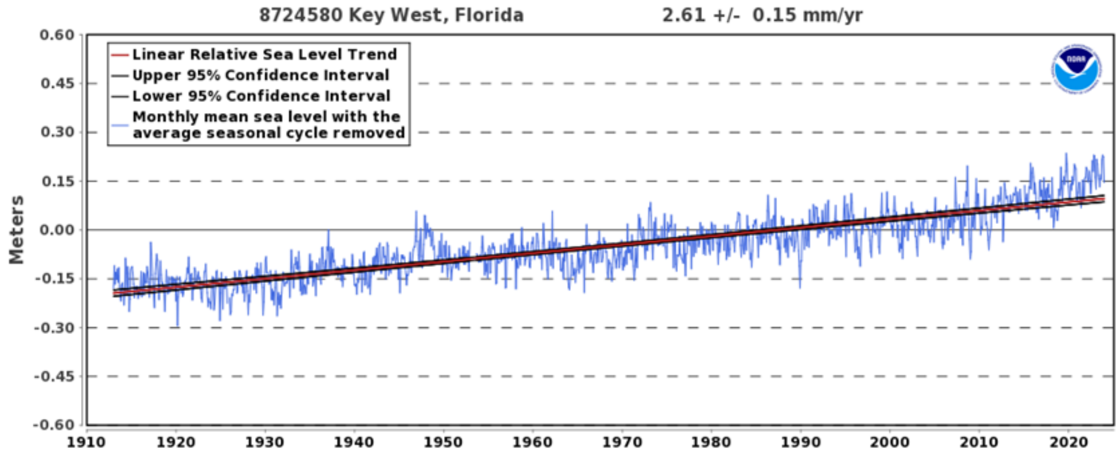
[5] USACE Sea Level Change Curve Calculator: https://cwbi-app.sec.usace.army.mil/rccslc/slcc_calc.html
[6] https://climate.sec.usace.army.mil/slat/
[7] Detailed Method for Mapping Sea Level Rise Inundation (NOAA, 2017): https://coast.noaa.gov/data/digitalcoast/pdf/slr-inundation-methods.pdf
[8] NOAA Vertical Datum Transformation: https://vdatum.noaa.gov/welcome.html

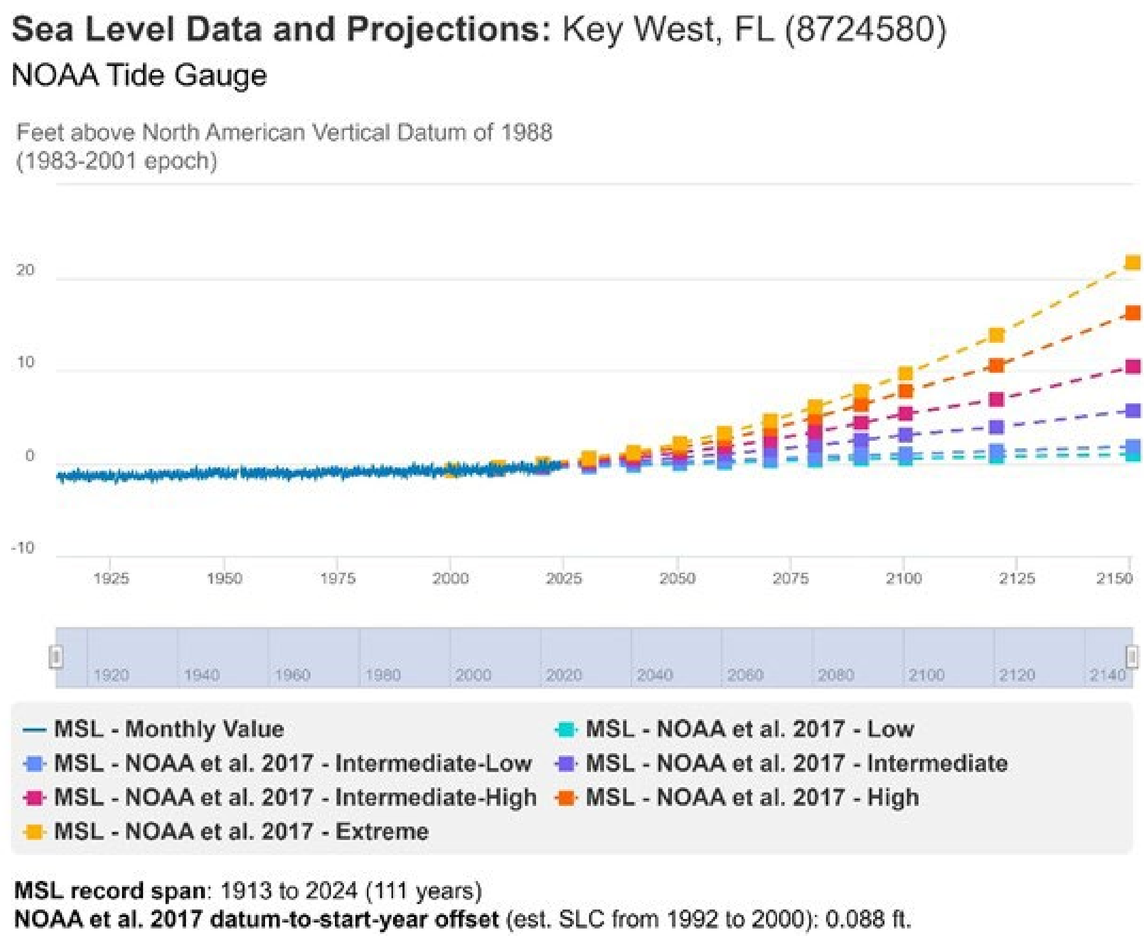
Figure 30 - Sea Level Increase from 1913 to 2023

(2.61 +/- 0. 15 mm/year), equivalent to 0. 86 ft in 100 years



The plots (Figure 30 and Figure 31) above and below describe the observed and future projected increase in sea levels within the region. Each of the curves *(Low, Intermediate-Low, Intermediate, Intermediate-High, and High)* in Figure 31 correspond with 0.4 m (or 15.75 inches), 0.6 m (or 23.62 inches), 1.05 m (or 41.34 inches), 1.5 m (or 59.06 inches) and 2 m (or 78.74 inches) of global mean sea level change, respectively.

Figure 31 - Mean Sea Level Projections for Key West



Exposure: Future High Tide

Using a planning-grade static coastal hydrology sea level rise modeling approach (NOAA, 2017), the project team assessed the area for its vulnerability to sea level rise (SLR) inundation, leveraging the latest version of ArcGIS Pro for data analysis and cartographic representation (Environmental Systems Research Institute, 2022). By following this comprehensive modeling process, detailed future high tide flooding maps are generated that account for both regional and local variations in tidal flooding, and specifically identify areas with similar elevation that are not tidally connected according to the elevation surface. These areas may still be vulnerable to flooding, especially if they are connected to tidally connected coastal systems via stormwater conveyance or some other type of groundwater/surface water connection not captured within elevation data.

Table 5 below outlines Islamorada's sea-level rise projections over the coming decades, utilizing the latest available data and climate models. These projections serve as a crucial foundation for the risk assessment, enabling evaluation of the potential consequences of rising sea levels in the context of this specific locale.

Table 5 - SLR with High Tide Flooding Modeling Scenarios

Timeframe	NOAA Intermediate Low 2017 (feet NAVD88)	NOAA Intermediate High 2017 (feet NAVD88)
Present Day	1.55	1.78
2040	1.91	2.60
2070	2.50	4.53
2100	2.99	7.35

The Future High Tide section makes use of ArcGIS Pro and NOAA's methods to predict flooding. It involves adjusting measurements for differences in sea level at various points and using algorithms to fill in gaps between these points. This process helps to accurately predict how high tides can rise, considering both current and future sea levels. Combining information on sea level rise with existing tide patterns yields detailed maps that show where and how high tide flooding could happen in the future. This method provides a clear picture of the risks of future high tide flooding.

Figure 32 - Vertical Datum Interpolation Surface

The above graphic shares the results of the tide gauge interpolation using NOAA's VDATUM tool. This surface, and others like it, is utilized within the modeling to convert between datums, specific to this assessment, conversions between NAVD88, and mean higher high water (MHHW) and mean sea level (MSL) all common place benchmarks in floodplain management. Utilizing derivatives of this tool, local tide records, future change factors and a digital elevation model the exposure analysis was conducted considering both the elevation of current storms but also and adjustment of current heights to projected future condition.

Islamorada's vulnerability to climate change, particularly concerning sea-level rise, necessitates a meticulous examination of projections tailored specifically to this island community. The analysis of sea-level rise projections and potential impacts is greatly enhanced by the incorporation of Islamorada-specific data and scenarios, especially those focused on the Village's location along the shoreline. In Islamorada, like many other locales with long, uninterrupted shorelines, the imminent threat of sea-level rise has the potential to significantly impact communities, infrastructure, and environment.

Exposure: Depth of Tidal Flooding, including Future High Tide Flooding

Incorporating the Florida Department of Environmental Protection's (FDEP) guideline of adding 2 feet to the Mean Higher High Water (MHHW) mark for determining the tidal flooding threshold, the "Sea Level Rise + High Tide Flooding Scenario" offers an enhanced perspective on anticipating future tidal flooding events. This adjustment to the MHHW benchmark is pivotal, as it provides a more conservative and therefore safer standard for assessing and preparing for tidal flooding risks. It acknowledges the potential for sea level rise to substantially elevate baseline water levels, which, when combined with high tide events, significantly intensifies the frequency and severity of tidal flooding.

This scenario, therefore, extends beyond merely understanding the dynamics of sea level rise and high tides; it actively incorporates FDEP's forward-looking standard to ensure that the projected impacts reflect a scenario where the threshold for tidal flooding is higher. This approach is critical for urban and infrastructure planning, highlighting the necessity for resilient coastal defense mechanisms designed to withstand not just current sea levels and tidal variations but also future increases. By integrating the +2 feet adjustment, the analysis underlines the imperative for seawalls, tide gates, and natural barriers that are not only effective under present conditions but are also robust enough to offer protection as sea levels continue to rise.

The following maps represent the results of projected scenarios incorporating high tide flooding in the present day and under future conditions based on the NIL and NIH[9] sea level rise curves.

[9] [1] Section 380.093(3)(d)2.b. requires: At least two local sea level rise scenarios, which must include the 2017 National Oceanic and Atmospheric Administration intermediate-low and intermediate-high sea level rise projections.

Figure 33 - NIH 2070 SLR with High Tide Flooding

Days of Tidal Flooding Analyses

Expanding upon the sea level rise and high tide flooding scenario, this part of the analysis focuses on quantifying the expected number of days experiencing tidal flooding under various future conditions. This projection is instrumental in understanding the temporal dimension of tidal flood risks, shifting the perspective from theoretical to tangible impacts on the community's day-to-day life. By estimating the frequency of tidal flooding days, the assessment highlights potential disruptions to transportation, economic activities, and the overall quality of life, especially in low-lying and waterfront areas. This scenario emphasizes the urgency of implementing comprehensive flood risk management strategies, including early warning systems, community education programs, and infrastructure resilience enhancements, to reduce the societal and economic impacts of increased tidal flooding.

The assessment of tidal flooding is an essential element of comprehensive vulnerability evaluations aimed at understanding the impacts of sea level rise on coastal communities. This analysis is meticulously conducted through the collection and examination of high and low tide data spanning at least 19 years, a period that encompasses the full metonic cycle, from specific NOAA tide gauges, such as the Key West Tide Gauge. The objective is to extrapolate high tide values from historical data, project them forward using the observed sea level trend, and then assess the potential frequency of tidal flooding events in the future.

Table 6 - Statistical Analysis of Historical Tide Record

Calculating the number of days where water elevations surpassed a "critical elevation"

Approximate Days of Tidal Flooding Observed	1992-2011 (feet NAVD88)	2004-2022 (feet NAVD88)
1	1.21	1.54
5	1.05	1.34
10	0.94	1.22
15	0.86	1.10
20	0.80	1.02
30	0.71	0.93
40	0.63	0.86
50	0.53	0.75
100	0.37	0.58
≥150	0.09	0.29

The above analysis employs statistical methods to correlate historic tide records with observed and projected days of tidal flooding, as illustrated in the provided table. Table 6 above reveals the changes in tide elevations over two distinct periods, 1992-2011 and 2004-2022, and associates these elevations with the observed frequency of tidal flooding events. The elevations are presented in feet NAVD88. A key observation from this data is the trend of increasing tide elevations over time, indicating rising sea levels and, consequently, an increased risk of tidal flooding.

Table 7 - Future Tidal Flooding Frequency

(feet NAVD88)

Approx. Days	NIL 2040	NIL 2070	NIL 2100	NIH 2040	NIH 2040	NIH 2040
1	1.72	2.07	2.26	2.60	4.51	6.95
5	1.54	1.83	2.09	2.39	4.26	6.76
10	1.43	1.71	1.99	2.28	4.08	6.65
15	1.33	1.60	1.90	2.18	3.93	6.51
20	1.25	1.53	1.81	2.09	3.85	6.42
30	1.17	1.44	1.73	1.98	3.74	6.30

Approx. Days	NIL 2040	NIL 2070	NIL 2100	NIH 2040	NIH 2040	NIH 2040
40	1.09	1.38	1.66	1.89	3.64	6.21
50	0.98	1.27	1.55	1.76	3.51	6.07
100	0.81	1.10	1.38	1.57	3.32	5.82
≥150	0.53	0.81	1.09	1.23	2.95	5.32

Understanding the implications of these findings is crucial. The elevations for the two periods underscore not just the absolute *rise* in sea levels but also the increasing likelihood of flooding events as these levels continue to rise. The observed days of tidal flooding serve as a direct indicator of how frequently communities might experience such events, given current and projected sea level rises.

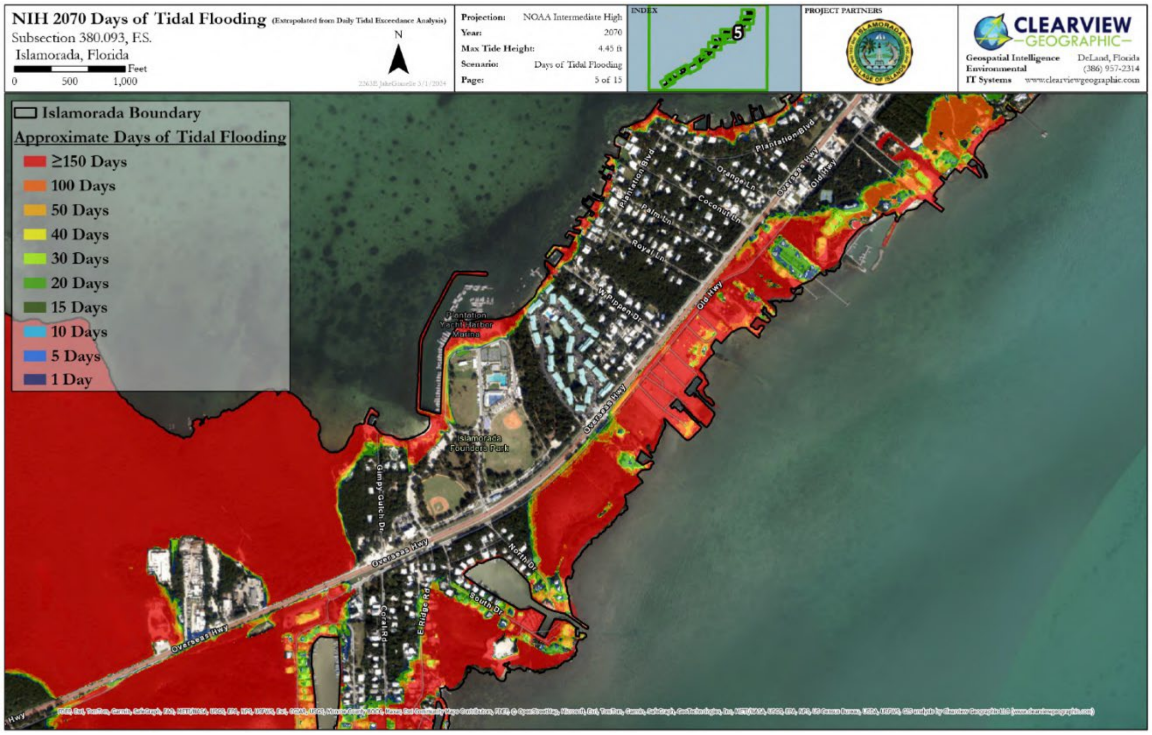
The vulnerability assessment further contextualizes these findings by projecting future sea level rises under different NOAA scenarios, including both intermediate-low and intermediate-high projections for the years 2040, 2070, and 2100. These projections enable the estimation of future tidal flooding events' frequency, providing invaluable insights for planning and adaptation strategies. For instance, the NOAA intermediate-low scenario estimates that by 2040, sea level rise will reach 1.72 feet, escalating to 2.26 feet by 2100. The intermediate-high scenario paints a more severe picture, with projections of up to 6.95 feet by 2100.

This forward-looking analysis is vital for urban planners, policymakers, and the community at large, offering a data-driven basis for understanding the risks associated with sea level rise and tidal flooding. By identifying the elevations at which tidal flooding becomes a significant risk and estimating the frequency of such events under various sea level rise scenarios, the assessment highlights the critical need for adaptive measures. These measures may include infrastructure improvements, policy adjustments, and community preparedness initiatives designed to mitigate the impacts of tidal flooding and enhance resilience against the growing threat of sea level rise.

Tidal flood days expected for each scenario and planning horizon

These maps, which can be found in the Exposure Map series, identify which communities, infrastructure, and natural areas are at increased risk due to multiple days of tidal flooding, capturing the various vulnerabilities from the range of tides based on the NIL and NIH sea level rise projections.

Figure 34 - NIH 2070 Days of Tidal Flooding



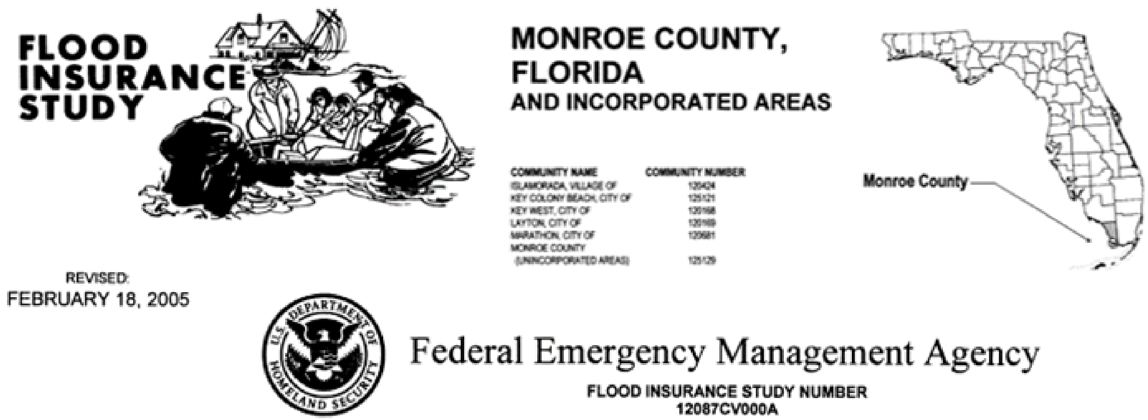
Exposure: Storm Surge

Storm Surge modeling in this context uses FEMA's data and HAZUS-MH[10] software, adapted for future sea level rise. The approach integrates historical storm surge data from FEMA's Flood Insurance Study[11] with projections of sea level rise, creating models of adjusted storm surge inundation. This methodology is crucial to understand and anticipate the augmented impacts of storm surges in the future, enabling effective planning and resilience strategies against these events. The models suggest how rising sea levels could intensify storm surges, which is essential for informed decision-making and mitigation efforts. Unlike sea level rise and tidal flooding, storm surge is a less permanent condition, but due to the force and depth of flooding can be extremely debilitating to a community.

[10] https://www.fema.gov/flood-maps/products-tools/hazus

[11] Specifically adjusting the 100-year stillwater elevations by the rate of sea level change.

Figure 35 - FEMA Flood Insurance Study Non-Coastal Stillwater Elevations



FLOODING SOURCE AND TRANSECT	FLOOD INSURANCE RATE MAP PANEL	STILLWATER ELEVATIONS (FEET NGVD)				ZONE	BASE FLOOD ELEVATION (FEET NGVD)[1,2]
		10% (10 YR.)	2% (50 YR.)	1% (100 YR.)	0.2% (500 YR.)		
GULF OF MEXICO 1	1508, 1516	3.2	5.5	8.4[3]	7.3	VE AE	11-13 8-10
		3.2	5.5	6.8	7.3	VE AE	9-11 7- 9
ATLANTIC OCEAN 2	1516	2.7	4.8	7.8[3]	6.4	VE AE	10-12 8-10
		2.7	4.8	6.0	6.4	AE	6- 8
GULF OF MEXICO 3	1509	5.1	6.5	7.4	9.2	VE AE	9-11 7- 9
ATLANTIC OCEAN 4	1509, 1517	3.0	5.5	8.5[3]	7.4	VE AE	11-13 9-11
		3.0	5.5	7.2	7.4	VE AE	9-11 7- 9
GULF OF MEXICO 5	1528	4.7	7.6	8.4	10.4	VE AE	11-13 9-11

[1]Rounded to Nearest Foot and may include effects of wave action
[2]Due to map scale limitations, Base Flood Elevations (BFEs) shown on the FIRM may represent average elevations for the zones depicted
[3]Include effects of wave setup

TABLE 2	FEDERAL EMERGENCY MANAGEMENT AGENCY MONROE COUNTY, FL AND INCORPORATED AREAS	SUMMARY OF STILLWATER ELEVATIONS GULF OF MEXICO – ATLANTIC OCEAN

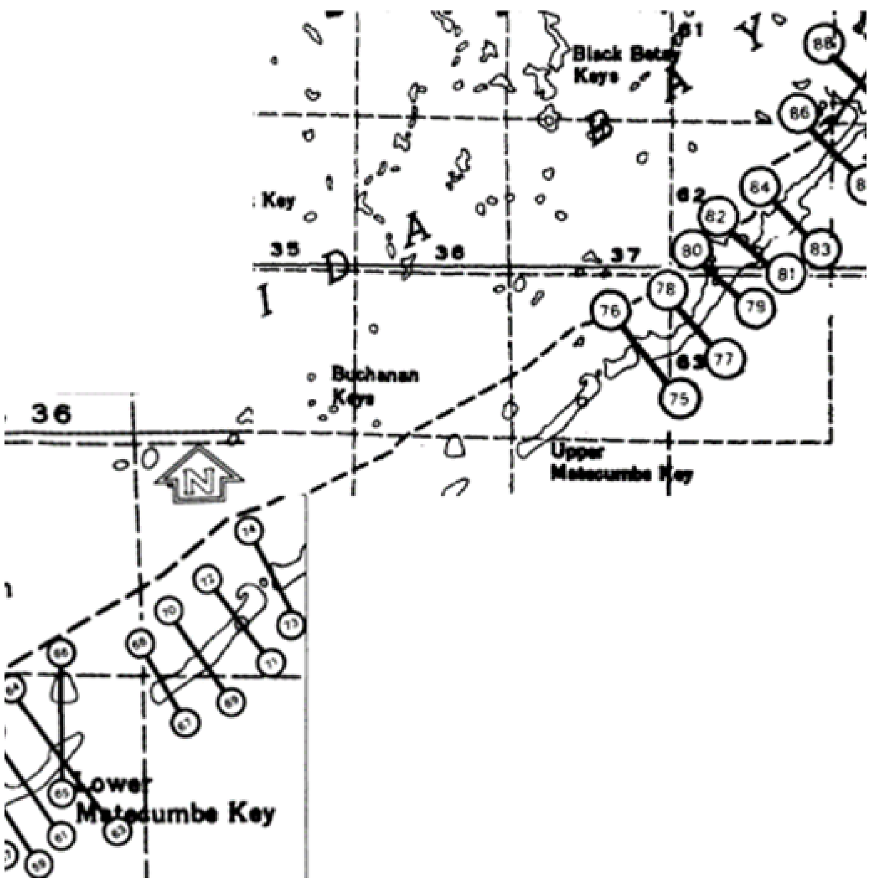
Stillwater Elevations[12]

The transects taken from the Flood Insurance Study are integral to the HAZUS-MH framework, which is designed to estimate storm surge and its potential impacts by modeling how surges of varying heights could affect both natural landscapes and urban development. The transects are used in the model to establish the still water elevations for the modeling to project surge. This process, depicted in Figure 36, is

[12] Stillwater elevations refer to the level of water in a body of water, such as a lake or river, under conditions of no wave action or minimal disturbance. This measurement is crucial in understanding water levels for purposes like flood prediction, navigation safety, and water resource management. It represents the height of the water surface when it is not affected by wind or tidal forces, providing a baseline for gauging water levels and their potential impacts.

critical for urban planners and emergency management professionals as it aids in anticipating the extent of possible flooding and crafting preemptive measures. While HAZUS-MH offers robust modeling capabilities, it does not factor in elements such as landscape friction, the carrying capacity of stormwater systems, the protective effects of shoreline armoring or the effects of employing nature-based shoreline resilience strategies — all variables that can dampen the real-world effects of storm surge. Consequently, the tool may present an overestimated scope of surge impact, highlighting the importance of contextual adaptation of its findings. Despite this, the results from HAZUS-MH provide valuable insights for vulnerability assessments, laying the groundwork for informed, risk-conscious planning and the evolution of resilient infrastructure strategies.

Figure 36 - Transect Location Map



Stillwater elevations across the coastal transects identified within the FEMA 2005 Monroe County Flood Insurance Study ("2005 Monroe FIS") were also averaged and adjusted by both NOAA Intermediate Low and Intermediate High Sea level change. Baseline still water elevations for the various return interval flood events (10-, 50-, 100-, and 500-year) were sourced from the 2005 Monroe FIS.

Table 8 - Critical Average Stillwater Elevations

Planning Horizon	100-Year (feet NAVD88)	500-Year (feet NAVD88)
Present Day Average Stillwater	8.17’	9.63’
NIL 2040 Adjusted Average Stillwater	10.08’	11.54’
NIL 2070 Adjusted Average Stillwater	10.72’	12.18’
NIL 2100 Adjusted Average Stillwater	11.16’	12.62’
NIH 2040 Adjusted Average Stillwater	10.77’	12.23’
NIH 2070 Adjusted Average Stillwater	12.7’	14.16’
NIH 2100 Adjusted Average Stillwater	15.52’	16.98’

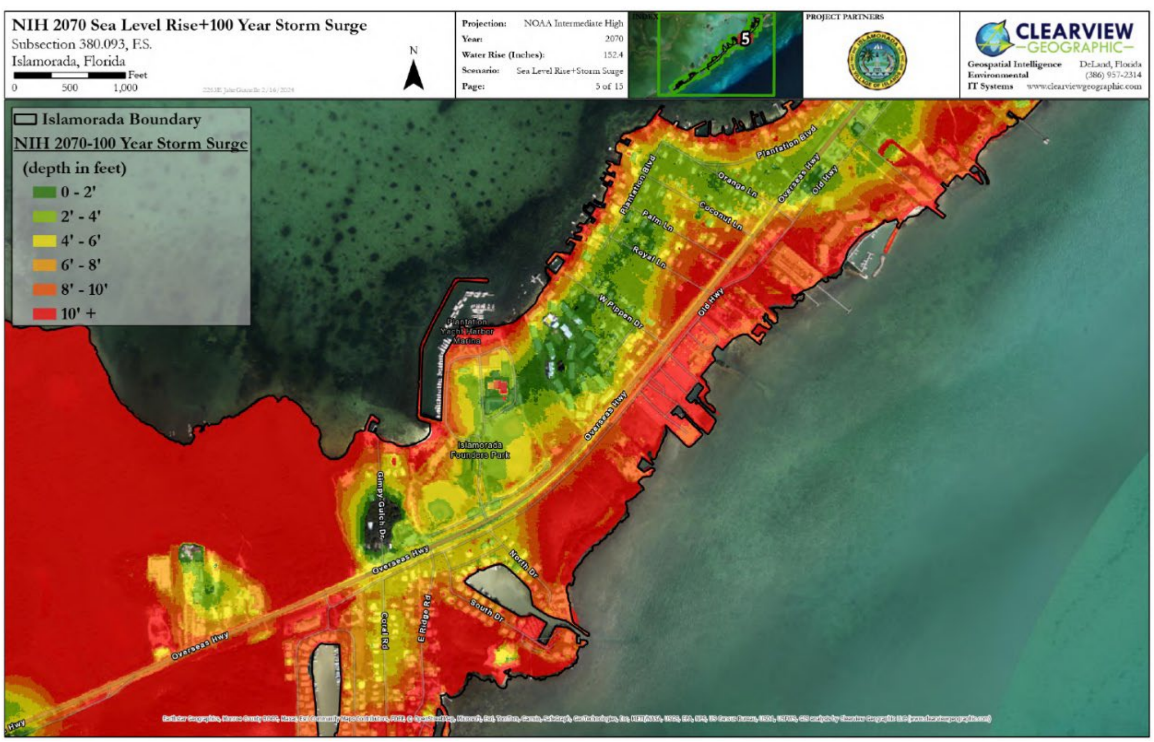
Using the outputs from the HAZUS-MH software, depth grids representing the maximum surge elevation (and corresponding flood depth) are created for a comparative overlay analysis with the critical asset inventory. Critical elevations utilized with the coastal floodplain module of HAZUS-MH are provided in Table 8 above.

Exposure: Depth of Current and Future Storm Surge Flooding

These maps identify the areas at increased risk from the combined effects of storm surges and sea level rise, combining the 2040, 2070, and 2100 NIH SLR projections with 100-year (1.0% annual chance) and 500-year (0.2% annual chance) storms. In the figures below, by 2070, flooding from even the 100-year storm inundates a significant portion of Islamorada at a depth of 10 feet or more.

Figure 37 - NIH 2040 SLR + 100-Year Storm Surge

Figure 38 - NIH 2070 SLR + 100-Year Storm Surge



100-Year Storm Surge Scenario

The 100-year storm surge scenario encapsulates a storm event that has a 1% chance of occurring in any given year. This scenario is instrumental in determining the maximum expected storm surge flooding level over the planned horizons, providing a crucial benchmark for urban planning and infrastructure resilience. By integrating this scenario with future sea level rise projections, the assessment illuminates the compounded effects of climate change on storm surge risks. The analysis leverages FEMA's storm surge data and employs the HAZUS-MH software, adjusted for future sea level rise projections, to predict the depth and extent of flooding across various parts of the Village. This scenario serves as a foundation for designing flood defense systems, updating building codes, and developing evacuation plans to mitigate the impacts of such extreme events on the community and critical infrastructure.

500-Year Storm Surge Scenario

Expanding the scope of the analysis, the 500-year storm surge scenario examines the impacts of a more severe but less frequent storm event, with a 0.2% chance of occurring in any given year. This scenario is crucial for stress-testing the Village's resilience against catastrophic storm surge events, offering insights into potential worst-case flooding scenarios. Similar to the 100-year scenario, this analysis incorporates adjustments based on projected sea level rises, employing advanced modeling techniques to provide detailed projections of storm surge depths and inundation extents. The outcome of this scenario analysis aids in the strategic placement of critical infrastructure, the design of more robust flood protection measures, and the prioritization of areas for targeted resilience enhancements.

Both the 100-year and 500-year storm surge scenarios are essential components of a comprehensive risk assessment framework, enabling Islamorada to proactively plan for and mitigate the risks associated with storm surge flooding. By accounting for these scenarios in conjunction with tidal flooding and sea level rise projections, the assessment offers a holistic view of the Village's flood risk landscape. This approach ensures that resilience planning is informed by a thorough understanding of the range and severity of potential flooding events, guiding investments in infrastructure, emergency preparedness, and community resilience initiatives. Ultimately, by preparing for these scenarios, Islamorada can enhance its ability to withstand and recover from storm surge events, safeguarding the well-being of its residents and the integrity of its critical assets against the challenges posed by a changing climate.

Exposure: Rainfall

The rainfall analysis in the Vulnerability Assessment employs HEC-RAS software for rainfall simulation and runoff computation. This part of the assessment integrates

NOAA's Atlas 14 data and SFWMD change factors to create baseline rainfall depth grids, aligning with legislative requirements without relying on developing entirely new hydrologic and hydraulic (H&H) modeling. This comprehensive approach makes it possible to understand and prepare for future climate impacts. This approach meets and exceeds the statutory requirements for rainfall evaluation in vulnerability assessments.

NOAA Atlas 14 provides high-quality data based on ongoing investigations of historical rainfall patterns across the United States. It offers site-specific rainfall distributions, which are essential for accurate hydrologic modeling. Compared to previous volumes, Atlas 14 estimates have longer periods of record and greater station density. NOAA Atlas 14 defines standard design rainfall distributions based on nesting high-intensity short durations within longer, lower-intensity durations. These distributions are used in hydrologic models to estimate rainfall intensity for specified durations and annual exceedance probabilities (Figure 39). The NOAA Atlas 14 serves as a guideline to assess flood potential in waterways and design stormwater infrastructure. The accuracy of rainfall data provided by NOAA Atlas 14 allows engineers and planners to make informed decisions when designing and managing infrastructure.

This document delineates the process of model development, touching upon terrain modeling, design storms, infiltration, runoff dynamics, soil conditions, boundary conditions, and the resultant analysis outputs.

Figure 39 - NOAA Atlas 14 Rainfall Time Series Table for Islamorada

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.532** (0.428-0.673)	**0.603** (0.485-0.764)	**0.724** (0.580-0.919)	**0.827** (0.659-1.06)	**0.974** (0.754-1.29)	**1.09** (0.826-1.47)	**1.21** (0.888-1.68)	**1.34** (0.942-1.91)	**1.51** (1.02-2.23)	**1.64** (1.09-2.46)
10-min	**0.779** (0.626-0.985)	**0.883** (0.710-1.12)	**1.06** (0.849-1.34)	**1.21** (0.964-1.54)	**1.43** (1.10-1.89)	**1.60** (1.21-2.15)	**1.78** (1.30-2.46)	**1.96** (1.38-2.80)	**2.21** (1.50-3.26)	**2.41** (1.59-3.61)
15-min	**0.950** (0.764-1.20)	**1.08** (0.866-1.36)	**1.29** (1.04-1.64)	**1.48** (1.18-1.88)	**1.74** (1.35-2.31)	**1.95** (1.47-2.62)	**2.16** (1.58-3.00)	**2.39** (1.68-3.41)	**2.70** (1.83-3.97)	**2.94** (1.94-4.40)
30-min	**1.47** (1.18-1.86)	**1.68** (1.35-2.12)	**2.02** (1.61-2.56)	**2.31** (1.84-2.94)	**2.72** (2.11-3.61)	**3.06** (2.31-4.12)	**3.40** (2.49-4.71)	**3.76** (2.64-5.36)	**4.24** (2.88-6.25)	**4.62** (3.06-6.92)
60-min	**2.00** (1.61-2.53)	**2.27** (1.82-2.87)	**2.73** (2.19-3.47)	**3.14** (2.50-4.01)	**3.73** (2.90-4.97)	**4.21** (3.19-5.69)	**4.72** (3.46-6.55)	**5.25** (3.70-7.52)	**5.99** (4.07-8.85)	**6.58** (4.35-9.86)
2-hr	**2.53** (2.05-3.18)	**2.87** (2.32-3.60)	**3.45** (2.78-4.36)	**3.97** (3.18-5.04)	**4.74** (3.70-6.28)	**5.37** (4.10-7.22)	**6.04** (4.46-8.34)	**6.75** (4.79-9.61)	**7.74** (5.30-11.4)	**8.54** (5.68-12.7)
3-hr	**2.83** (2.29-3.54)	**3.20** (2.59-4.01)	**3.87** (3.12-4.86)	**4.47** (3.59-5.65)	**5.38** (4.23-7.14)	**6.15** (4.71-8.26)	**6.97** (5.17-9.62)	**7.85** (5.60-11.2)	**9.11** (6.26-13.4)	**10.1** (6.76-15.0)
6-hr	**3.29** (2.69-4.10)	**3.74** (3.05-4.66)	**4.58** (3.72-5.72)	**5.37** (4.34-6.74)	**6.60** (5.24-8.75)	**7.66** (5.92-10.3)	**8.82** (6.60-12.2)	**10.1** (7.26-14.3)	**11.9** (8.27-17.4)	**13.4** (9.03-19.8)
12-hr	**3.70** (3.04-4.58)	**4.25** (3.49-5.26)	**5.31** (4.34-6.59)	**6.34** (5.15-7.91)	**7.98** (6.40-10.6)	**9.42** (7.35-12.6)	**11.0** (8.31-15.2)	**12.8** (9.28-18.1)	**15.4** (10.7-22.4)	**17.5** (11.9-25.6)
24-hr	**4.17** (3.44-5.12)	**4.84** (3.99-5.95)	**6.15** (5.05-7.57)	**7.43** (6.07-9.20)	**9.48** (7.66-12.5)	**11.3** (8.87-15.1)	**13.3** (10.1-18.2)	**15.6** (11.4-21.9)	**18.9** (13.3-27.3)	**21.6** (14.7-31.4)
2-day	**4.85** (4.02-5.92)	**5.63** (4.66-6.87)	**7.13** (5.89-8.73)	**8.60** (7.07-10.6)	**11.0** (8.91-14.4)	**13.0** (10.3-17.3)	**15.3** (11.7-20.9)	**17.9** (13.2-25.1)	**21.7** (15.4-31.2)	**24.8** (17.0-35.8)
3-day	**5.44** (4.53-6.61)	**6.22** (5.17-7.56)	**7.74** (6.42-9.44)	**9.25** (7.62-11.3)	**11.7** (9.51-15.2)	**13.8** (10.9-18.2)	**16.2** (12.4-21.9)	**18.8** (13.9-26.3)	**22.8** (16.2-32.6)	**26.0** (17.9-37.4)
4-day	**5.96** (4.97-7.22)	**6.71** (5.59-8.14)	**8.21** (6.82-9.98)	**9.69** (8.01-11.8)	**12.1** (9.90-15.8)	**14.3** (11.3-18.8)	**16.7** (12.8-22.5)	**19.3** (14.3-26.9)	**23.3** (16.6-33.3)	**26.6** (18.4-38.2)
7-day	**7.18** (6.02-8.65)	**7.88** (6.59-9.50)	**9.29** (7.75-11.2)	**10.7** (8.90-13.0)	**13.1** (10.8-16.9)	**15.2** (12.2-19.9)	**17.6** (13.6-23.6)	**20.3** (15.1-28.0)	**24.3** (17.4-34.5)	**27.6** (19.2-39.4)
10-day	**8.11** (6.81-9.74)	**8.85** (7.43-10.6)	**10.3** (8.63-12.4)	**11.8** (9.79-14.3)	**14.1** (11.6-18.1)	**16.2** (13.0-21.1)	**18.6** (14.4-24.8)	**21.2** (15.8-29.1)	**25.1** (18.0-35.5)	**28.3** (19.7-40.2)
20-day	**10.4** (8.81-12.4)	**11.6** (9.76-13.8)	**13.5** (11.4-16.2)	**15.3** (12.8-18.4)	**17.9** (14.6-22.4)	**20.0** (16.0-25.5)	**22.2** (17.2-29.1)	**24.6** (18.4-33.2)	**27.9** (20.1-38.9)	**30.6** (21.4-43.2)
30-day	**12.4** (10.5-14.7)	**13.9** (11.8-16.5)	**16.4** (13.8-19.5)	**18.4** (15.5-22.1)	**21.3** (17.3-26.3)	**23.5** (18.7-29.6)	**25.7** (19.9-33.3)	**27.9** (20.8-37.3)	**30.9** (22.3-42.6)	**33.2** (23.3-46.6)
45-day	**15.1** (12.9-17.9)	**17.0** (14.5-20.2)	**20.0** (17.0-23.8)	**22.5** (18.9-26.8)	**25.7** (20.9-31.5)	**28.0** (22.4-35.0)	**30.3** (23.5-38.9)	**32.5** (24.3-43.0)	**35.2** (25.4-48.2)	**37.2** (26.3-52.2)
60-day	**17.6** (15.0-20.8)	**19.8** (16.9-23.4)	**23.2** (19.7-27.5)	**25.9** (21.9-30.8)	**29.4** (24.0-35.9)	**31.9** (25.6-39.7)	**34.3** (26.6-43.8)	**36.6** (27.4-48.2)	**39.3** (28.4-53.6)	**41.3** (29.2-57.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

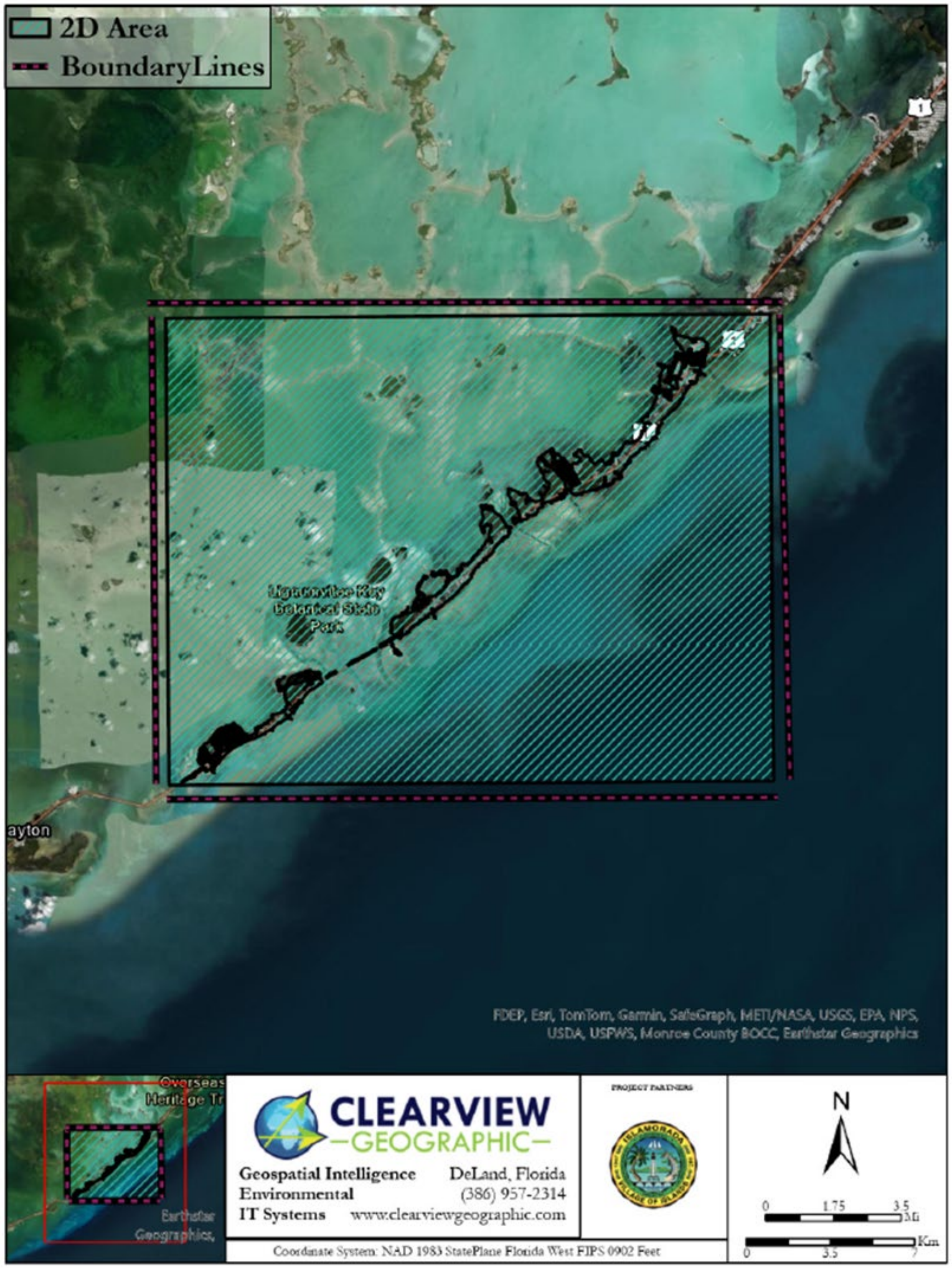
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Terrain

To accurately capture the nuances of the terrain's elevation and slope, a model was constructed utilizing digital elevation models (DEMs). These DEMs serve as a foundational element in mapping and understanding the area's physical characteristics. The elevation data within these models adhere to the North American Vertical Datum of 1988 (NAVD88). Figure 40 is the outline of the 2D DEM area and the boundary condition lines used in conjunction with the DEM as terrain inputs in the modeling environment.

Figure 40 - LiDAR Data Extent and Boundary Condition Lines for N, S, E, and W Boundaries



Design Storms

The Precipitation Data files were generated using Intensity/Precipitation curves derived from the FDOT Drainage manual for 24-hour design storms. The design storms represent current (2023) rainfall patterns: 500-, 100-, 50-, and 25-year return interval 24-hour rainfall events and the rainfall depths representing each 24-hour hypothetical storm event were taken from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 annual maxima series to represent 2023 rainfall patterns (NOAA, 2023). Future rainfall depths were computed using the current precipitation depths in Table 9, deriving the intensity for the respective future conditions by using the South Florida Water Management change factors to arrive at the projected precipitation in Table 10. The current and projected precipitation depths are then subjected to the storm design criteria in Table 11 below to arrive at a storm design that is suitable for varying present and future conditions.

Table 9 - Precipitation for 24-Hour Storm Duration - Present Day

Year	Scenario	Precipitation (inches)[13]
Present Day	25-Year	9.93
Present Day	50-Year	11.70
Present Day	100-Year	13.70
Present Day	500-Year	19.00

Table 10 - Projected Precipitation for 24-Hour Storm Duration

Year	Scenario	Precipitation (inches)
2040	25-Year	13.05
2040	100-Year	18.82

[13] [1] (NOAA, 2023)

Year	Scenario	Precipitation (inches)
2070	25-Year	14.15
2070	100-Year	20.28
2100	25-Year	15.61
2100	100-Year	22.34

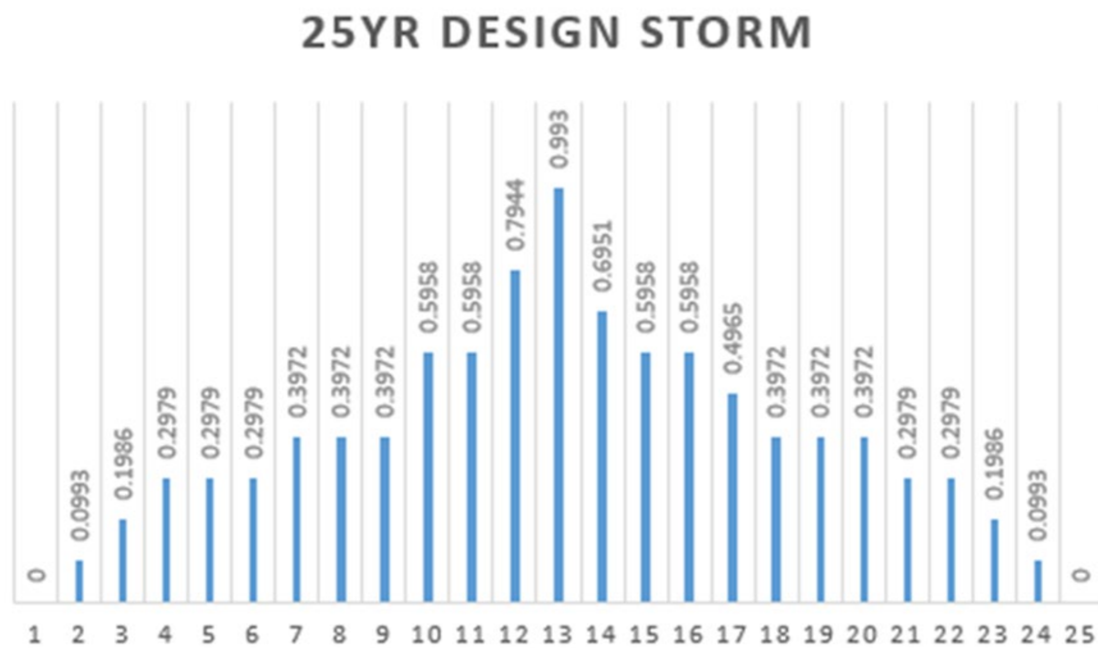
Table 11 - Rainfall Design Storm Criteria for Varying Storm Events[14]

T hours	I/P Total	25-Year Intensity	50-Year Intensity	100-Year Intensity	500-Year Intensity
0	0	0	0	0	0
1	0.010	0.099	0.117	0.137	0.190
2	0.020	0.198	0.234	0.274	0.380
3	0.030	0.298	0.351	0.411	0.570
4	0.030	0.298	0.351	0.411	0.570
5	0.030	0.298	0.351	0.411	0.570
6	0.040	0.397	0.468	0.548	0.760
7	0.040	0.397	0.468	0.548	0.760
8	0.040	0.397	0.468	0.548	0.760
9	0.060	0.596	0.702	0.822	1.140
10	0.060	0.596	0.702	0.822	1.140
11	0.080	0.794	0.936	1.096	1.520

[14] FDOT drainage manual for design storms, https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/roadway/drainage/files/idfcurves.pdf

12	0.100	0.993	1.170	1.370	1.900
13	0.070	0.695	0.819	0.959	1.330
14	0.060	0.596	0.702	0.822	1.140
15	0.060	0.596	0.702	0.822	1.140
16	0.050	0.500	0.585	0.685	0.950
17	0.040	0.397	0.468	0.548	0.760
18	0.040	0.397	0.468	0.548	0.760
19	0.040	0.397	0.468	0.548	0.760
20	0.030	0.298	0.351	0.411	0.570
21	0.030	0.298	0.351	0.411	0.570
22	0.020	0.199	0.234	0.274	0.380
23	0.010	0.099	0.117	0.137	0.190
24	0	0	0	0	0

Figure 41 - 25-Year Design Storm Criteria for Islamorada



Infiltration and Runoff

The infiltration method employed in this HEC-RAS model utilizes the Soil Conservation Service (SCS) Curve Number (CN) method, designed to estimate direct runoff and infiltration rates from rainfall events. This approach is particularly suitable for varying soil conditions, and land use offering a comprehensive understanding of how different terrains respond to precipitation.

The SCS CN method is based on empirical data, correlating soil type and land use to a curve number that represents the potential for runoff. This method simplifies the calculation of effective rainfall (precipitation that contributes to runoff) by considering the initial abstraction and potential maximum retention after runoff begins.

Infiltration rates are dynamically adjusted for each simulation. This adaptation ensures the model's responsiveness to varying hydrological conditions, offering a more nuanced depiction of infiltration and runoff dynamics within the study area. Manning’s n roughness and percent impervious values were assigned to each USGS National Land Cover Database (NLCD) land cover category representing 2021 conditions (USGS, 2023a) (Figure 43). Manning’s n roughness ranges were taken from the HEC-RAS technical reference guide (USACE, 2021) Table 13 shows the land cover categories, Manning’s n roughness, percent impervious, and area within the modeled 2D flow area.

Soil Classification

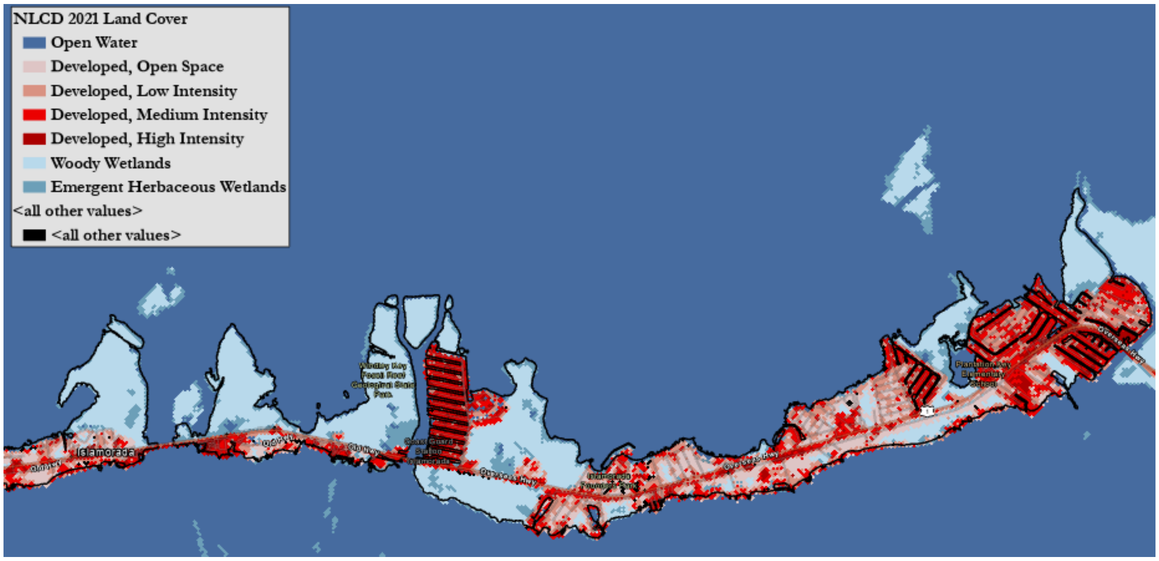
The Gridded Soil Survey Geographic (gSSURGO) Database was used to identify the soil texture and hydrologic soils group for soils within the 2D flow area (USDA-NRCS, 2023). Figure 42 shows the gSSURGO soil map classifications in the 2D flow area. The most dominant soil texture throughout the city is primarily Sand. Aside from sandy soil classifications there was also a notable presence of Gravelly muck soils. In the model the gravelly muck soils are treated as poorly drained soils where there is limited capacity to transmit water because of the shallow depth of the water table. Typically these muck soils carry dual hydrologic soil group with soil group A or B applying to the drained condition and soil group. The sandy soils are considered well drained and without frequent ponding with a hydrologic soil group classification of A indicating low runoff potential.

Table 12 - Extent of Soil Textures

Soil Texture	Acres
Fine sand	9.18
Marly silt loam	482.97
Extremely gravelly sand	1111.67
Muck	1127.43
Gravelly muck	1599.61

Figure 42 - Soil Texture Categories

Figure 43 - Land Cover Categories



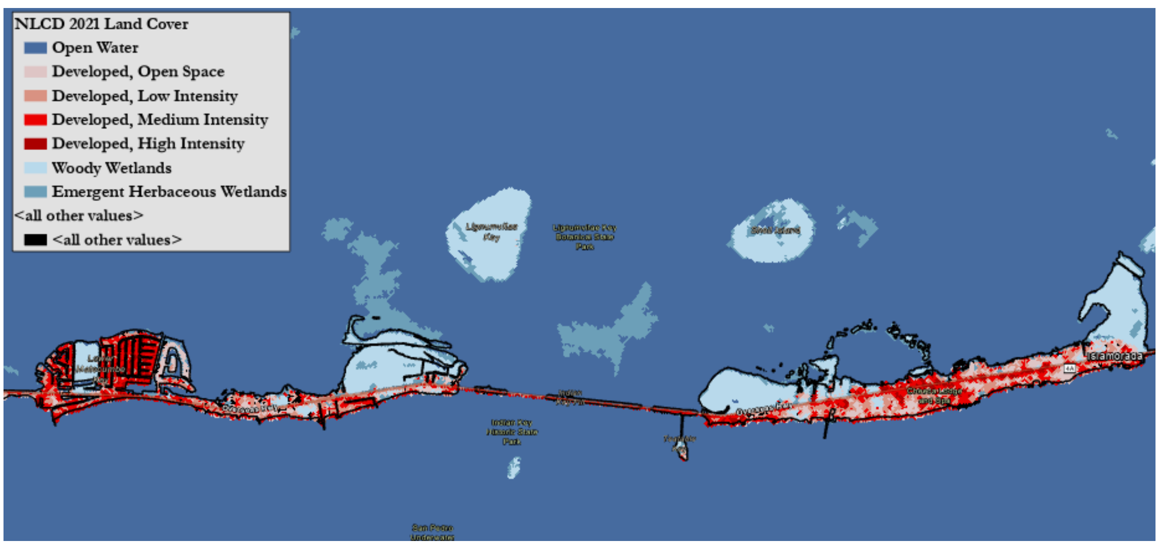


Table 13 - Land Cover Category - Manning's N Roughness and Impervious Surface[15]

ID	Name	Manning's n Range[1]	Mannings n^2	Impervious[3] %
31	Barren Land Rock-Sand-Clay	0.023-0.030	0.030	0
82	Cultivated Crops	0.020-0.050	0.050	0
24	Developed, High Intensity	0.120-0.200	0.150	80
22	Developed, Low Intensity	0.060-0.120	0.080	40
23	Developed, Medium Intensity	0.080-0.160	0.120	60
21	Developed, Open Space	0.030-0.050	0.035	0
95	Emergent Herbaceous Wetlands	0.050-0.085	0.070	75
42	Evergreen Forest	0.080-0.160	0.150	0
71	Grassland-Herbaceous	0.025-0.050	0.040	0
43	Mixed Forest	0.080-0.200	0.120	0
11	Open Water	0.025-0.050	0.035	100
81	Pasture-Hay	0.025-0.050	0.045	0
52	Shrub-Scrub	0.070-0.160	0.080	0
90	Woody Wetlands	0.045-0.150	0.100	50

[15] USACE Creating Land Cover, Manning's N Values, and % Impervious Layers (USACE, 2021).

Baseline Rainfall-Induced Flooding

The modeling approach uses generally accepted analysis and modeling techniques, which meet and exceed the requirements of Section 380.093(3)(d)2.c., F.S. Rainfall precipitation data sourced from NOAA's Atlas 14 provides the baseline rainfall depth grids and depth duration hydrographs for different storm events (25-year, 50-year, 100-year, and 500-year).

Figure 44 - 25-Year 24-Hour Rainfall - Present Day

25-Year 24-Hour Scenario

This scenario models a storm event with a 4% chance of happening in any given year. It provides insights into moderate but significant flooding risks that can disrupt daily life and damage less resilient infrastructure. The analysis of this frequency helps in identifying flood-prone areas that require improved drainage, enhanced stormwater management systems, and community flood preparedness programs.

50-Year 24-Hour Scenario

Elevating the analysis, the 50-year 24-hour scenario, with a 2% annual occurrence probability, examines the impacts of more intense rainfall. This scenario assists in evaluating the adequacy of existing flood defenses and identifying critical infrastructure that might be at risk during such events. It also underscores the need for robust emergency response strategies and infrastructure resilience against more severe flooding.

100-Year 24-Hour Scenario

A cornerstone of flood risk management, the 100-year 24-hour scenario represents a severe storm event with a 1% chance of occurring in any given year. This scenario is crucial for urban planning and development, guiding the design standards for flood mitigation infrastructure, zoning regulations, and insurance requirements. It highlights areas where strategic investments can significantly reduce flood risks and enhance community resilience.

500-Year 24-Hour Scenario

The 500-year 24-hour scenario represents an extreme rainfall event with a 0.2% chance of occurring in any given year. This scenario is crucial for understanding the upper limits of flood risk, highlighting areas and infrastructure that could be subjected to unprecedented water levels. The potential for catastrophic flooding under this scenario demands comprehensive planning and robust mitigation strategies, far beyond the routine flood management measures.

1,000-Year 24-Hour Scenario

This scenario represents an exceptionally rare and extreme rainfall event with a 0.1% chance of occurring in any given year, offering a detailed examination of the potential for catastrophic flooding. The 1,000-year scenario is critical for comprehensive risk assessment and planning, necessitating advanced preparedness and mitigation strategies to safeguard lives, property, and critical infrastructure. The profound implications of such an event underscore the importance of forward-looking, resilient urban planning and the development of robust emergency management systems to handle potential catastrophic impacts.

Figure 45 - 100-Year 24-Hour Rainfall - Present Day

Future Rainfall-Induced Flooding

These baseline depth grids are then adjusted by the sea level rise projection data based on NOAA's Intermediate Low and Intermediate High projections for the respective timeframes and rainfall precipitation by the SFWMD's published change factors. These predict approximately 1.12 times more rain in 2040 than present day conditions, 1.22 times more rain in 2070, and 1.34 times more rain in 2100. It should be noted that coastal communities are not required to include rainfall-induced flooding in their vulnerability assessments per Section 380.093(3), F.S. However, non-coastal communities must perform a rainfall-induced flooding assessment.

Figure 46 - NIH 2070 SLR + 25-Year 24-Hour Rainfall

Adjusted 25-Year and 100-Year 24-Hour Scenarios

Recognizing the influence of climate change on weather patterns, the assessment includes adjusted scenarios for the 25-year and 100-year events. These adjusted models take into account the anticipated increase in rainfall intensity and frequency, offering a forward-looking perspective on flood risks. By integrating climate change projections, these scenarios provide a more accurate reflection of future flood hazards, guiding the development of adaptive infrastructure and policies that are resilient to changing climatic conditions.

Together, these rainfall-induced flooding scenarios form a critical component of Islamorada's comprehensive flood risk assessment. By encompassing a broad range of event frequencies and intensities, the analysis equips Village planners, policymakers, and community leaders with the data necessary to make informed decisions about flood mitigation, emergency preparedness, and climate adaptation strategies. The detailed examination of both standard and adjusted scenarios ensures that the Village's resilience planning remains dynamic and responsive to both current and future flood risks, safeguarding the well-being of the community and the sustainability of its development in the face of increasing rainfall events.

Compound Modeling

The compound modeling section of the Vulnerability Assessment focuses on assessing the combined impacts of various flooding scenarios. This includes high tide flooding, storm surge, and rainfall-induced flooding. The methodology involves overlaying depth grids from each scenario to identify compounded flood heights at a well-defined scale. The approach is designed to provide a comprehensive understanding of the potential cumulative impacts of different flooding events simultaneously occurring, aiding in effective planning and mitigation strategies. This planning process, however, does not simulate the hydrologic interactions between these events or the stormwater management system's response. This could be done with a more complex engineering-based model.

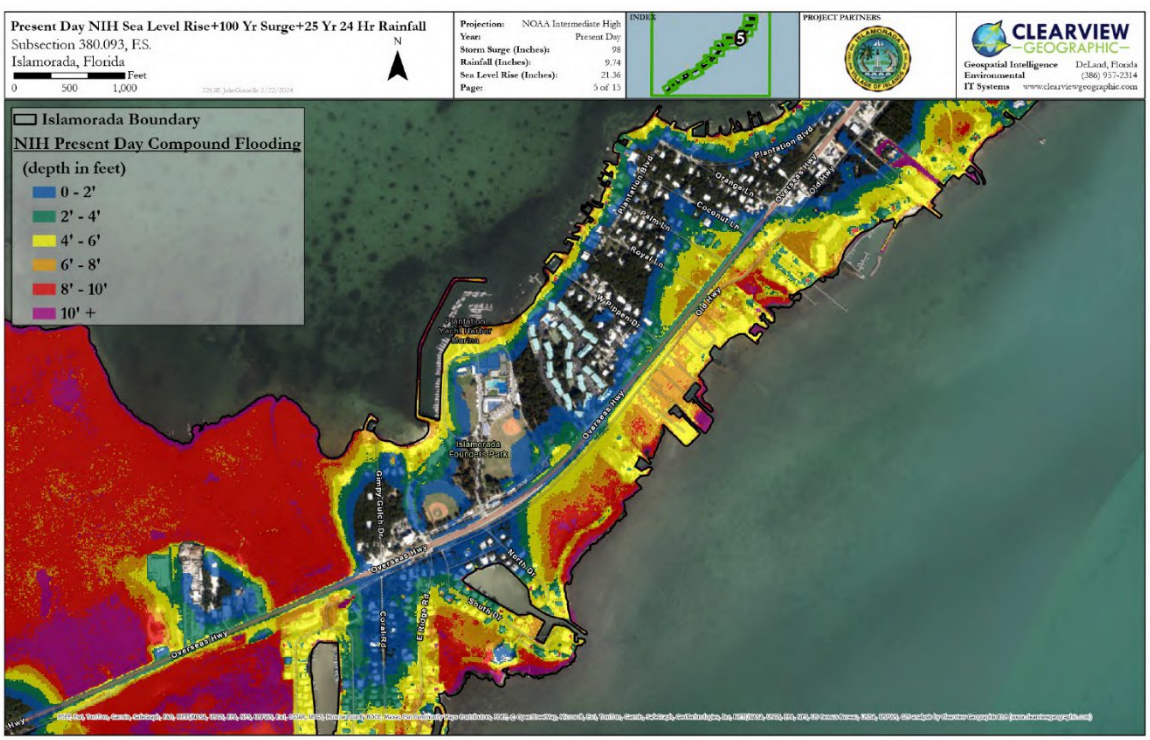
Sea level rise inundation modifies the "coastline," representing an approximate new coastal boundary under mean higher high water (MHHW) or the highest high tide of the day. Stormwater structures along coastal waters, inundated by sea level rise are expected to no longer function and exacerbate flooding. Surge impacts are large but temporary in nature, caused by the force of storm pushing water onto the terrain.

Table 14 - NOAA Intermediate Low and High Combined Flood Scenario Water Rise Impacts

Sea Level Rise Scenario	Surge Scenario	Rainfall Scenario	Combined Water Rise (ft)
NIL Present Day	100-Year	25-Year 24-Hour	10.53
NIL Present Day	100-Year	100-Year 24-Hour	10.84
NIL Present Day	500-Year	25-Year 24-Hour	11.99
NIL Present Day	500-Year	100-Year 24-Hour	12.30
NIH Present Day	100-Year	25-Year 24-Hour	10.76
NIH Present Day	100-Year	100-Year 24-Hour	11.07
NIH Present Day	500-Year	25-Year 24-Hour	12.22
NIH Present Day	500-Year	100-Year 24-Hour	12.53
NIL 2040	100-Year	25-Year 24-Hour	12.92
NIL 2040	100-Year	100-Year 24-Hour	13.33
NIL 2040	500-Year	25-Year 24-Hour	14.39
NIL 2040	500-Year	100-Year 24-Hour	14.79
NIH 2040	100-Year	25-Year 24-Hour	14.30
NIH 2040	100-Year	100-Year 24-Hour	14.71
NIH 2040	500-Year	25-Year 24-Hour	15.76
NIH 2040	500-Year	100-Year 24-Hour	16.17
NIL 2070	100-Year	25-Year 24-Hour	14.15
NIL 2070	100-Year	100-Year 24-Hour	14.56

Sea Level Rise Scenario	Surge Scenario	Rainfall Scenario	Combined Water Rise (ft)
NIL 2070	500-Year	25-Year 24-Hour	15.61
NIL 2070	500-Year	100-Year 24-Hour	16.02
NIH 2070	100-Year	25-Year 24-Hour	18.16
NIH 2070	100-Year	100-Year 24-Hour	18.57
NIH 2070	500-Year	25-Year 24-Hour	19.62
NIH 2070	500-Year	100-Year 24-Hour	20.03
NIL 2100	100-Year	25-Year 24-Hour	15.08
NIL 2100	100-Year	100-Year 24-Hour	15.49
NIL 2100	500-Year	25-Year 24-Hour	20.90
NIL 2100	500-Year	100-Year 24-Hour	21.31
NIH 2100	100-Year	25-Year 24-Hour	23.80
NIH 2100	100-Year	100-Year 24-Hour	24.21
NIH 2100	500-Year	25-Year 24-Hour	25.26
NIH 2100	500-Year	100-Year 24-Hour	25.67

Figure 47 - Present Day SLR + 100-Year Storm Surge + 25-Year Rainfall



Sea Level Rise + 100-Year Storm Surge with 25-Year + 100-Year Rainfall Scenarios

This scenario amalgamates the risks of significant sea level rise, a century-scale storm surge, and both moderate and severe rainfall events, offering a detailed perspective on flooding risks over a broad spectrum of frequencies and intensities.

Sea Level Rise + 500-Year Storm Surge with 25-Year + 100-Year Rainfall Scenarios

By considering a more extreme storm surge event alongside the same rainfall probabilities within the context of rising sea levels, this scenario highlights the utmost extents of potential flooding impacts, emphasizing the critical need for robust resilience planning.

Sea Level Rise with 100-Year + 500-Year Storm Surge Scenarios

This scenario focuses on the compounded effects of sea level rise and both the 100-year and 500-year storm surge events, providing a stark overview of the most extreme surge events' potential amplification due to rising sea levels.

Sensitivity: Ranked Prioritization in Hot Spots

The sensitivity analysis helps prioritize resilience adaptation efforts based on how the various sea level rise projections affect critical assets within key geographic areas in the Village of Islamorada. The assessment should be utilized to guide land use regulations, building codes, land development policies, emergency response strategies and inform various justice, equity, diversity and inclusion (JEDI) initiatives[16] that are associated with climate resilience adaptation planning.

The information provided by this assessment allows decision makers to implement measures that reduce vulnerability and mitigate future harms in a staged manner. The vulnerability assessment also aims to facilitate collaboration between communities surrounding the long-term goals of sustainable coastal management and environmental conservation. Regions that are highly exposed to multiple flood scenarios are identified as a flooding “hot spot” area. These hot spots contain a mix of government facilities, commerce areas, critical transportation hubs, and residential neighborhoods where there is a high concentration of publicly owned assets. By mapping these hot spots and prioritizing the assets within them, resources can be focused where multiple risks intersect, identifying a highly vulnerable asset creating an adaptation plan that is both prioritized by geographic area and immediate need.

[16] https://www.cdc.gov/climateandhealth/JEDI.htm

Ranked Flood Exposure Tiers

To add context to the flood exposure analysis, the team developed the following table in tandem with Village officials. It defines the flood thresholds used to assign no, low, medium, high, and very high flood exposure levels based on the GIS modeling.

Table 15 - Exposure Descriptions

Flood Depth	Exposure Ranking	Description
0 feet	No Exposure	No flooding detected. Areas with no impact from sea level rise or flooding.
0 to 0.5 feet	Low Exposure	Minor flooding. Shallow inundation typically causing minimal impact.
0.5 feet to 1.0 foot	Medium Exposure	Moderate flooding. Likely to impact structures and disrupt daily life.
1.0 foot to 3.0 feet	High Exposure	Significant flooding. Serious degree of inundation causing damage and major disruptions.
More than 3.0 feet	Very High Exposure	Severe flooding. Extensive inundation posing critical threats and causing extensive damage.

Table 15 above outlines Islamorada's determined exposure levels for this project. These ranking levels serve as a crucial foundation for the risk assessment, enabling evaluation of the potential consequences of rising sea levels and overall flooding impact in Islamorada's specific context.

Identifying High-Risk Areas with Hot Spots

Identification of high-risk areas and assets is a cornerstone of this vulnerability assessment. Based on modeling and the concentration of critical assets, high-risk areas within Islamorada have been identified, as reflected in Figure 48, Hot Spot Map of Islamorada. This map series reflects the areas where 1) there are aggregations of critical assets that are 2) subject to some level or multiple levels of flood risk. The map is color coded to reflect the type of flood risk and the approximate year that area will be impacted by that flood risk. A summary table is embedded that shows each hot spot breakdown and which flood scenarios impact that hot spot. The hot spots are numbered according to their priority of impact based on need and geography as defined in FDEP's Vulnerability Assessment Checklist and by statute.

Figure 48 - Hot Spot Map of Islamorada

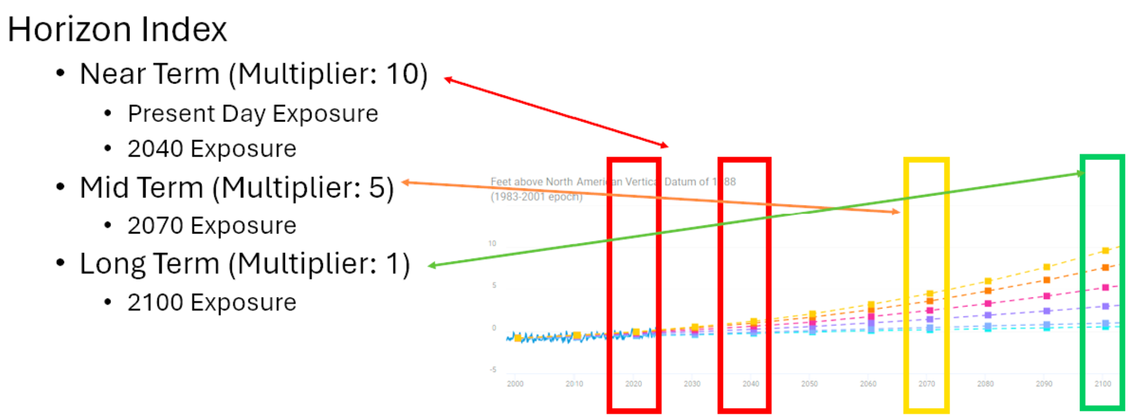
Modeling Impact to Assets

Within the highest risk areas, quantitative analysis was performed on the critical assets to assign the flood depths derived from the exposure modeling directly to the assets within the underlying data tables. This impact modeling contributes directly to the method of prioritization discussed later in this section and aligns with FDEP Vulnerability Assessment Checklist criteria and the methodologies outlined in the assessment framework, ensuring a meticulous and precise identification process for asset risk and enables the identification of specific flood scenarios each asset is impacted by.

Prioritizing Based on Planning Horizon

The planning horizons are categorized into near-term (approximately 0-20 years), mid-term (~20-50 years), and long-term (~50-100 years). The Horizon Index reflects this temporal segmentation, using a multiplier system to emphasize the criticality of impacts in the near term. Assets are ranked based on their Horizon Index scores, a derived metric that segments out the modeling into near term, mid-term and long term, with a multiplier system identifying those with the nearest term impacts. It helps in making informed decisions about near-term planning, adaptation measures, and risk management related to flooding. It also serves as a guide for prioritizing investments in infrastructure and formulating policy responses to the challenges posed by sea level rise and climate change.

Figure 49 - Planning Horizon Prioritization



Prioritizing Based on Flood Risk

Assets are ranked based on their Flood Risk Index scores, with a tiered system identifying those at highest risk. This prioritization informs resource allocation and intervention strategies by delineating areas of high vulnerability where adaptation strategies can be the most impactful.

Table 13 – Flood Risk Metric Weighting

Metric	Weight
Rain and Sea Level Rise Combo	0.35
Sea Level Rise Impact	0.25
Rain, Sea Level Rise and Storm Surge	0.15

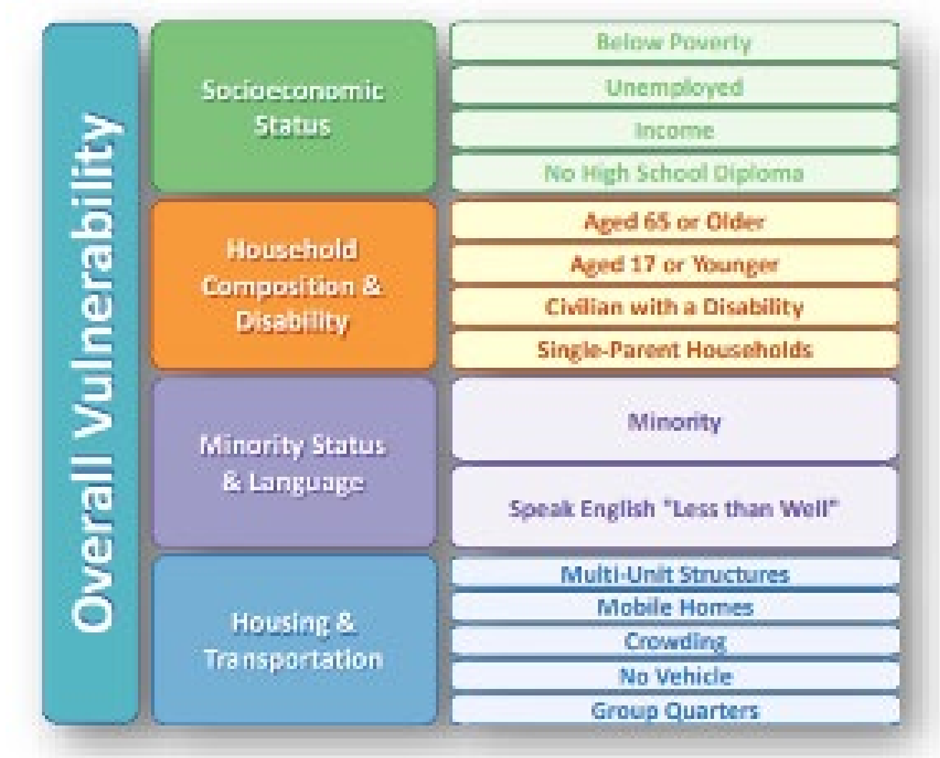
Metric	Weight
Number of Times Asset is Exposed	0.10
Average Flood Depth	0.10
Average Flood Depth Percentile Rank	0.05
Total	**1.00**

Prioritizing Based on Social Vulnerability

This assessment recognizes that social vulnerability significantly affects how communities experience and recover from flood events. Hence, integrating these factors ensures that our resilience strategies are inclusive and equitable. Assets are ranked based on their Social Index scores, a derived metric that helps support prioritization of more socially vulnerable census tracts, integrating the CDC Social Vulnerability Index and the HUD Location Affordability Index, each with its own set of values and corresponding multipliers, reflecting the severity of social vulnerability and housing affordability issues, respectively.

In the CDC Social Vulnerability Index, values range from 0.25 to 1.00, with higher values indicating greater vulnerability, and are assigned multipliers from 1 to 4. It assesses aspects like socioeconomic status, household composition and disability, minority status and language, and housing and transportation.

Figure 50 - CDC Social Vulnerability Index Metrics



The HUD Location Affordability Index considers housing affordability in various household profiles, ranging from median-income families to dual-professional families, in relation to the median household income (MHHI) for a given area. Similar to the CDC index, values assigned to each profile range from 0.25 to 1.00, with associated multipliers from 1 to 4.

Table 16 - HUD LAI's Household Profile Median Household Income Thresholds

Household Profile	MHHI (Median Household Income for a Given Area)
1. Median-Income Family	MHHI
2. Very Low-Income Individual	National Poverty Line
3. Working Individual	50% of MHHI
4. Single Professional	135% of MHHI
5. Retired Couple	80% of MHHI
6. Single-Parent Family	50% of MHHI

Household Profile	MHHI (Median Household Income for a Given Area)
7. Moderate-Income Family	80% of MHHI
8. Dual-Professional Family	150% of MHHI

By combining these factors, the Social Index creates a weighted sum that helps to identify and prioritize intervention areas where people may be more affected by socioeconomic and housing-related challenges. This tool is particularly useful for policy makers and planners to direct resources and efforts to improve the resilience and support of communities that are most at risk.

Prioritizing within the Composite Index

Each of the components described above assesses different aspects of risk and vulnerability and is assigned a specific weight within the Composite Index.

1. **Horizon Index**: This measures the potential future impact of flooding, considering the planning horizon or the timeframe within which the impacts are expected. It is given a weight of 0.6, indicating that it accounts for more than half of the Composite Index value, recognizing the importance of long-term flood risk projections in overall risk assessment but focusing on the immediacy of near-term impacts.

2. **Flood Risk Index**: It evaluates the current exposure to flood risks, including the frequency and depth of potential flooding events. This index has a weight of 0.4, suggesting that immediate flood risks are also a significant factor in the overall assessment but less so than long-term projections.

The final metric, the Composite Index, offers a holistic measure of flood-related risk by combining these weighted components. It provides a more comprehensive assessment that can guide decision-making in urban planning, emergency preparedness, resource allocation, and other critical areas of public policy and infrastructure development. This Composite Index is essential in our toolkit, allowing us to overlay various risk factors and identify where they converge to create heightened risk profiles. It is not just a measure but a strategic guide for directing our efforts effectively. By factoring in both the likelihood and potential severity of flood events, as well as the social dimensions of vulnerability, the Composite Index serves as a robust tool for prioritizing actions and investments to mitigate flood risks.

Identifying Most At-Risk Assets Based on Three-Tiered Prioritization

Employing the composite index described above, the hot spot prioritization analysis assigned a priority 1 through 5, or not prioritized, ranking based on the indexed score. Table14 below provides the index thresholds of utilized to assign the priorities.

Table 14 – Composite Risk Index Scores and Prioritization

Composite Index Score Threshold	Assigned Priority
Top 5% Highest Values	1
5-10%	2
10-15%	3
15-25%	4
25-50%	5
Below 50%/Median Value – Not Prioritized	0

These derived outputs, together, provide the prioritized asset inventory when linked back to the critical asset inventory and the assets unique identifier. This prioritization is a critical step in linking our strategic planning with on-the-ground realities, ensuring that our response is not only theoretically sound but practically actionable.

To carry the prioritization process into the various high-risk areas and provide numerical calculations that harmonize various Resilient Florida Grant criteria, the analysis results were then re-ordered by the overall risk determination, assigned based on percentages of land area inundated and the number of critical assets affected in the identified hot spots, as described in Table 15. This final step of our analysis harmonizes the various assessment criteria to produce a coherent risk profile for each hot spot. It ensures that both the spatial extent of the flood risk and the density of critical assets are factored into our overall risk determinations.

Table 15 – Hot Spot Risk Assessment Criteria

Overall Risk Assessment	Land Area Inundated (% of Census Tract or Neighborhood)	Critical Assets Affected (% of Total Assets or Within Each Asset Category)
None	0%	0%

Overall Risk Assessment	Land Area Inundated (% of Census Tract or Neighborhood)	Critical Assets Affected (% of Total Assets or Within Each Asset Category)
Low	Less than 25%	<25%
Medium	25-50%	25-50%
High	50-75%	50-75%
Very High	>75%	>75%

Results and Analysis

This vulnerability assessment extends beyond numerical projections and embraces the intricacies of Islamorada's unique physical landscape. Guided by the FDEP Vulnerability Assessment Checklist, this comprehensive vulnerability assessment considers specific data related to Islamorada and its critical assets. Islamorada's geographical location on the border between the Gulf of Mexico and the Atlantic Ocean makes it particularly susceptible to a range of climate-related hazards.

Flood Vulnerability

The elevation profile provided below is of Founders Park within Islamorada and is designed to assist with the visualization process in applying critical elevations to coastal planning. This profile is an essential tool for understanding the varying heights and depths that characterize coastal landscapes, offering insights into how different elevations can impact both natural and built environments. By examining these profiles, planners and developers can make informed decisions about where and how to construct infrastructure, considering factors such as flood risk, sea level rise, and coastal erosion. The goal is to promote resilient coastal development that accounts for the unique challenges posed by critical elevations, ensuring that communities are better prepared to face the impacts of climate change and protect valuable ecosystems.

Figure 51 – Founders Park Shoreline Profile

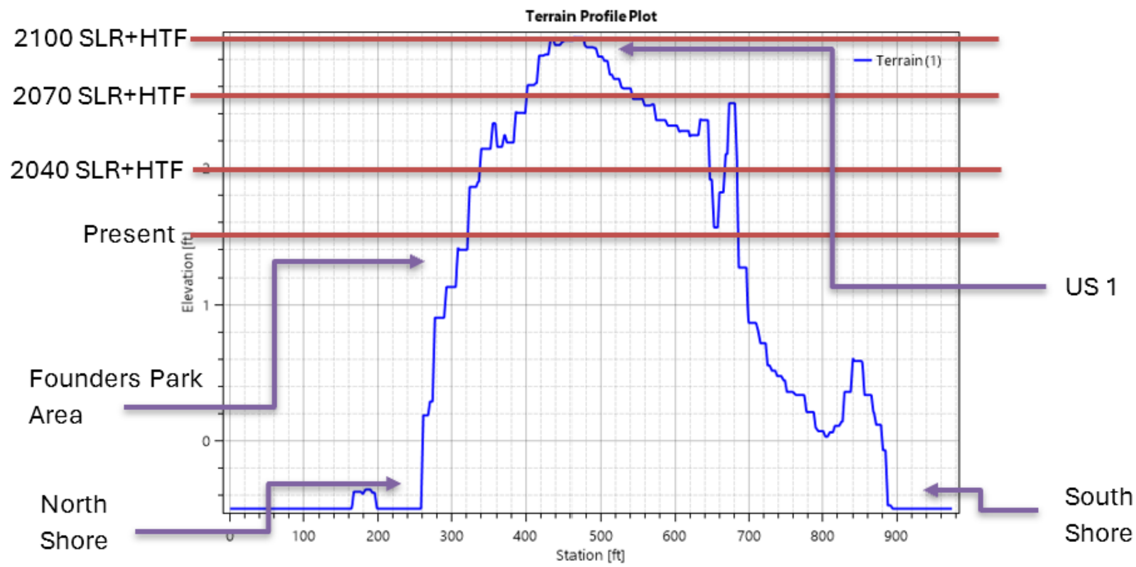


Figure 52 – Founders Park Shoreline Profile Location

The analysis described above, utilizing the NOAA Intermediate High projection, was applied to the land area within Islamorada utilizing the sea level rise and high tide flooding thresholds and the elevation at which the tides for the given year are anticipated to be at for at least 90 days throughout the planning horizons to determine the acres of landward inundation that Islamorada is expected to experience based on future sea level rise projections.

Table 17 - Area of Inundation

Based on SLR and Tide Extent 90 Days of Year

Projection	NIL SLR + High Tide Flooding (in acres)	NIL 90 days of High Tide Flooding (in acres)	NIH SLR + High Tide Flooding (in acres)	NIH 90 Days of High Tide Flooding (in acres)
2040	2,834.8	1,314.4	3,135.7	1,526.2
2070	3,090.4	1,441.2	4,218.8	2,340.6
2100	3,371.9	1,497.7	4,915.6	3,353.7

Sea Level Rise (SLR) and High Tide Flooding (HTF) in Table 17 above are both terms used in the context of climate change and its impact on coastal and low-lying areas. However, they refer to slightly different phenomena:

- **Sea Level Rise (SLR)** is a gradual increase in the average level of the world's oceans. It is caused by factors such as the melting of ice sheets and glaciers, and the thermal expansion of seawater as it warms. SLR is a long-term change that occurs over years and decades, contributing to the permanent alteration of coastal landscapes. It can exacerbate coastal erosion, increase the risk of coastal flooding, and lead to the loss of habitat for plants, animals, and even humans.

- **High Tide Flooding (HTF)**, sometimes referred to as "nuisance flooding" or "sunny day flooding," occurs when tides reach two feet above the mean higher high water via FDEP Threshold and begin to flood onto streets or flood areas that are historically dry. It is more immediate and often associated with specific high tide events that can cause flooding in coastal areas even in the absence of storms or rainfall. HTF is becoming more frequent in many areas as sea levels rise and can disrupt daily life by flooding roads, overwhelming drainage systems, and damaging property.

- **90 Days of Tidal Inundation** refers to a specific metric used to assess the impact of SLR and HTF, indicating the number of days within a given year when tidal levels exceed a certain threshold, leading to flooding conditions. This metric is useful for understanding how often an area might experience tidal flooding under current and future sea level conditions. It helps in planning and preparing for increased flooding events, identifying vulnerable infrastructure, and implementing adaptation strategies.

In summary, SLR is about the long-term increase in sea levels affecting coastlines and oceans globally, while HTF deals with the more immediate effects of unusually high tides leading to flooding. The 90 days of tidal inundation metric helps quantify the extent and frequency of HTF and its potential increase due to SLR, providing crucial data for resilience planning and mitigation efforts.

Critical and Prioritized Assets in Flooding Hot Spots

This section of the Flood Vulnerability Assessment systematically analyzes and provides recommendations to address critical vulnerabilities identified within Islamorada, Florida. Following a detailed evaluation of flood risk models, historical data, and geographical assessments, this document outlines specific interventions required to mitigate flood risks in designated hot spots where critical assets are significantly threatened.

The Village of Islamorada, celebrated for its coral reefs, marine life, and as a fishing destination, faces unique challenges that necessitate tailored, proactive measures. The project recommendations are organized by identified hot spots—areas where aggregations of critical assets are most impacted by modeled flood events. Each recommendation aims to enhance immediate resilience and establish a foundation for sustainable environmental and infrastructural health.

By pinpointing various vulnerability hot spots, each with unique assets and inherent risks, the assessment prioritizes actions and strategies to bolster collective resilience. This exploration covers four critical domains: transportation infrastructure, critical infrastructure, critical community and emergency facilities, and the preservation of natural, cultural, and historical resources.

The Village is actively working on master planning efforts for the road system and stormwater infrastructure. These studies will supplement the analysis below and, in some cases, provide a duplicative project that will be vetted during the analysis to ensure continuity within the Village in addressing the challenges due to climate change.

As part of the Village's Roadway Vulnerability Analysis and Capital project, the roadways maintained by the Village will be evaluated to develop a long-term roads adaptation plan based on design criteria, Sea Level Rise (SLR) projections, adaptation methodology, policy/financing evaluation, and public/stakeholder outreach. The project's main objective will analyze the impacts of current and projected levels of SLR on all Village maintained roads and develop an implementation plan and timeline to adapt roads for SLR. The results will be used to determine new policy considerations and design criteria for what acceptable levels of service should be.

The objective for the stormwater master plan project is to develop a clear, comprehensive, and forward-looking Master Plan that encompasses the Village's stormwater management program, presents a detailed investigation into key components of stormwater as it is related to the Village of Islamorada, establishes goals and provides a foundation for future policy decisions. The Stormwater Master Plan Update will help the Village guide its stormwater management program for the next 10 or more years. The plan will utilize these plans to update and create a stormwater management master plan addressing water quality, climate change and re-development, and growth to allow for a more livable Islamorada for the future.

1. Transportation Infrastructure

- **Assets Impacted:**
    - **Bridges and key roadways** crucial for maintaining connectivity and facilitating evacuation, such as the Overseas Highway which is vital for both daily commute and emergency evacuation.
- **Recommendations:**
    - **Elevate and Reinforce Bridges:** Specifically target older bridges for upgrades, using materials and designs adapted to withstand intense storms and surge events typical to the Keys.
    - **Enhance Road Drainage Systems:** Implement advanced drainage solutions that address the unique topography of the Keys, ensuring effective water removal during heavy rainfall and storm surges.
    - **Develop Elevated Pathways:** Construct raised pathways along critical evacuation routes, incorporating features that reflect the aesthetic and environmental characteristics of the area.

2. Critical Infrastructure

Assets Impacted:

- **Potable water treatment and sewage systems** located near coastlines, vulnerable to storm surges and saltwater intrusion.
- **Electrical substations,** particularly those on lower ground, prone to flooding during hurricane season.

Recommendations:

- **Flood-proofing Utilities:** Apply robust flood-proofing technologies such as watertight barriers and elevated platforms at treatment facilities.

- **Secure and Elevate Electrical Infrastructure:** Upgrade and elevate electrical substations and associated infrastructure, incorporating redundancy systems that cater to the frequent and intense weather events experienced in Islamorada, adjusted by sea level rise appropriate for the life of the asset.
- **Alternative Supply:** Due to extreme weather events, the need to evaluate redundancy is important in the energy grid. Renewable energy generation and storage are focus areas that could help strengthen the grid for Islamorada and the Florida Keys. Some of the components include solar generation, wind generation, electric vehicle grid integration, and battery storage.

3. Critical Community and Emergency Facilities

Assets Impacted:

- **Hospitals and healthcare facilities** like Mariner's Hospital which must be fully operational to manage emergency situations.
- **Fire stations and police departments** located throughout the islands, essential for timely disaster response.

Recommendations:

- **Hardening of Facilities:** Reinforce structures using hurricane-resistant materials and technologies.
- **Emergency Power Solutions:** Install high-capacity generators with extended fuel reserves and/or renewable energy systems with battery storage to ensure continuous operation during extended power outages.
- **Flood Response Planning:** Develop tailored flood response protocols that account for the logistical challenges of the islands, including potential isolation due to road closures.

4. Preservation of Natural, Cultural, and Historical Resources

Assets Impacted:

- **Ecologically significant areas** such as Indian Key Historic State Park and Lignumvitae Key Botanical State Park, susceptible to both flooding and erosion.
- **Cultural landmarks and historical sites** that showcase the rich history of the Keys.

Recommendations:

- **Protective Landscaping**: Employ eco-friendly landscaping techniques that strengthen shoreline defenses and prevent erosion, using native plant species that are resilient to local climate conditions.

- **Elevation and Barriers for Cultural Sites**: Implement adaptive measures such as elevating structures and installing protective barriers around vulnerable sites.
- **Community Engagement and Education**: Launch initiatives to involve local communities in conservation efforts, promoting awareness and participation through educational programs tailored to the heritage and environmental significance of the Keys.
- **Shoreline Stabilization Initiatives:** Develop and implement shoreline fortification strategies that use natural elements such as mangrove restoration, reef construction, and beach nourishment to stabilize and protect the shoreline at the Fills. These methods not only preserve the natural landscape but also enhance the area's resilience against storm surges and high tides.
- **Integrated Coastal Management:** Work in partnership with environmental agencies, such as the U.S. Army Corps of Engineers, to conduct comprehensive coastal studies that inform sustainable management practices.
- **Recreational Area Enhancement:** Redesign the recreational use of the Fills to incorporate sustainability and safety without compromising its attractiveness as a community hub. This could include improved waste management systems, designated gathering areas that minimize environmental impact, and clear signage educating visitors on the importance of preserving the natural setting.

This collaborative effort, in conjunction with insights from Greg Corning, PE of WSP Engineering, underscores the importance of a targeted approach to infrastructure resilience. By prioritizing interventions within these critical domains, Islamorada can enhance its preparedness for flood events, safeguard its essential services and cultural heritage, and build a more resilient community in the face of climate change.

Hot Spot 1: Coastal Utilities and Essential Service Area - MM 88 Bay Side

Figure 53 - Prioritized Assets in Hot Spot 1

The Coastal Utility Corridor in Islamorada encompasses a critical area with high-density residential development alongside essential infrastructure, located within a region prone to flooding. This hot spot is vital due to its strategic inclusion of crucial assets such as electrical transformers, stormwater systems, wastewater control infrastructure, and potable water conveyance facilities. Additionally, the recent acquisition of the Machado properties within this corridor marks a significant development, earmarked as a potential site for future affordable housing projects. This designation underscores the importance of integrating flood resilience into future developmental plans to ensure the safety and sustainability of these vital community enhancements.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Electrical Infrastructure:

- **Elevate critical electrical transformers** to mitigate flood impact and maintain reliable power.

- **Install flood barriers around substations** to safeguard against water damage.

Water Management Systems:

- **Reinforce stormwater and wastewater infrastructure** to enhance handling of storm surge and runoff.
- **Protect potable water systems** with elevated and flood-proofed components to ensure safe water supply.

Machado Properties Development:

- **Incorporate flood-resilient designs** in the planning and construction of affordable housing on the Machado properties, considering elevation and flood-proofing measures.
- **Evaluate renewable energy** opportunities from solar panels, wind farms, battery storage, electric vehicle charging stations.
- **Plant salt-resistant, native vegetation** for habitat enhancement and erosion protection along the canal.
- **Create a dual-purpose stormwater and tidal retention and tidal flex connections** that allows for stormwater discharge but prevents tidal backflow, supplemented by hardened and elevating perimeter walls along canal to protect these properties.

Community Infrastructure:

- **Develop flood response strategies** that include community engagement and emergency preparedness specific to the needs of the Coastal Utility Corridor.
- **Enhance local roads and bridges** within the corridor with improved drainage systems and elevated pathways to ensure accessibility during flood events.

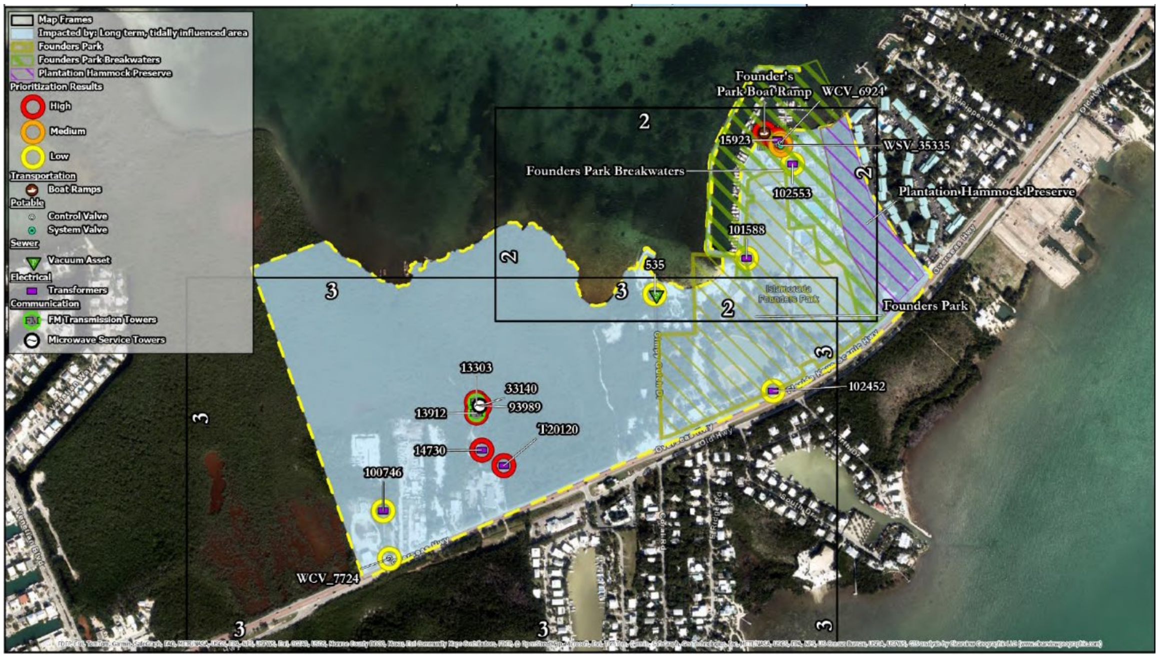
Preservation and Environmental Protection:

- **Employ sustainable landscaping and natural barriers** around residential areas and critical sites to reduce erosion and absorb floodwaters.
- **Community education and involvement programs** to engage residents in sustainability efforts and flood preparedness activities, particularly focusing on the new developments at the Machado properties.

These targeted recommendations aim to fortify the areas utilities against the increasing threat of flooding while accommodating future growth through resilient community planning. By ensuring that critical infrastructure and new developments like those planned for the Machado properties are protected and sustainably integrated, Islamorada can secure its long-term viability and enhance the quality of life for its residents.

Hot Spot 2: Founder's Park Coastal Resilience Zone - MM 87 Bay Side

Figure 54 - Prioritized Assets in Hot Spot 2



The Founder's Park Coastal Resilience Zone is identified as Hot Spot 2 in the Islamorada Flood Vulnerability Assessment, encompassing key community and infrastructural assets such as Founder's Park, the Florida Keys Waste Management facility, critical communication towers, electrical transformers, marinas, and essential water management systems. This zone is located in a strategic area prone to significant tidal flooding as early as 2040 with severe flooding by the year 2100, highlighting the urgent need for enhanced resilience strategies to protect these assets. Founder's Park, serving as a central recreational and communal gathering point, alongside the adjacent critical infrastructure, plays a pivotal role in the community’s daily function and emergency management.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Sea Wall and Shoreline Reinforcement:

- **Enhance existing sea walls and shorelines** around Founder's Park and adjacent coastal areas to withstand increased tidal events and storm surges.
- **Strengthen dune vegetation** to naturally mitigate erosion and provide additional protection against storm surges.

Plantation Hammock Preserve Improvements:

- **Elevate parking facilities** to prevent inundation during high tide and flooding events, ensuring accessibility and safety.
- **Expand stormwater and tidal storage capacity** to manage increased runoff effectively during heavy rainfall events and king tide / sea level rise, minimizing overflow and local flooding.
- **Evaluate adding a berm** along the boundary of the preserve to provide floodplain protection to surrounding properties and incorporating the natural grade to create a flow way within the extent of the preserve to allow for natural habitat restoration.

Communication and FM Towers:

- **Assess and implement relocation or elevation strategies for communication towers** to maintain critical communication lines during severe weather events.
- **Harden structures** to improve resilience against high winds and flooding.

Electrical Infrastructure Enhancements:

- **Elevate transformers and other critical electrical components** within the hotspot to secure a continuous power supply during flood events.

Founder's Park Infrastructure Upgrades:

- **Elevate parking facilities** to prevent inundation during high tide and flooding events, ensuring accessibility and safety.
- **Expand stormwater and tidal storage capacity** to manage increased runoff effectively during heavy rainfall events and king tide / sea level rise, minimizing overflow and local flooding.
- **Evaluate adding a berm** along the boundary of the preserve to provide floodplain protection to surrounding properties and incorporating the natural grade to create a flow way within the extents of the preserve to allow for natural habitat restoration.

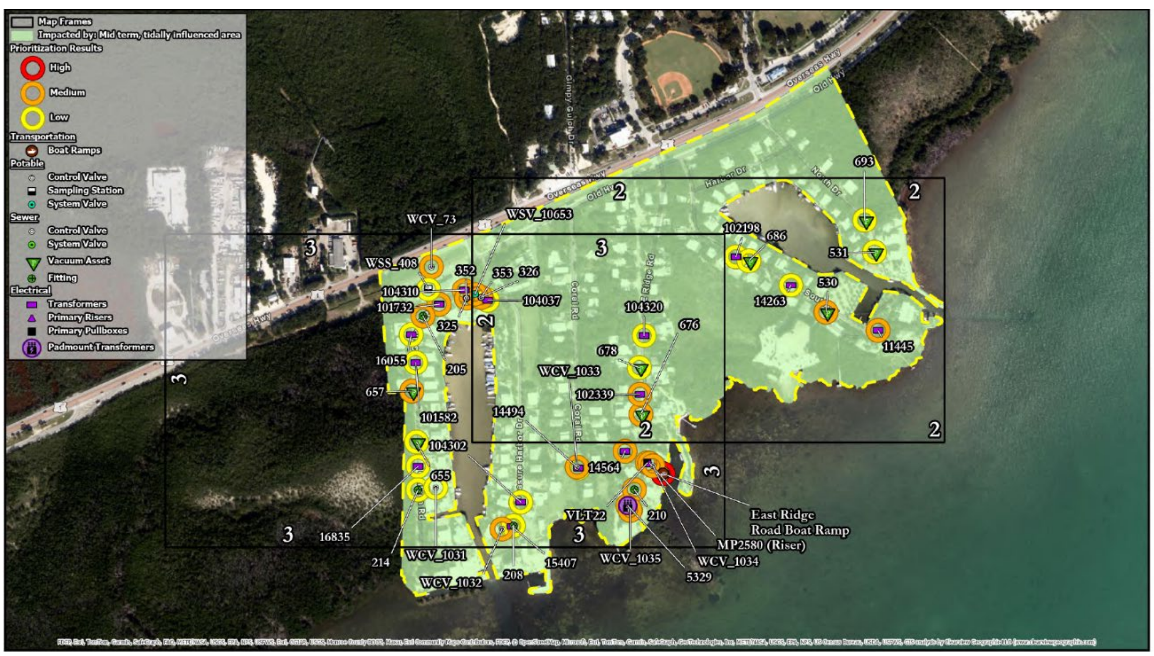
Community Preparedness and Response Planning:

- **Develop comprehensive emergency response plans** specific to Founder's Park and the surrounding areas, which are tailored to address the unique challenges posed by tidal flooding.
- **Conduct regular community drills and information sessions** to enhance public awareness and preparedness for flood-related emergencies.

By prioritizing these recommendations, Islamorada can significantly bolster the resilience of the Founder's Park Coastal Resilience Zone, safeguarding key community assets and infrastructure against future flooding risks. This strategic approach not only protects the physical assets but also ensures the continuity of essential services and community functions that are vital to the well-being and safety of the residents.

Hot Spot 3: East Ridge Resilience Sector - MM 87 Ocean Side

Figure 55 - Prioritized Assets in Hot Spot 3



The East Ridge Resilience Sector, identified as Hot Spot 3 in the Islamorada Flood Vulnerability Assessment, encapsulates a critical residential area featuring medium to high-density living spaces. This sector is particularly vulnerable due to its proximity to coastal zones and the expected significant tidal flooding impacts by 2070, as projected from sea level rise and high tide occurrences. The prioritized assets within this hot spot primarily include wastewater and electrical infrastructure, as well as marinas that serve both functional and recreational purposes. Given the residential nature of this sector and its dependence on these assets for daily operations and quality of life, enhancing its resilience is imperative for sustainable living and community safety.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Enhancement of East Ridge Road Boat Ramp:

- **Reconstruct and elevate the East Ridge Road boat ramp** to ensure continued accessibility and safety, even during higher tide levels.
- **Implement shoreline restoration techniques,** such as mangrove plantings and rock riprap, around the boat ramp to reduce erosion and provide natural barriers against surges.

Park and Public Space Adaptations:

- **Elevate and redesign parks** near roadways to increase accessibility and use the areas as natural buffers against storm surges, while accommodating water flow from king tides without permanent inundation.
- **Incorporate flood-resilient features** in public spaces, such as permeable surfaces and elevated walkways, to enhance usability during adverse weather conditions.

Electrical Infrastructure Upgrades:

- **Elevate transformers** to ensure they remain above projected flood levels, securing power supply during flood events.
- **Retrofit substations** with elevated structures or components and consider implementing flow-through designs in buildings to allow water passage without damaging critical equipment.

Wastewater System Reinforcements:

- **Enhance wastewater infrastructure** by elevating key components to prevent overflow and contamination during floods.
- **Integrate advanced backflow prevention systems** to protect the sewage system from sea water intrusion during high tide events.

Community Preparedness and Infrastructure Hardening:

- **Develop comprehensive flood response plans** specific to the needs of the East Ridge Resilience Sector, focusing on evacuation routes and emergency service accessibility.
- **Conduct regular community engagement** sessions to educate residents on flood risks, personal preparedness, and response strategies.

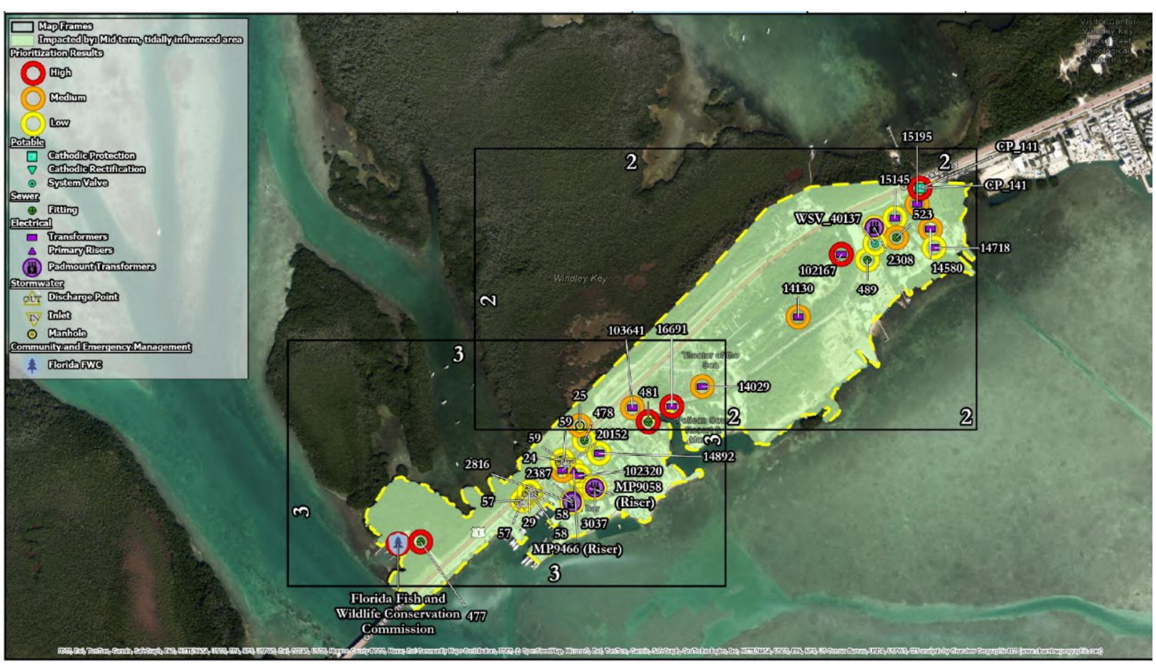
Monitoring and Continuous Improvement:

- **Install tide and flood monitoring systems** within the sector to provide real-time data that can help in anticipating flood events and organizing timely responses.
- **Review and update infrastructure plans** regularly based on new data and changing environmental projections to ensure ongoing effectiveness of implemented measures.

By focusing on these specific interventions, the East Ridge Resilience Sector can be better prepared to handle the challenges posed by the impending increase in tidal flooding and sea level rise, thereby ensuring the safety and sustainability of its residential communities and critical infrastructure.

Hot Spot 4: Commerce and Resilience Quarter - MM 84 Ocean Side

Figure 56 - Prioritized Assets in Hot Spot 4



Identified as Hot Spot 4, the Commerce and Resilience Quarter is a commercially vibrant area of Islamorada that plays a pivotal role in the local economy and infrastructure. Situated along a key stretch of the island, this hotspot is home to a variety of high-priority assets including the Florida Fish and Wildlife Conservation (FWC) office, electrical substations, wastewater and stormwater systems, potable water conveyance infrastructure, gas stations, and marinas. Projections indicate that by 2070, this area will experience significant flooding due to sea level rise and high tide events, necessitating preemptive action to protect these essential services and commercial activities.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Electrical and Utility Infrastructure Enhancements:

- **Elevate electrical substations and transformers** to safeguard against anticipated flood levels, ensuring continuous power supply and reducing the risk of outages.
- **Reassess the need for cathodic protection systems selectively,** especially for remaining metal components that are susceptible to corrosion under saline flood conditions, while continuing to replace vulnerable metals with more durable materials like plastic.

Water and Sewer Infrastructure Upgrades:

- **Reinforce wastewater infrastructure** by elevating critical components and installing flood-resistant measures to prevent system overflows and contamination.
- **Enhance stormwater systems** by increasing their capacity and improving drainage efficiency to manage the larger volume of runoff expected during flood events.
- **Protect potable water systems** from flood-induced contaminants and ensure the integrity of water supply under flood conditions.

Florida Fish and Wildlife Conservation (FWC) Office:

- **Fortify the FWC facility** to ensure it remains operational during floods, considering its critical role in environmental monitoring and emergency wildlife response.
- **Integrate resilient design** features such as elevated platforms and flood barriers to protect the office and its equipment.

Gas Stations and Commercial Entities:

- **Implement flood-proofing measures** for gas stations and other commercial entities to prevent environmental hazards and ensure continuity of services during flood events.
- **Elevate fuel pumps and critical service** equipment to mitigate the risk of flooding and potential spillage.

Community and Business Continuity Planning:

- **Develop a comprehensive flood response strategy** for commercial entities, focusing on quick recovery and continuity of operations.
- **Conduct regular flood preparedness workshops** for business owners and employees within the hotspot to enhance community resilience and readiness.

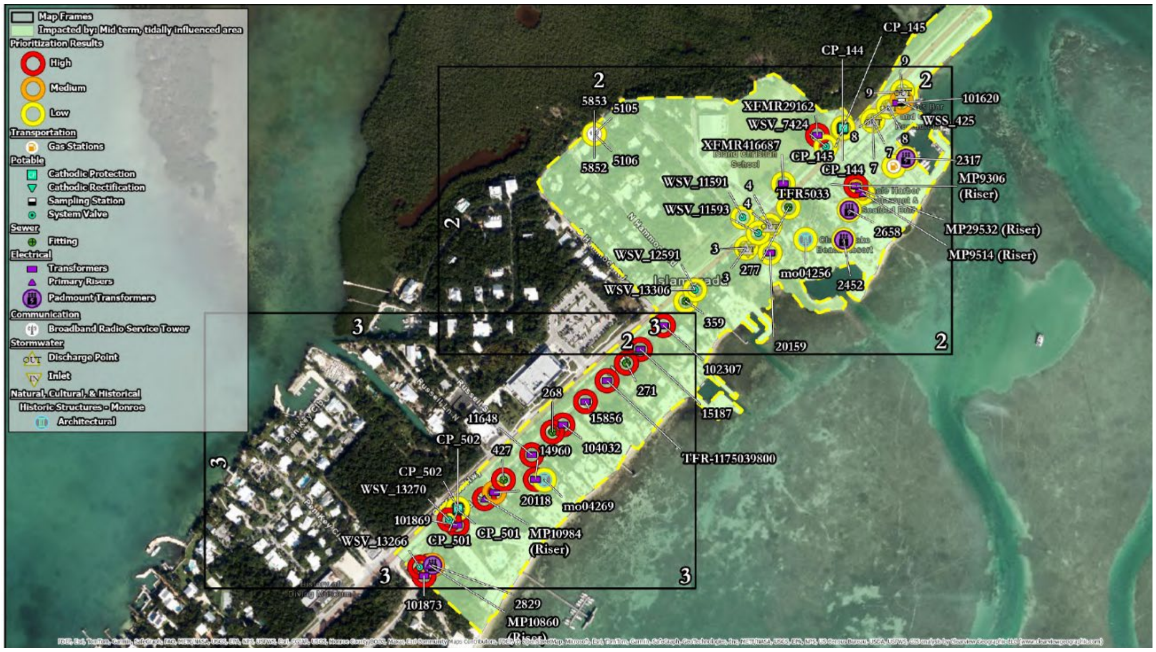
Environmental and Infrastructure Monitoring:

- **Install advanced monitoring equipment** to provide real-time data on rising water levels and potential flood threats, allowing for timely precautions and responses.
- **Regularly assess and update infrastructure adaptation strategies** to align with the latest projections and technological advancements.

By implementing these targeted recommendations, the Commerce and Resilience Quarter can enhance its preparedness for the significant flooding challenges expected by 2070, securing the economic vitality and environmental safety of Islamorada.

Hot Spot 5: Historic Coastal Gateway - MM 83 Ocean Side

Figure 57 - Prioritized Assets in Hot Spot 5



Hot Spot 5, known as the Historic Coastal Gateway, is a vital commercial and residential region in Islamorada, reflecting a blend of modern living and historical significance. This area is expected to face significant flooding by 2070 due to projected sea level rise and high tide events. The presence of critical electrical infrastructure, including transformers and substations, along with a historical structure and a marina, makes this hot spot particularly vulnerable. The challenges posed by its geographical positioning and its assets' susceptibility to flooding necessitate robust and innovative flood mitigation strategies to protect this key gateway to Islamorada.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Environmental and Wetland Enhancements:

- **Develop and restore wetlands** along the coastline to serve as natural flood buffers that absorb surges and runoff, while also enhancing local biodiversity.
- **Create floodable parks and open spaces** that are designed to accommodate water during high tide events, reducing overflow in densely populated or commercially active areas.

Infrastructure Resilience Upgrades:

- **Elevate and secure electrical transformers and substations** to ensure they remain operational during floods, preventing critical power outages.
- **Strengthen sewer infrastructure** to withstand flood conditions, incorporating advanced materials and designs to prevent system breaches.

Historical Structure Protection:

- **Implement protective measures for historical buildings**, including waterproofing, elevation, or the construction of defensive barriers to preserve these cultural assets.
- **Engage in historical preservation planning** that includes climate adaptation to ensure the longevity and integrity of historical sites.

Erosion and Shoreline Management:

- **Integrate natural and engineered erosion control measures** along waterways and vulnerable shorelines to prevent land loss and protect infrastructure.
- **Use vegetation and sustainable materials** in erosion control efforts to enhance environmental and aesthetic value.

Communication and Safety Enhancements:

- **Relocate, elevate, or harden communication towers** to maintain essential communication links during severe weather events, ensuring public safety and emergency responsiveness.
- **Upgrade marine facilities** to better resist flooding and storm surges, ensuring the safety and operational continuity of these critical transport and leisure hubs.

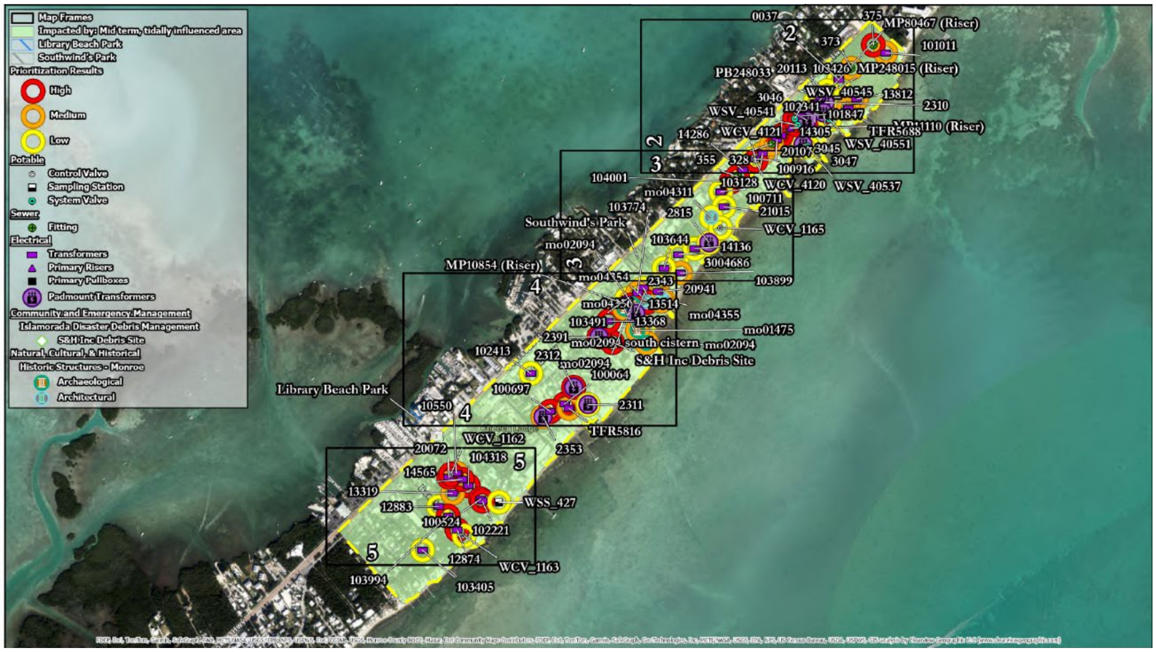
Community Preparedness and Engagement:

- **Develop comprehensive community response plans** that include evacuation routes, flood shelters, and emergency service access points.
- **Conduct regular community workshops** and simulations to educate and prepare residents for flood scenarios, enhancing local resilience and response capability.

By implementing these strategies, the Historic Coastal Gateway can significantly enhance its resilience against the impending increase in flood events, securing its vital role in the economic and social fabric of Islamorada while protecting its historical and cultural heritage.

Hot Spot 6: Southwind Resilience District - MM 82 Ocean Side

Figure 58 - Prioritized Assets in Hot Spot 6



The Southwind Resilience District, recognized as Hot Spot 6, is a critical commercial and residential area in Islamorada, characterized by its vibrant community life and significant infrastructure. This district is projected to face severe flooding by 2070 due to sea level rise and high tide events, threatening vital assets including electrical infrastructure, historical structures, a disaster debris management area, and a marina. The strategic importance of this district, combined with its exposure to flooding, underscores the need for innovative and sustainable flood mitigation solutions to protect and enhance the area's resilience.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Infrastructure Resilience Upgrades:

- **Elevate electrical transformers and substations** to safeguard against flood impacts, ensuring uninterrupted power supply.
- **Strengthen and protect sewer infrastructure** to prevent overflows and maintain sanitation during flood events.

Historical Structure Preservation:

- **Implement flood protection measures for historical buildings**, such as elevation, waterproofing, and the construction of barriers to preserve these cultural landmarks.

Southwind Park Enhancements:

- **Integrate rain gardens and low-impact development (LID) treatment areas** to manage **stormwater** effectively, capturing and treating runoff onsite to reduce pollution and lessen stormwater impacts.
- **Develop subsurface water storage facilities** to capture and temporarily store excess stormwater, releasing it gradually to reduce peak flow impacts on the drainage system.

Innovative Building Designs:

- **Promote amphibious architecture** for new developments in flood-prone zones, where buildings are designed to float or remain operational during floods, ensuring resilience and continuity of habitation.

Natural and Engineered Environmental Solutions:

- **Establish coral reef restoration projects** along the coastline to serve as natural breakwaters. These reefs will help reduce wave energy, protect shorelines from erosion, and provide critical habitats for marine biodiversity.
- **Implement coral nurseries and artificial reefs** to accelerate the growth of coral populations, enhancing the structural complexity of the marine environment which is crucial for coastal protection and biodiversity

Community Preparedness and Engagement:

- **Conduct regular community resilience workshops** to educate residents on flood risks and personal preparedness, including how to effectively use new infrastructure adaptations like rain gardens and LID areas.
- **Develop and distribute flood response and evacuation plans** tailored to the unique challenges and assets of the Southwind Resilience District.

By implementing these strategies, the Southwind Resilience District can dramatically improve its capacity to withstand and recover from flooding events, safeguarding its community, and ensuring the sustainability of its infrastructure and historical sites.

Hot Spot 7: Central Utility Lifeline Corridor - MM 82 Bay Side

Figure 59 - Prioritized Assets in Hot Spot 7

The Central Utility Lifeline Corridor is a critical commercial and residential region in Islamorada that includes vital infrastructure such as electrical substations, potable water infrastructure, stormwater systems, and community spaces. Projections indicate that this area could face moderate impacts from a 100-year 24-hour rain event, necessitating resilient infrastructure planning to protect these assets from increased flooding frequency and intensity. The Blackwood Drive boat ramp and Library Beach Park are integral features in this area that need specific attention due to their unique roles in the community and their vulnerability to flooding.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Infrastructure Resilience Enhancements:

- **Elevate critical electrical infrastructure,** including transformers and substations, to prevent flood-induced failures and ensure continuous power supply.
- **Strengthen potable water and sewer infrastructure** using flood-resistant designs and materials to safeguard water quality and prevent contamination during flooding events.

Stormwater and Environmental Management:

- **Modernize stormwater infrastructure** to increase capacity and efficiency, incorporating innovative solutions such as bioswales and permeable pavements for enhanced natural water absorption.
- **Restore natural buffer zones** along waterways and flood-prone areas to improve filtration and reduce runoff impacts on developed areas.

Blackwood Drive Boat Ramp Enhancement:

- **Evaluate and redesign the Blackwood Drive boat ramp** to enhance community safety and accessibility, ensuring it remains operational and effective even during flood conditions.
- **Evaluate opportunities for stormwater and tidal retention** with the incorporation of berms, native vegetation, and tide flex valves.

Library Beach Park Enhancement:

- **Design flood-resilient features** for Library Beach Park to allow the park to handle increased water levels during floods without sustaining major damage.
- **Incorporate living shoreline components** to protect the park from erosion and support natural water flow, elevating and hardening shoreline defenses while promoting natural park flowage.

Historical and Cultural Asset Protection:

- **Implement specialized flood protection measures** for historical structures to ensure their preservation through elevation, the use of water-resistant materials, and the construction of barriers.

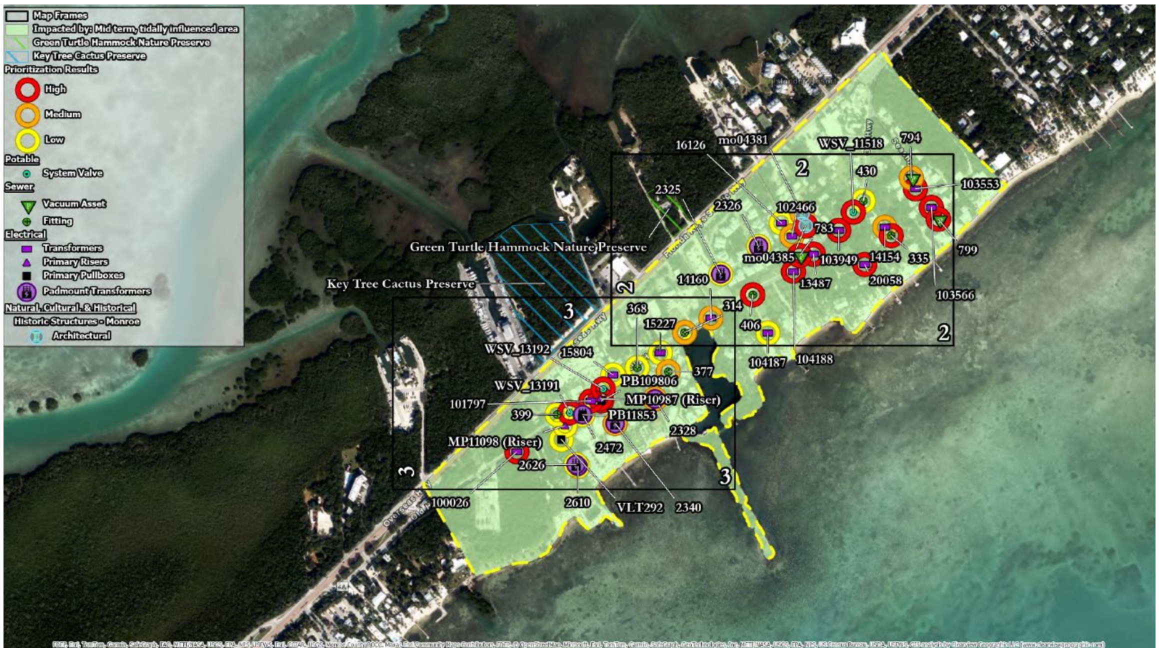
Advanced Monitoring and Community Engagement:

- **Install advanced flood monitoring systems** throughout the corridor to provide real-time data that can trigger early response actions, helping mitigate potential damages.
- **Engage the community through educational progra**ms that focus on flood preparedness, sustainability practices, and the importance of community involvement in maintaining and protecting infrastructure.

By implementing these strategic recommendations, the Central Utility Lifeline Corridor will be well-equipped to handle the future challenges posed by flooding, ensuring that essential services and recreational areas remain safe and functional for the residents of Islamorada.

Hot Spot 8: Coastal Corridor Protection Zone - MM 81 Ocean Side

Figure 60 - Prioritized Assets in Hot Spot 8



The Coastal Corridor Protection Zone, identified as Hot Spot 8, is a mixed-use region in Islamorada, encompassing a variety of commercial and residential areas, along with vital infrastructure and natural assets. Due to projections of significant flooding by 2070 from sea level rise and high tide events, this zone requires focused strategies to protect its electrical transformers, wastewater systems, potable water infrastructure, and historic structures, and is directly adjacent to natural preserves such as Key Tree Cactus Preserve and Green Turtle Hammock Nature Preserve.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Electrical and Wastewater Infrastructure Protection:

- **Elevate and secure transformers and substations** to withstand flood impacts, ensuring a continuous power supply.
- **Improve and safeguard sewer infrastructure**, ensuring resilience against flooding and avoiding contamination or overflow.
- **Strengthen potable water infrastructure** to maintain water quality and supply during flood events.

Historical Structures Preservation:

- **Implement flood-proofing** and elevation measures for historical buildings to safeguard the cultural heritage of the region.

Natural Preserve Conservation:

- **Key Tree Cactus Preserve:**
    - **Elevate parking and access** areas to ensure visitor accessibility while minimizing the impact on natural habitats.
    - **Assess infrastructure** vulnerabilities within the preserve, relocating components if necessary to maintain ecological integrity.
- **Green Turtle Hammock Nature Preserve:**
    - **Adjust and relocate infrastructure** to higher ground or protected areas to reduce the risk of flood damage.
    - **Enhance natural barriers** such as mangroves and vegetation to naturally mitigate flooding and erosion.

Flood-Resilient Public Infrastructure:

- **Design and implement amphibious infrastructure** for critical facilities, allowing buildings to remain functional during floods.

Advanced Monitoring and Community Preparedness:

- **Deploy advanced monitoring systems** to provide real-time data on flood risks and infrastructure performance.
- **Conduct regular community engagement sessions** focusing on flood preparedness and the importance of maintaining and protecting infrastructure.

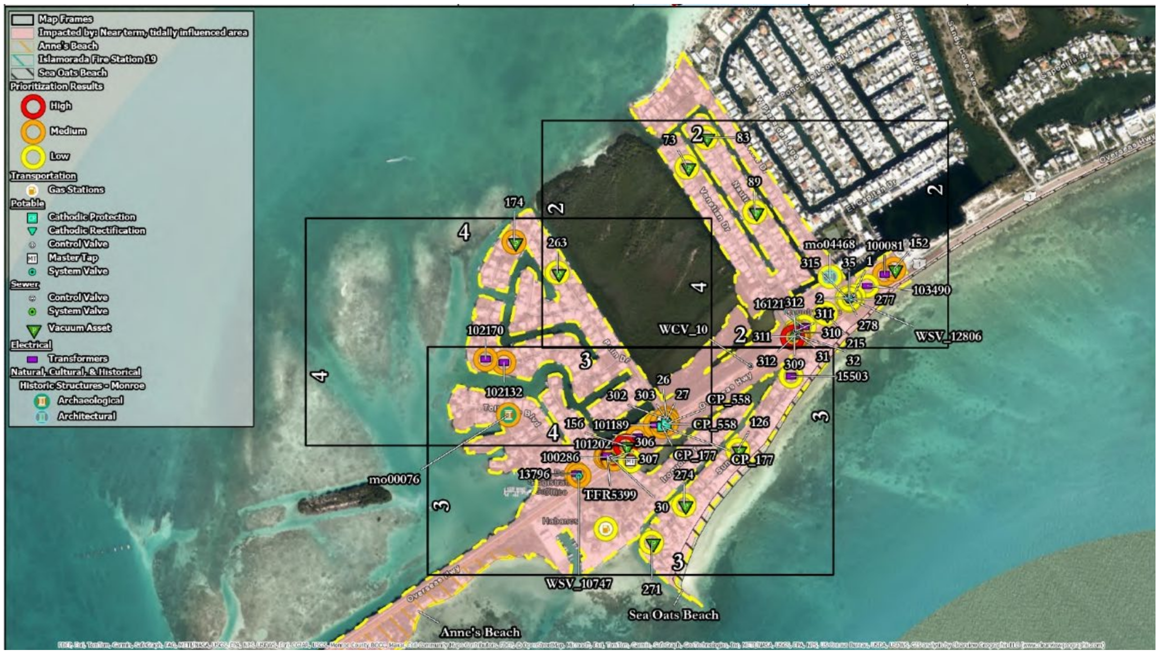
Old Highway:

- **Add stormwater pipes where viable** to hydraulically connect the poorly draining stormwater infrastructure along Old Hwy. The pipes will drain to an inlet prior to discharging through designed stormwater and tidal retention area within right of way.

By implementing these strategies, the Coastal Corridor Protection Zone will be able to significantly improve its resilience against flooding, ensuring the safety and sustainability of its vital assets, infrastructure, and natural preserves.

Hot Spot 9: Coastal Integration District - MM 74

Figure 61 - Prioritized Assets in Hot Spot 9



The Coastal Integration District, formerly known as Hot Spot 9, represents a crucial zone in Islamorada, blending high residential and medium commercial developments. This district is anticipated to encounter significant flooding by 2040 due to sea level rise and high tide events, impacting vital infrastructure including wastewater facilities, electrical systems, potable water infrastructure, and historical structures. Situated near community focal points such as Fire Station 19 and popular beaches like Sea Oats Beach and Anne's Beach, the district demands robust and integrated flood management strategies to safeguard its infrastructure, preserve its historical heritage, and maintain its vibrant community life.

Appendix G contains the list of prioritized critical assets within this hotspot.

Project Recommendations

Infrastructure Resilience and Upgrades:

- **Elevate and secure electrical transformers and substations** to prevent flood-induced outages and maintain essential services.
- **Reinforce wastewater and potable water systems** using flood-resistant materials and designs, ensuring the continuity and safety of water services.

Integrated Water Management:

- **Develop advanced stormwater management systems** in available green spaces, incorporating bioswales, constructed wetlands, and rain gardens to enhance runoff absorption and filtration.

Fire Station 19 Enhancements:

- **Adapt Fire Station 19 for improved stormwater management**, including elevation adjustments and designated areas for water ingress and egress that direct stormwater towards nearby canals efficiently.
- **Implement shoreline hardening measures** to protect the station from erosion and water damage.

Coastal and Beach Area Protection:

- **Implement shoreline stabilization at Sea Oats Beach and Anne's Beach**, using articulated block mats and other erosion control techniques to safeguard against storm surges.
- **Adjust jetty configurations** to enhance sand retention, protecting critical turtle nesting zones and maintaining beach integrity.
- **Replace older boardwalks with durable materials** like concrete, integrating living shoreline elements to bolster natural defenses against floods.

Historical Structures Conservation:

- **Apply tailored flood-proofing measures** to historical buildings, ensuring their longevity and structural integrity through elevations, water-resistant materials, and protective barriers.

Community Engagement and Preparedness:

- **Host community workshops and information sessions** focused on flood resilience, promoting understanding and involvement in local conservation and preparedness initiatives.
- **Enhance public information efforts** to keep the community informed about ongoing and planned resilience measures, fostering a collaborative approach to district-wide protection.

Toll Gate Shores:

- **Add stormwater infrastructure, wet well, and pump station** on the southeast intersection of Toll Gate Blvd. and Toll Gate Shores Dr. to provide floodplain protection for the community.

By proactively addressing these areas, the Coastal Integration District can effectively manage the forthcoming flood risks, ensuring the long-term sustainability and vibrancy of this vital community area. This holistic approach will not only protect physical and economic investments but also enhance the quality of life for all residents and stakeholders.

Other Projects

- **Add two wet stormwater detention facilities** on the intersection of US1, Old Hwy, and Palma Lane along with routing the flow from the mitered end section to the ocean with tide flex valve.
- **Add inlets** to capture runoff along Palermo Dr and discharge to existing swale system along Venetian Blvd.
- **Raise roadways and improve stormwater systems** in several residential areas in upper Plantation Key.

Habitat Change Due to Sea Level Rise

Islamorada's environmental and ecological well-being are integral to its resilience in the face of climate change. This evaluation of environmental vulnerabilities includes a habitat change analysis due to shifting ecological conditions from sea level rise. This is only an evaluation based on sea level rise impacts.

The Sea Level Affecting Marshes Model (SLAMM) is an advanced land cover and ecosystem change tool (Warren Pinnacle Consulting, Inc., 2016). SLAMM, unlike other flood vulnerability assessment methods, integrates long-term hydrologic functions and ecosystem parameters to provide projections about future changes to tidal habitat types, such as saltwater marshes, mangroves, and other coastal wetlands, which are already subjected to regular tidal flooding.

The sea level rise-induced habitat change projections were conducted in SLAMM using a variety of data inputs: Florida Fish & Wildlife Conservation Commission's 2019 Cooperative Land Cover Database, a digital elevation model-derived slope raster, and other parameters were either obtained during the data collection effort, taken from Monroe County's previous Vulnerability Assessment or derived from calculation. Default values within the program and the 2019 land cover database quantified a total amount of carbon sequestration change.

Below the baseline condition is detailed within the SLAMM modeling in relation to the NOAA Intermediate Low and Intermediate High Sea level rise projections.

Figure 62 - SLAMM Map Legend

Figure 63 - NIH SLAMM – Present Day Overview Map

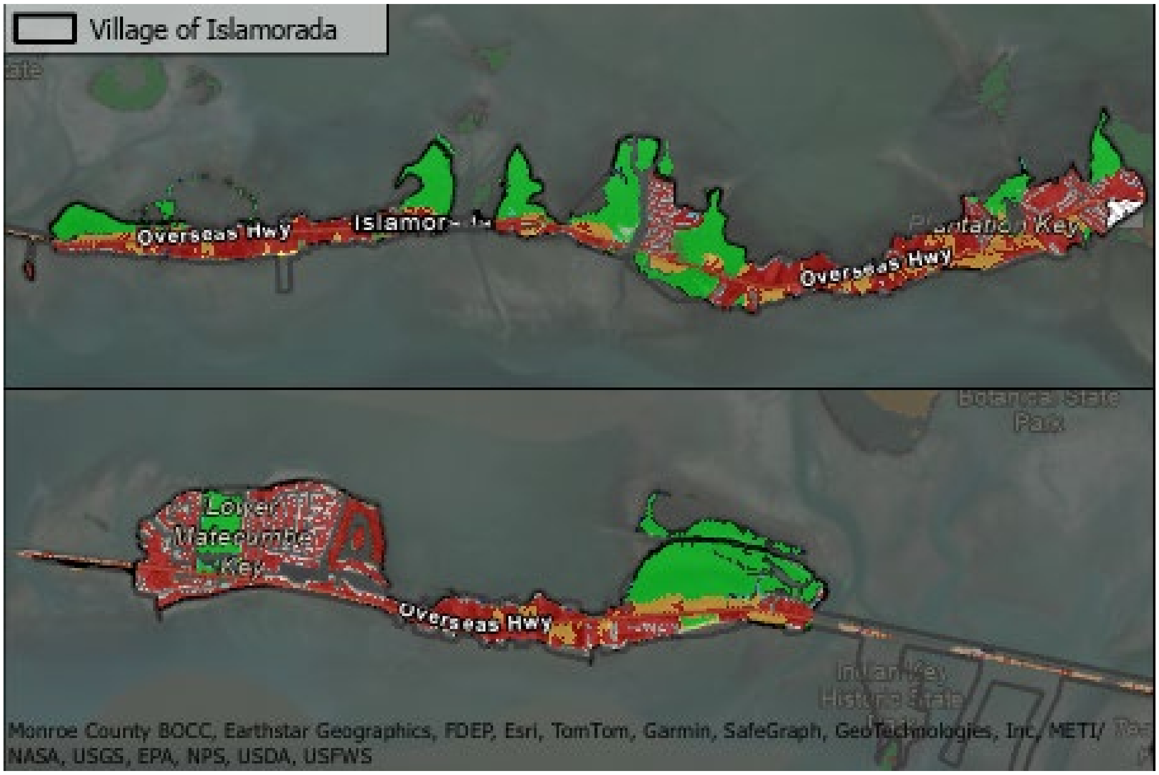


Figure 64 - NIH 2040 SLAMM Map

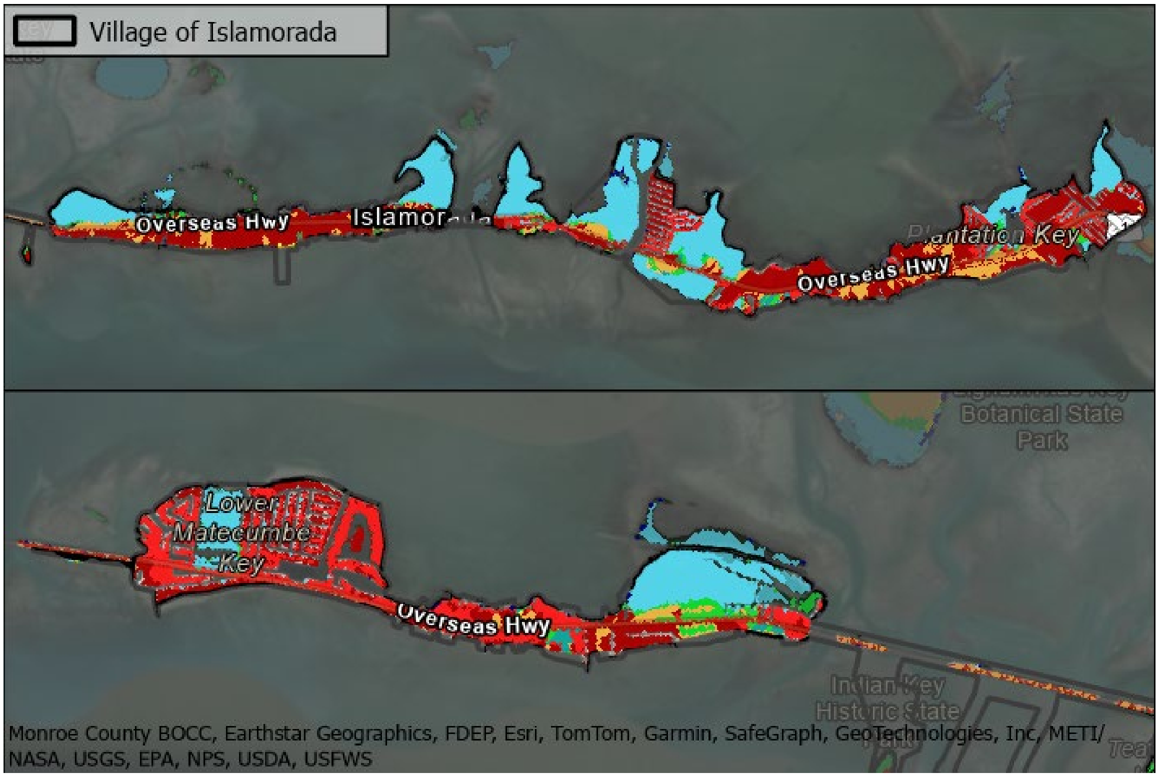


Figure 65 - NIH 2070 SLAMM Map

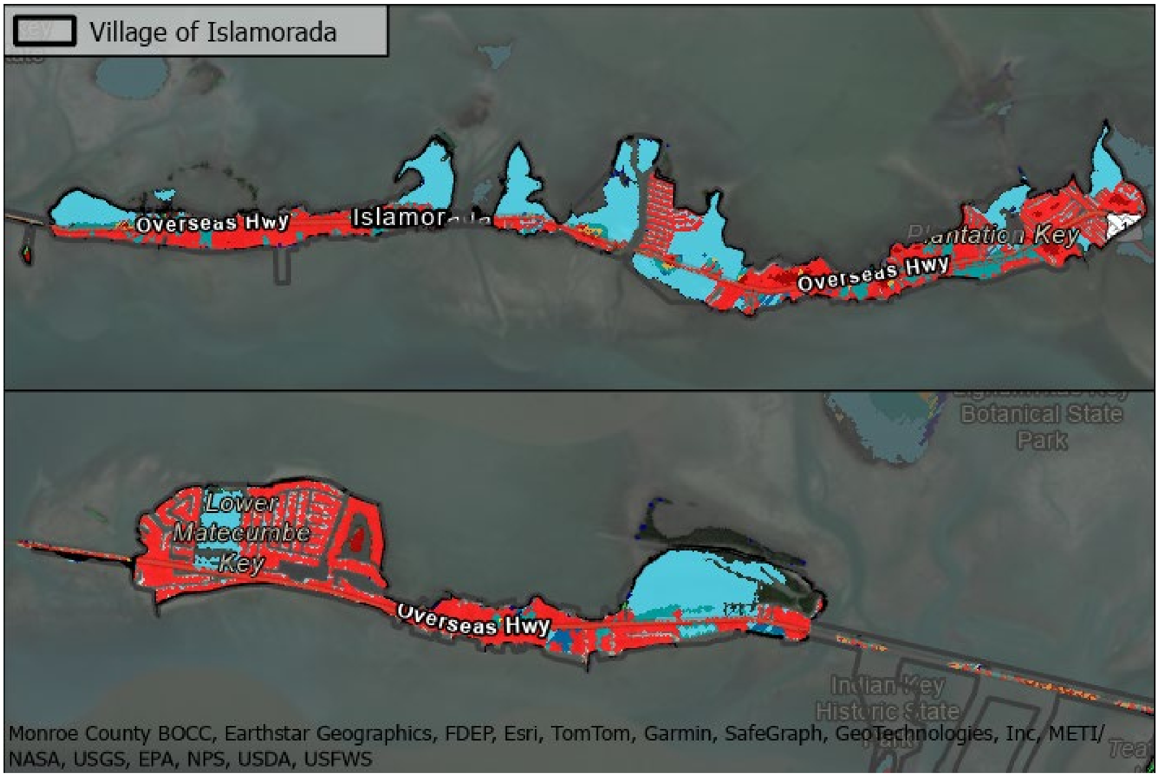
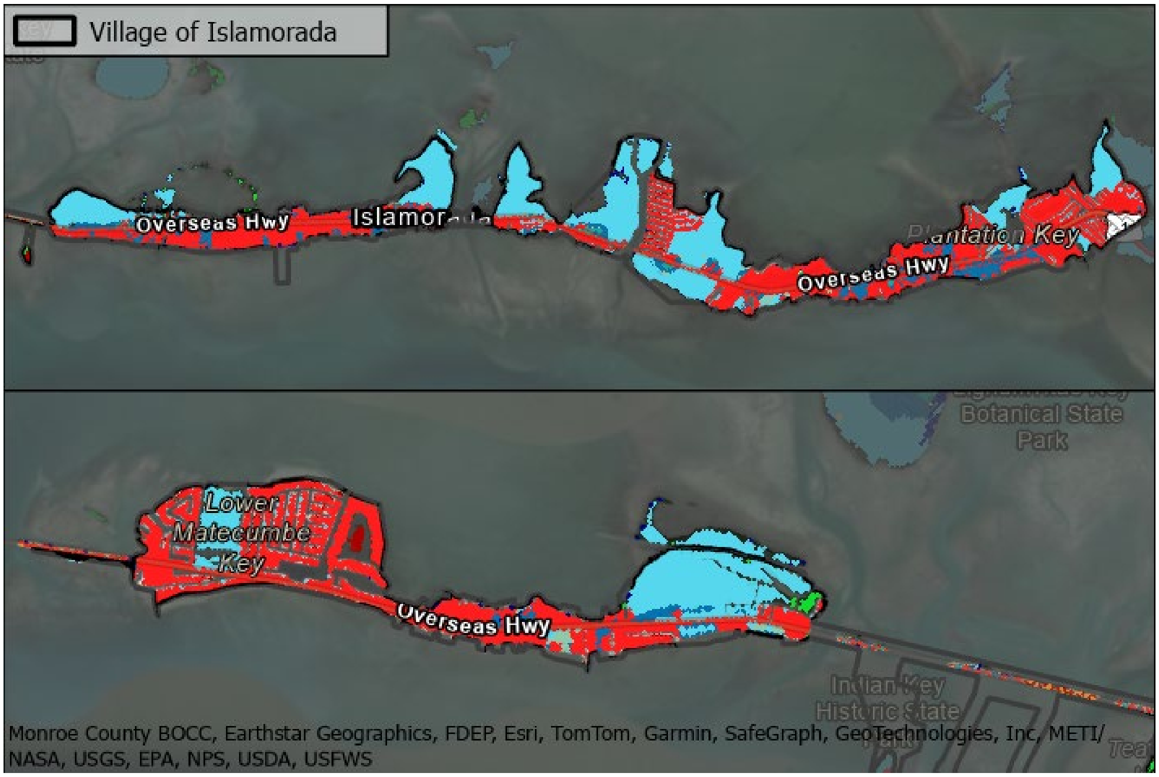


Figure 66 - NIH 2100 SLAMM Map



The tabular outputs below provide total hectares and percent change from the baseline year by habitat type within the study area for the NOAA Intermediate Low and NOAA Intermediate High Sea level rise projections. Tables 18 and 19 show the sum of all changes by habitat type in hectares model wide. A negative value in the "Change from Present Day" in the last three columns represents a loss of that habitat type due to sea level rise for that scenario year. There is more loss associated with the NOAA Intermediate High Sea level rise scenarios than the NOAA Intermediate Low scenarios.

Table 18 - Habitat Change under NOAA Intermediate-Low SLR Scenario

SLAMM Category	Present Day Hectares	2040 Hectares	2070 Hectares	2100 Hectares	Change from Present Day to 2040	Change from Present Day to 2070	Change from Present Day to 2100
Developed Dry Land	9015	8845	5187	3037	-2%	-42%	-66%
Undeveloped Dry Land	2886	2737	1959	1091	-5%	-32%	-62%
Swamp	119	103	25	12	-14%	-79%	-90%
Trans. Salt Marsh	55	41	810	824	-24%	1386%	1411%
Regularly-Flooded Marsh	0	0	60	820	-	-	-
Mangrove	7789	1487	291	238	-81%	-96%	-97%
Tidal Flat	186	95	6	87	-49%	-97%	-53%
Ocean Beach	32	47	50	30	50%	59%	-4%
Rocky Intertidal	419	381	21	11	-9%	-95%	-97%
Inland Open Water	20	19	7	1	-4%	-65%	-92%
Estuarine Open Water	734	7328	8966	9038	899%	1122%	1132%
Open Ocean	302	303	348	391	0%	15%	29%
Flooded Developed Dry Land	65	235	3894	6043	259%	5847%	9129%
Aggregated Non Tidal	11967	11817	11039	10171	-1%	-8%	-15%
Freshwater Non-Tidal	119	103	25	12	-14%	-79%	-90%
Open Water	1056	7650	9321	9430	625%	783%	793%
Low Tidal	637	524	77	128	-18%	-88%	-80%
Saltmarsh	0	0	60	820	-	-	-
Transitional	7844	1529	1100	1062	-81%	-86%	-86%
GHG (10^3 Kg)	0	10540	30702	76525	-	-	-

Table 19 - Habitat Change under NOAA Intermediate-High SLR Scenario

SLAMM Category	Present Day	2040 Hectares	2070 Hectares	2100 Hectares	Change from Present Day to 2040	Change from Present Day to 2070	Change from Present Day to 2100
Developed Dry Land	9015	6964	517	63	-23%	-94%	-99%
Undeveloped Dry Land	2886	2265	234	14	-22%	-92%	-100%

SLAMM Category	Present Day	2040 Hectares	2070 Hectares	2100 Hectares	Change from Present Day to 2040	Change from Present Day to 2070	Change from Present Day to 2100
Swamp	119	69	0	0	-42%	-100%	-100%
Trans. Salt Marsh	55	206	1997	204	278%	3564%	274%
Regularly-Flooded Marsh	0	0	215	1994	-	-	-
Mangrove	7789	785	132	126	-90%	-98%	-98%
Tidal Flat	186	3	3	223	-99%	-98%	20%
Ocean Beach	32	62	91	9	97%	188%	-71%
Rocky Intertidal	419	49	7	6	-88%	-98%	-99%
Inland Open Water	20	7	0	0	-64%	-99%	-100%
Estuarine Open Water	734	8770	9467	9476	1095%	1190%	1191%
Open Ocean	302	326	397	489	8%	31%	62%
Flooded Developed Dry Land	65	2116	8563	9017	3132%	12978%	13671%
Aggregated Non Tidal	11967	11346	9314	9094	-5%	-22%	-24%
Freshwater Non-Tidal	119	69	0	0	-42%	-100%	-100%
Open Water	1056	9103	9863	9965	762%	834%	844%
Low Tidal	637	114	101	239	-82%	-84%	-63%
Saltmarsh	0	0	215	1994	-	-	-
Transitional	7844	991	2129	330	-87%	-73%	-96%
GHG (10^3 Kg)	0	10028	39266	108939	-	-	-

Summary of Habitat Changes

Decrease in Developed Dry Land:

- Developed Dry Land is projected to decrease drastically from 9015 hectares to just 63 hectares by 2100, representing a 99% loss. This significant reduction highlights the vulnerability of developed areas to flooding and sea level rise, posing substantial risks to infrastructure, homes, and businesses. This could lead to substantial economic losses and the displacement of communities.

Expansion of Transitional Salt Marsh:

- Transitional Salt Marsh is expected to expand significantly from 55 hectares to 204 hectares by 2100, a 274% increase. This expansion is crucial for carbon sequestration, helping to mitigate climate change, and providing protection against storm surges by acting as natural barriers. However, the rapid expansion could be detrimental to adjacent habitats by potentially overtaking areas previously occupied by other important ecosystems, leading to a loss of biodiversity and habitat displacement.

Decrease in Mangroves:

- Mangrove areas are anticipated to decrease drastically from 7789 hectares to 126 hectares by 2100, a 98% reduction. Mangroves are vital for coastal protection, stabilizing shorelines, and reducing the impact of storm surges and waves. Their loss could increase the vulnerability of coastlines to erosion and storm damage. Additionally, mangroves serve as important breeding and nursery grounds for many marine species. The reduction in mangrove areas could impact fish populations and biodiversity, affecting both the ecosystem and local fisheries.

Increase in Estuarine Open Water:

- Estuarine Open Water is expected to increase significantly from 734 hectares to 9476 hectares by 2100, a 1191% increase. Estuarine waters provide essential habitats for marine life, including fish and shellfish, and play a key role in nutrient cycling. However, the expansion of estuarine open water at the expense of other habitats like marshes and swamps could reduce the area available for other critical ecosystems, potentially impacting species that rely on those habitats.

Dramatic Increase in Flooded Developed Dry Land:

- Flooded Developed Dry Land is expected to increase dramatically from 65 hectares to 9017 hectares by 2100, representing a 13671% increase. This change underscores the increasing risk and vulnerability of developed areas to flooding, likely due to rising sea levels and climate change. The change could result in substantial economic losses, displacement of communities, and destruction of infrastructure.

These examples demonstrate the complex interplay between different habitats under changing environmental conditions and highlight the importance of managing and protecting these ecosystems in the face of climate change.

Shoreline Assessment

Islamorada’s proximity to tidally influenced waters increases its risk of suffering from shoreline erosion, inland flooding, and infrastructure damage caused by storm surge. Storm surge is the result of hurricanes and tropical storms with strong wind gusts that force high volumes of sea water inland eroding beaches and dunes, damaging seawalls, roadways, and properties, and costing millions of dollars in beach and dune refurbishment and infrastructure repair. However, though storm surge can be the most destructive component of storm damages, the implementation of living shorelines, natural resource restoration and hybrid shorelines has been shown to greatly reduce the destructive wave energy that is associated with storm surge and in turn greatly reduce the damage that is caused by it.

This assessment is aimed at determining areas where Islamorada's shoreline may benefit from the installation of living shorelines to reduce beach erosion and loss or the raising and armoring of seawall infrastructure to impede inland flooding that is projected to occur based on future sea level rise projections.

Through the analyzation of available historic storm tide levels, Light Detecting and Ranging (LiDAR) data, the shoreline composition of Islamorada, and NOAA tide gauge data the project team identified 6 sites that are at an increased risk of experiencing beach erosion and inland tidal flooding caused by storm surge and by 2040 as a result of sea level rise.

Historic Storm Data

Based on data retrieved from the NOAA Oceanic Atmospheric Administration (NOAA) between 2010 and 2023 Monroe County has been affected by 5 tropical storms and 2 hurricanes, Hurricane Irma 2017 and Ian 2022 both registered a significant increase in tide levels at the Key West NOAA tide gauge during the time of the storm.

Figure 67 – Key West Tide Gauge: Hurricane Irma, 2017

Verified Tide Height: 2.70 feet NAVD88

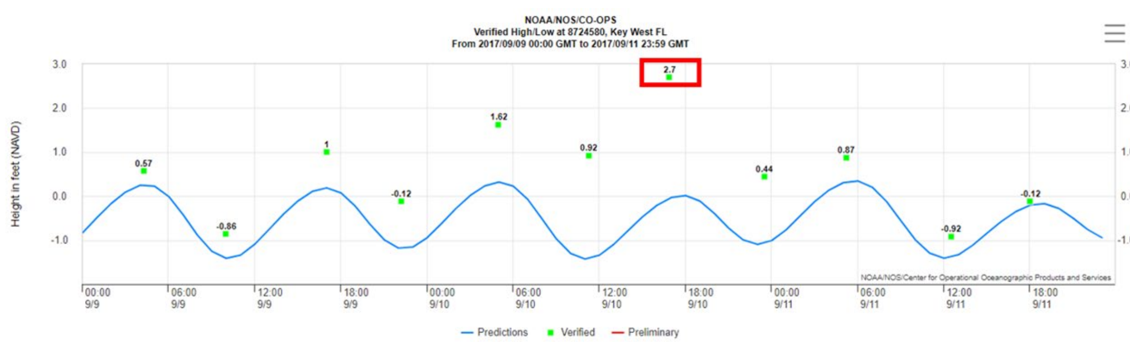
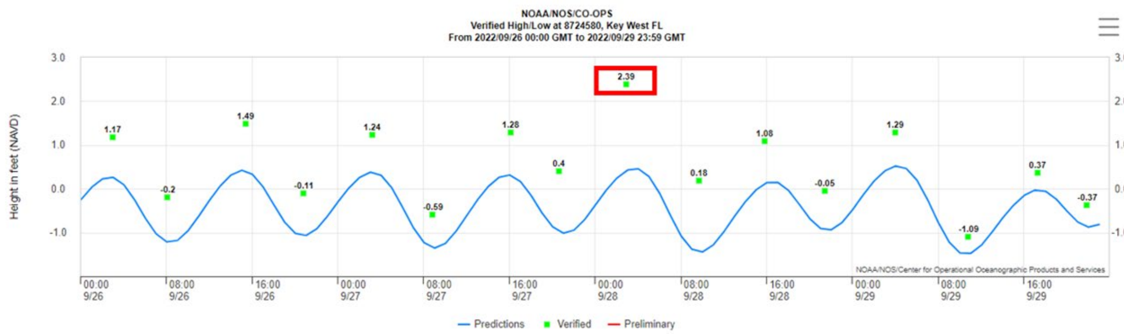


Figure 68 - Key West Tide Gauge: Hurricane Ian, 2022

Verified Tide Height: 2.39 feet NAVD88



Leveraging the verified tide height measurements, depth grids of historical storms were generated utilizing the same modeling techniques applied in forecasting flooding from future sea level rise. This analysis combined the generated storm depth grids, existing FEMA flood hazard zones, Islamorada's latest Light Detection and Ranging (LiDAR) digital elevation model (DEM), and current shoreline data. This comprehensive approach established a foundational understanding of regions most vulnerable to storm surge. It also pinpointed areas where the introduction of native vegetation could play a crucial role in mitigating future erosion and flood impacts.

By employing the latest LiDAR DEMs, detailed topographical contours and shorelines in the lowest elevation zones and those with the most direct exposure to coastal forces were meticulously mapped. These areas, often nearest to the coastal waters, emerged as the most at risk to the perils of storm surges. This identification process is vital in developing strategic interventions to fortify these critical zones against the increasing threats of flooding and coastal erosion.

Figure 69 - Elevation Map of North Islamorada with Shoreline Resilience Sites 1-3

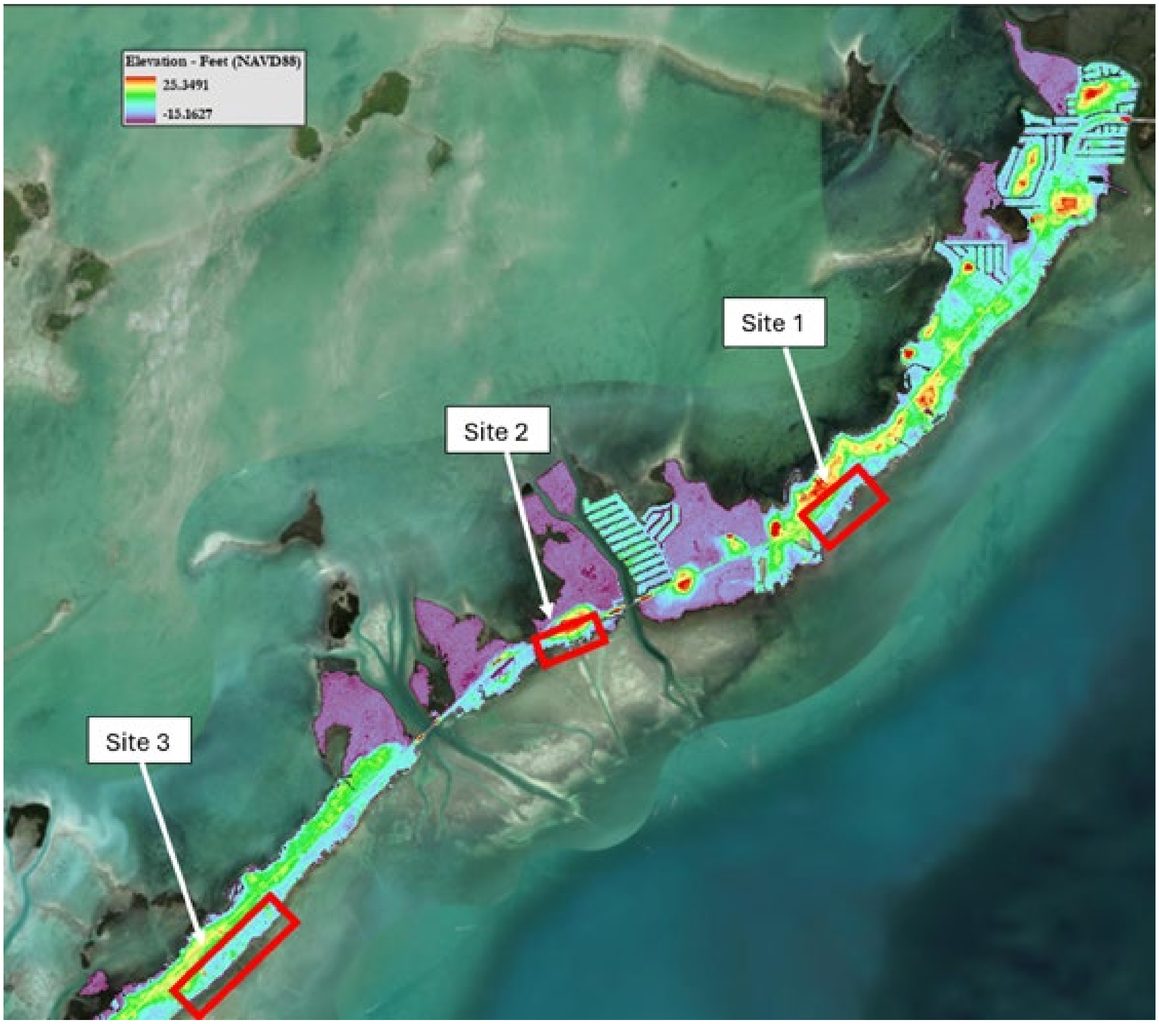
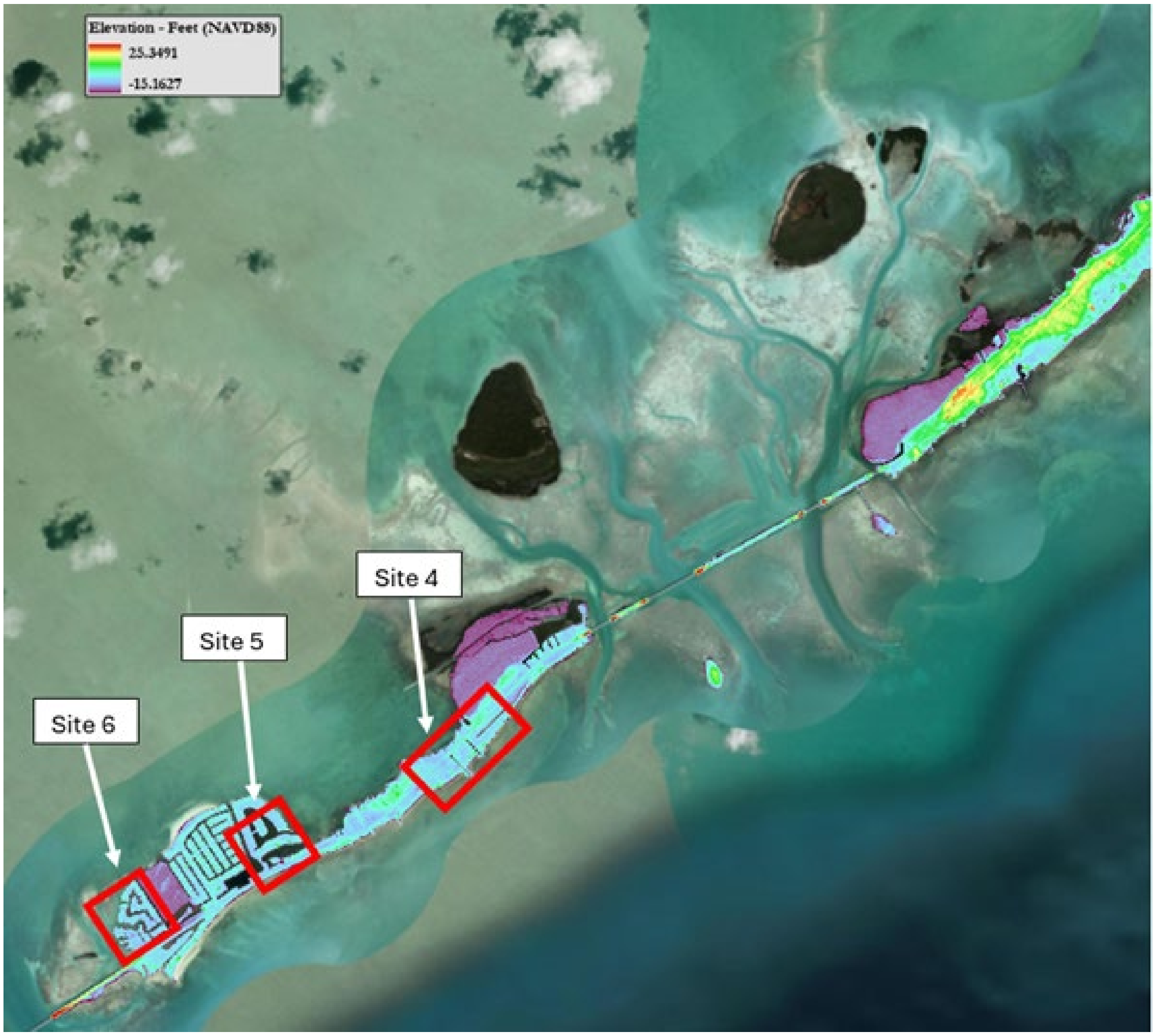


Figure 70 - Elevation Map of North Islamorada with Shoreline Resilience Sites 4-6



Based on data collected from the Florida Fish & Wildlife Conservation Commission (FWC), the project team determined the composition of the shoreline. The current composition of the shoreline is reflected as either beach, man-made structure, rip rap or vegetation. Identifying the composition of the shoreline in parallel with the shoreline's elevation and its susceptibility to storm events can assist in determining for which areas restoration projects or seawall improvement may be best suited. Shorelines comprised of beaches could benefit from the installation of natural vegetation on the beach and offshore to reduce the impacts of sediment erosion associated with storm surge events. Installation of salt marsh habitat, oyster reefs, or breakwater in shallow areas around man-made structures and riprap could reduce wave energy associated with storm surge events, which could support the reduction of infrastructure damage.

Figure 71 - Shoreline Resilience Improvement Site 1

Figure 72 - Shoreline Resilience Improvement Site 2

Figure 73 - Shoreline Resilience Improvement Site 3

Figure 74 - Shoreline Resilience Improvement Site 4

Figure 75 - Shoreline Resilience Improvement Site 5

Figure 76 - Shoreline Resilience Improvement Site 6

Utilizing historical tide data extrapolated from the Key West NOAA tide gauge, graphical outputs were produced to represent the frequency in which areas of Islamorada are projected to experience high tide flooding by 2040.

Figure 77 - Site 1 Projected Tidal Flooding Frequency

Figure 78 - Site 2 Projected Tidal Flooding Frequency

Figure 79 - Site 3 Projected Tidal Flooding Frequency

Figure 80 - Site 4 Projected Tidal Flooding Frequency

Figure 81 - Site 5 Projected Tidal Flooding Frequency

Figure 82 - Site 6 Projected Tidal Flooding Frequency

Based on the assessment of the data described above, the project team provides the following recommendations to improve the resiliency of the six identified sites.

Figure 83 - Shoreline Resilience Improvement Site 1: Project Recommendation

Site 1: Though the aerial image does not currently show it, this area is highly developed as a RV and vacation rental complex referred to as Sun Outdoors Islamorada. Rip rap comprises most of the shoreline here. Current projections show this site experiencing tidal flooding up to 100 days out of the year. The project team recommends converting the shoreline of the developed area from rip rap to a seawall and expanding conservation areas of the natural areas to the north and south of the developed area to increase flood storage in the surrounding area.

Figure 84 - Shoreline Resilience Improvement Site 2: Project Recommendation

Site 2: This site is a highly developed area mostly made up of hotel resorts, mobile home parks, and marinas. The shoreline of this site is comprised of mostly rip rap and seawall with a small beach area. Based on future sea level rise projections, the majority of this area is expected to experience up to 30 days of tidal flooding by 2040. The project team recommends converting the shoreline of the developed area from rip rap to a seawall, raising the existing seawall, and converting the beach area to a salt marsh or mangrove to reduce erosion and improve flood storage capacity for the surrounding area.

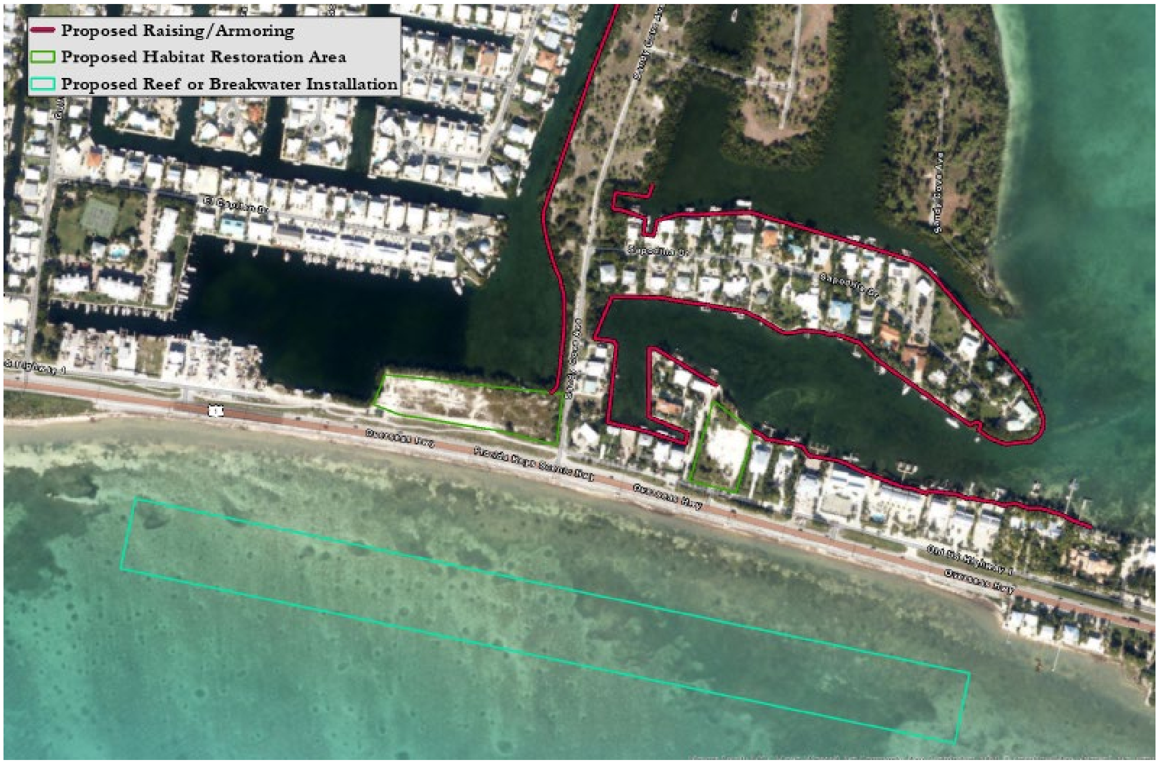
Figure 85 - Shoreline Resilience Improvement Site 3 : Project Recommendation

Site 3: This site is medium to highly developed, mostly comprised of hotel resorts and residential properties. Beaches form the majority of this site's shoreline, with small stretches of seawall and rip rap. Based on current sea level rise projections, the resort hotel areas to the north are expected to experience up to 20 days of tidal flooding in some areas, while the residential beach area is expected to experience 150 days or more of tidal flooding. The project team recommends reenforcing or raising the seawall and rip rap shorelines and installing breakwaters or restoring coral reefs off the coast to reduce energy of incoming tides and protect beaches against erosion.

Figure 86 - Shoreline Resilience Improvement Site 4 : Project Recommendation

Site 4: This site is medium to highly developed, mostly comprised of residential development with some commercial development. Rip rap and beaches form the majority of this site's shoreline, with some stretches of seawall and natural vegetation. Based on current sea level rise projections, a large portion of this site is expected to experience approximately 20 days of tidal flooding throughout the year by 2040, while the rip rap and beach shorelines are expected to experience 150 or more days of tidal flooding. The project team recommends armoring, raising, or converting rip rap areas to seawall to protect developed areas from rising sea levels, restoring coral reefs or installing breakwaters off the coast to reduce wave energy and protect beaches from erosion, and increasing conservation areas at this site to increase tidal flood storage.

Figure 87 - Shoreline Resilience Improvement Site 5 : Project Recommendation



Site 5: This site is a high-density residential area. Seawall comprises the majority of this site's shoreline, with a long stretch of beach along Florida Key Scenic Highway. Based on current sea level rise projections, this site, especially along Sandy Cove Avenue and Old US Highway 1, is expected to experience up to 100 days of tidal flooding throughout the year by 2040. The beach stretching along Florida Keys Scenic Highway is expected to experience 150 or days of tidal flooding. The project team recommends raising seawalls surrounding residential areas, restoring mangroves or salt marshes in open areas to improve flood storage capacity of the site, and restoring coral reefs or installing breakwaters off the coast of the Florida Keys Scenic Highway to reduce wave energy and protect mass wasting of a critical evacuation route.

Figure 88 - Shoreline Resilience Improvement Site 6 : Project Recommendation

Site 6: This site is a high-density residential area. The entirety of the shoreline is made up of seawalls. Based on current sea level rise projections, the majority of this site is expected to experience 40 days of tidal flooding throughout the year by 2040, with some areas experiencing 150 or more days of tidal flooding. Due to the high development of this area, the project team recommends raising the seawall to reduce sea level rise impacts.

Socioeconomic Vulnerability

A comprehensive vulnerability assessment encompasses not only physical factors but also socioeconomic considerations. These considerations reveal the increased risks faced by a community's most vulnerable communities.

This section presents an analysis aimed at understanding the impact of flood vulnerability on the Village's people. Spanning both urban and suburban communities, special attention is paid to identifying vulnerable populations. Those with limited resources or access to essential services require additional focus and call for special delineation of resources. Tailoring effective flood mitigation strategies specifically for these groups is critical.

A census tract is a geographic region defined for population study. Census tracts are used in this analysis to identify particularly vulnerable populations within flooding hot spots.

Description of Analysis

The exploration of Islamorada's flood risk planning through the lens of socioeconomic vulnerability uncovers the nuanced challenges faced by the Village's most exposed communities. This approach, centered around the Social Vulnerability Index (SVI) and Location Affordability Index (LAI), emphasizes the importance of tailored flood mitigation strategies.

Incorporating LAI into the analysis adds depth, revealing how housing and transportation costs impact the financial stability of various household profiles. From very low-income individuals to moderate-income families, each group's economic reality underscores the importance of integrated planning that considers both flood risks and affordability. This comprehensive approach ensures that flood resilience measures are not only effective in reducing physical vulnerabilities but also in supporting the economic well-being of Islamorada's residents.

The findings underscore the critical need for Islamorada to adopt a multi-faceted approach to flood risk planning. By acknowledging the intersection of physical vulnerabilities with socioeconomic factors, the Village can develop more inclusive and sustainable strategies. These strategies should aim to not only protect infrastructure and property but also to enhance the resilience of communities, particularly those who are most vulnerable to the adverse effects of flooding. Through targeted interventions and supportive policies, Islamorada can work towards a future where all residents, regardless of their economic status, are safeguarded against the impacts of climate change and sea-level rise.

Efforts to address these vulnerabilities must consider the complex interplay of factors that contribute to the community's risk, prioritizing strategies that support the most affected populations through financial assistance, social services, and inclusive policymaking. This targeted approach is essential for improving quality of life and ensuring equitable access to resources and support in the face of climate change and flood risks.

Social Vulnerability Index

In Islamorada, consisting of only three census tracts, a detailed study of each area tract helps in identifying populations that are especially vulnerable to flood risk. Vulnerability is based on the overall composite ranking within the Social Vulnerability Index, where values of 50% (or .50) or greater are prioritized higher than lower values. Table 20 provides the census tracts within Islamorada and their corresponding SVI Composite Index. Higher values indicate a higher susceptibility to flood-related adversities and other stressors. This detailed breakdown serves as a critical tool for prioritizing action and directing resources towards the most vulnerable sectors of the population. Ensuring that mitigation efforts are both efficient and equitable is crucial for protecting vulnerable communities.

Table 20 - Census Tracts in Islamorada

Census Tract	Land Area (in square miles)	SVI Composite Index
12087970900 / Tract 9709	4.4	41% (.406)
12087970800 / Tract 9708	2.9	30% (.298)
12087970700 / Tract 9707	2.7	72% (.718)

Figure 89 – Census Tracts with SVI Scores and Total Population

Location Affordability Index

The Location Affordability Index (LAI) provides a comprehensive view of the cost burdens of housing and transportation on different household profiles and analyzes them to determine the true cost of living, not just in terms of rent and/or mortgages but also commuting and travel expenses. This index is a key factor when analyzing the vulnerability of a community. Metrics for each household profile identified within the analyzed census tracts are detailed below.

Household Profiles

The 2024 Vulnerability Assessment for Islamorada introduces several household profiles to better understand the socioeconomic fabric of the Village and tailor resilience strategies accordingly. Each profile encapsulates distinct economic realities, from those barely making ends meet to families enjoying financial stability.

Very Low-Income Individuals: These are residents at the lowest economic tier within the community, earning significantly less than the majority. They represent the segment most in need of comprehensive support and intervention, reflecting profound financial challenges that necessitate targeted assistance programs to ensure their well-being and societal integration. This suggests significant economic challenges and a potential need for targeted financial assistance and social services to improve their quality of life and economic stability.

Working Individuals: This group includes a broad spectrum of the workforce, from those employed full-time to part-time across various sectors. Their economic situation is somewhat stable, yet precarious, marked by a delicate balance between earnings and expenditure that could be easily disrupted by unforeseen financial demands or economic downturns. This group likely includes a mix of full-time and part-time workers in various sectors, possibly facing moderate financial constraints with some disposable income but also vulnerabilities to economic downturns or unexpected expenses.

Retired Couples: Enjoying the fruits of their lifelong labor, retired couples generally occupy a more comfortable economic position, buoyed by pensions, savings, or other retirement benefits. While they are less vulnerable to immediate financial shocks, they may require support with healthcare and aging-related services to maintain their quality of life. This suggests that they likely have a stable source of retirement income, such as pensions or savings, positioning them relatively comfortably in terms of economic security. This group may have fewer financial vulnerabilities but could still require services geared towards healthcare and aging.

Single-Parent Families: Single parents navigate the complexities of raising children on a single income, a challenge compounded by the costs associated with childcare and education. This group's economic positioning, while not at the bottom, is fraught with unique pressures that call for policies aimed at easing their financial and caregiving burdens. Despite being in the middle-income bracket, the demands of single parenting, including childcare and educational expenses, can strain their financial resources, highlighting the need for supportive policies that address childcare, education, and healthcare.

Moderate Income Families: Representing a relatively comfortable middle ground in the economic spectrum, families in this category have a stable income that supports a decent standard of living. However, they are not immune to financial strains, particularly regarding housing, education, and healthcare expenses, underscoring the need for adaptable support systems.

Table 21 - LAI Household Profiles of Interest and their Median Household Income

Household Profile	Median Household Income for a Given Area (MHHI)
2. Very Low-Income Individual	National Poverty Line
3. Working Individual	50% of MHHI
5. Retired Couple	80% of MHHI
6. Single-Parent Family	50% of MHHI
7. Moderate-Income Family	80% of MHHI

Each of these profiles plays a crucial role in shaping Islamorada's approach to building a resilient and inclusive community. By acknowledging the diverse economic realities of its residents, the Village can devise targeted strategies that not only address immediate vulnerabilities but also lay the groundwork for sustainable development and prosperity.

Policy, Land Use and Development

When conducting a vulnerability assessment, an immense amount of data and analysis is generated, but even more important than the information is what the community does with it. Key mechanisms through which a community can make better decisions based on the outcomes of a vulnerability assessment include its budget, infrastructure design, and land use / land development policies. Each of these examples is discussed in this section.

Budget Implications

This vulnerability assessment can help the Village target investments into priority areas by focusing on the flooding hot spots identified. The flooding hot spots show current and increasing flood risk based on the type of flooding. For hot spots subject to tidal flooding, shoreline defense strategies might include living shorelines or controlling other tidal impacts through backflow prevention on stormwater outfalls. These strategies can help protect the critical assets identified in those hot spots, as well as the property and business owners relying on those assets for their day-to-day quality of life. Hot spots where rainfall is the primary driver of current and future flood risk are generally already known to be flood-prone areas, so any updated, more advanced hydrological modeling will serve as a further check and balance on stormwater improvement priorities. Two other projects - the Village's Watershed Management Plan under the CRS program and the forthcoming Stormwater Master Plan – will help verify these results and dive more deeply into actual project recommendations, conceptual designs, and cost estimates. Prioritizing investments in the hot spots can maintain or improve stormwater levels of service defined with the Village's Comprehensive Plan and Code and again assist in targeting investments to the areas that will be impacted the soonest. These prioritization strategies would occur as part of the Village's existing capital improvements and budgeting processes.

Infrastructure Design

When designing infrastructure in the City, there are two basic concepts: the actual design of a project and the level of service it provides. A couple of examples from the Village's Code and Comprehensive Plan can demonstrate this concept and how this vulnerability assessment can help shape those policies based on its outcomes.

Stormwater

In Sec. 30-1727 of the Code of Ordinances, the Village requires design standards for stormwater management systems. Relevant provisions include:

(a) A stormwater management system designed and installed for the development shall contain provisions for:

1) Pollution abatement (Category 1, Category 2, and Category 3): Refer to the Design Criteria, Performance and Maintenance section of the stormwater design criteria technical manual to determine required pollution abatement volume.

2) Rate of discharge limitations (Category 2 and Category 3): The post-development peak rate of discharge permitted from the site shall not exceed the pre-peak rate of discharge from the site during a 72-hour/25-year frequency storm event. Those sites with no positive outfall shall be required to retain total runoff from a 72-hour/25-year storm event.

3) Finished floor elevation: The finished floor elevation of a retention/detention facility shall be designed to contain a 100-year storm event with no discharge.

4) Protection from flooding (Category 2 and Category 3): All structures are to be constructed in a manner consistent with flood protection and floodplain encroachment standards established in the village land regulations and comprehensive land use plan.

To account for the outcomes from this vulnerability assessment, the Village should consider the following changes to existing stormwater system design standards:

- Stormwater systems may have to manage for different conditions over the next 50 years due to changing rainfall conditions, or in some areas, impacts from sea level rise to operations throughout a rising tailwater condition. The Village may wish to adopt a "useful life" threshold to include future conditions related to changing rainfall conditions and a reduced tailwater condition due to sea level rise. Pinellas County has incorporated tailwater conditions into its Code to address this issue.[17]
- The 25-year duration storm event may not be sufficient, given that storms are occurring more frequently and for longer durations. In certain parts of the Village, the existing design standard may simply be too low for these expected changes to rainfall and/or may be compromised by increased tidal flooding from sea level rise. The Village should consider incorporating higher frequency critical duration storm events in its advanced stormwater

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modeling. Fortunately, the Village is currently pursuing this modeling for a CRS Watershed Management Plan under a separate grant, as well as in its forthcoming Stormwater Master Plan Update. Both planning efforts can help define the needed future parameters and identify areas of the Village where the stormwater system may be compromised by more frequent, higher volume rain or storm events.

In the Village's 2022 Comprehensive Plan found online, the level of service for drainage is as follows in Policy 4-1.1.2:

Islamorada, Village of Islands hereby adopts LOS standards for stormwater management as currently mandated by State agencies, as defined in the Village's adopted Stormwater Management Master Plan as follows:

1. *Post development runoff shall not exceed the pre-development runoff rate for a 25-year storm event, up to and including an event with a 24-hour duration;*
2. *Stormwater treatment and disposal facilities shall be designed to meet the design and performance standards established in F.A.C. Ch. 62-25, § 25.025, with treatment of the runoff from the first one (1) inch of rainfall on-site to meet the water quality standards required by F.A.C. Ch. 62, § 302.500; and*
3. *Stormwater facilities which directly discharge into 'Outstanding Florida Waters' (OFW) shall provide an additional treatment pursuant to F.A.C. Ch. 62-25.025 (9). Stormwater facilities must be designed so as to not degrade the receiving water body below the minimum conditions necessary to assure the suitability of water for the designated use of its classification as established in F.A.C. Ch. 62-302.*

The Village is built out. Even though the existing 25-year, 24-hour design storm standard may provide a very low level of service, but full build out means that that the only opportunities to upgrade this level of service will come from new capital projects or larger redevelopment projects. The results of the vulnerability assessment suggest higher-volume rainfall events (1.16 times more rainfall in 2040 than present day and 1.21 times more rainfall in 2070). Therefore, the Village may wish to reevaluate its adopted level of service standards in the Comprehensive Plan based upon the information in this vulnerability assessment and the more advanced modeling currently underway for the CRS Watershed Management Plan and Stormwater Master Plan Update.

Land Use / Land Development

Land use and land development policies generally control how communities develop and where. Again, the Village is effectively built out, so the potential to address new development is limited in terms of large-scale planned unit developments or larger projects. However, redevelopment opportunities do exist. There are also implications for affordable housing projects given the outputs of the vulnerability assessment.

The Village should consider the following land use policy changes:

- Amending the Village's Floodplain Management Ordinance in Article 6-III. Key provisions might include enhanced freeboard in certain areas of the Village and/or for substantial improvements to property.
- Requiring enhanced pervious surfaces as part of landscaping regulations (Division 30-V-6 Landscaping Standards).
- Adopting a shoreline ordinance revision that harmonizes concepts of seawall heights, promotes living or hybrid shorelines in key locations, and ties useful life of shoreline improvements to future flood risk. Currently, Section 30-1545 Bulkheads, Seawalls or Riprap does not currently address living shorelines or a shoreline structure height.

Conclusion

In summary, this comprehensive vulnerability assessment has illuminated critical insights into Islamorada's susceptibility to climate change and sea-level rise. These findings underscore the urgent need for proactive measures to safeguard the Village's communities, infrastructure, and environment.

By conducting an in-depth analysis of physical, socio-economic, and environmental vulnerabilities specific to Islamorada, this vulnerability assessment equips decision-makers with a holistic understanding of the Village's susceptibility to climate change impacts. This knowledge forms the basis for tailored mitigation and adaptation strategies aimed at enhancing the Village's resilience and sustainability.

Islamorada's coastal location exposes it to the relentless forces of sea-level rise, storm surges, and high tide flooding. The potential impacts on critical infrastructure, communities, and the economy are significant and cannot be ignored. By further developing these types of adaptation strategy recommendations and working together, Islamorada can fortify its defenses against the growing threats of climate change.

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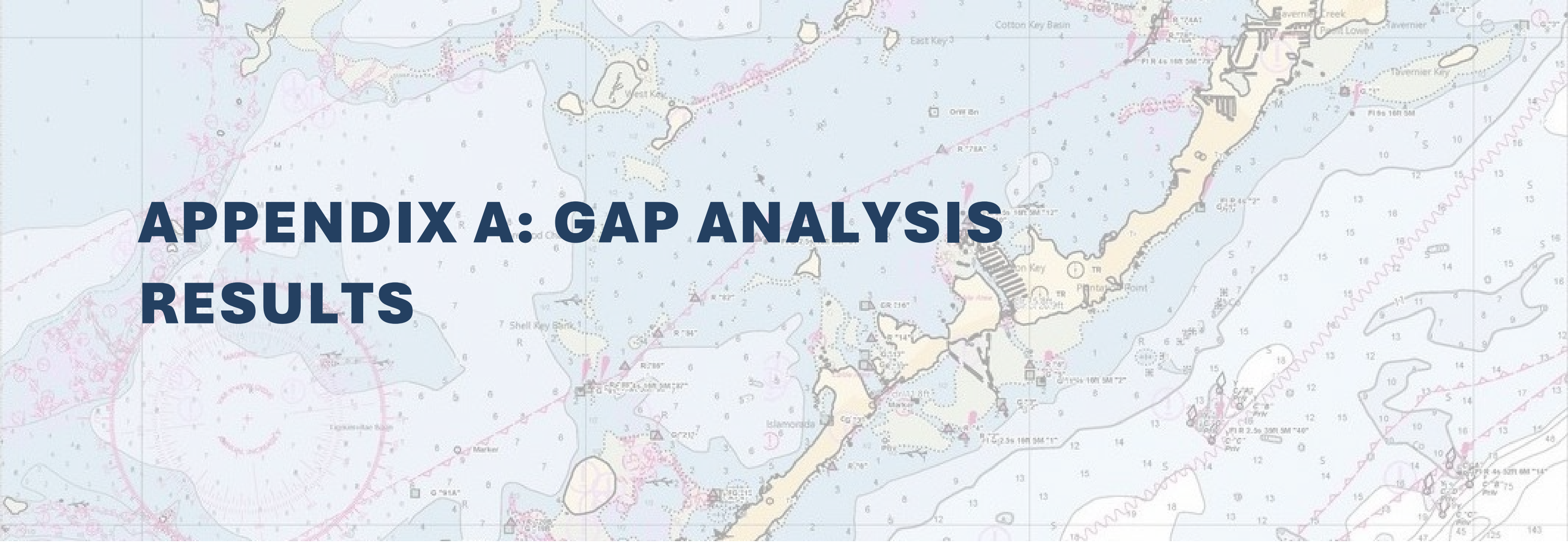


APPENDIX A: GAP ANALYSIS RESULTS

A thorough gap analysis was conducted to identify areas where data were insufficient or missing. This analysis played a crucial role in identifying regions and parameters that required additional data or alternative approaches to fill the gaps.

By pinpointing data deficiencies, the assessment team was able to prioritize efforts to collect missing data or explore alternative methods to estimate the required information. This iterative process allows for continuous refinement of the data collection strategy and ensures the assessment is built on the most reliable and comprehensive data available.

The analysis focused on comparing available data against the information required for effective vulnerability assessment. The identified gaps can be broadly categorized into five challenges, with potential solutions to each.

- **INSUFFICIENT GEOSPATIAL DATA:** Geospatial data provides a geographic dimension to the analysis. The data was insufficient or missing in certain regions, impacting the ability to map and visualize spatial relationships between different entities, such as transportation networks, critical infrastructure, and natural resources. Another example of this is seemingly more relevant to older communities and is exemplified in areas where infrastructure (like stormwater systems) may have been installed but are not mapped within presently available datasets.
    - **Solution to Consider:** Create maps of the areas missing asset data to direct field teams. Utilize permitting systems where possible to extract geospatial data and fill gaps where practicable (for example: stormwater management systems).
- **INCOMPLETE INFRASTRUCTURE AND FACILITIES DATA:** Data within attribute tables were incomplete. This gap affects the assessment of potential

vulnerabilities these critical infrastructures may face due to changing environmental conditions. Including more specific components about each asset within geospatial databases allows for those components to be analyzed in similar studies.

- **Solution to Consider:** Perform department specific assessments on most frequently utilized data, encourage data stewardship, and assign specific "owners" for maintaining data quality. Additionally, assigning a data owner enables the public to interact with a particular person, division, branch, or department rather than the general organization.

- **LACK OF UPDATED NATURAL, CULTURAL, AND HISTORIC RESOURCES DATA:** The existing data for some natural, cultural, and historic resources might be outdated or missing, creating gaps in assessing the impact of climate change and sea-level rise on these resources. This data is traditionally limited to land use inventories, protected species inventories, and protected structures.

    - **Solution to Consider:** Solicit community input on identifying/locating socially and/or culturally significant natural areas, cultural assets, and historic resources within the community. Connecting with people and understanding the landscape from a "boots on the ground" perspective is critical.

- **TERMINOLOGY AND NAMING CONVENTION DISCREPANCIES:** A significant challenge that arose during the gap analysis was discrepancies in naming conventions and terminologies across different data sources. For instance, certain datasets might refer to an asset under a different name or categorize it under a different heading. This inconsistency makes it difficult to ascertain whether a critical asset is truly missing from the data, or whether it's simply listed under a different term.

    - **Solution to Consider:** Coordinate with data providers to clarify what assets are included in each data category. Develop a standardized nomenclature and taxonomy for the assets and facilities. This approach can help reduce ambiguity and ensure a consistent understanding across all data sources. Additionally, consider creating a cross-reference glossary of terminologies used by different data sources to mitigate the risk of overlooking critical assets due to naming discrepancies. This can be done in collaboration with data providers to ensure the terminologies align with industry standards and local context. Information within associated metadata would help future analytics teams.

- **INCONCLUSIVE DATA COVERAGE AND METAINFORMATION:** In some cases, it is unclear whether certain databases include certain types of critical assets. For example, bus stops and routes may be included under the general heading of 'Bus Routes' or 'Streets,' but without more specific information, it is difficult to be sure.

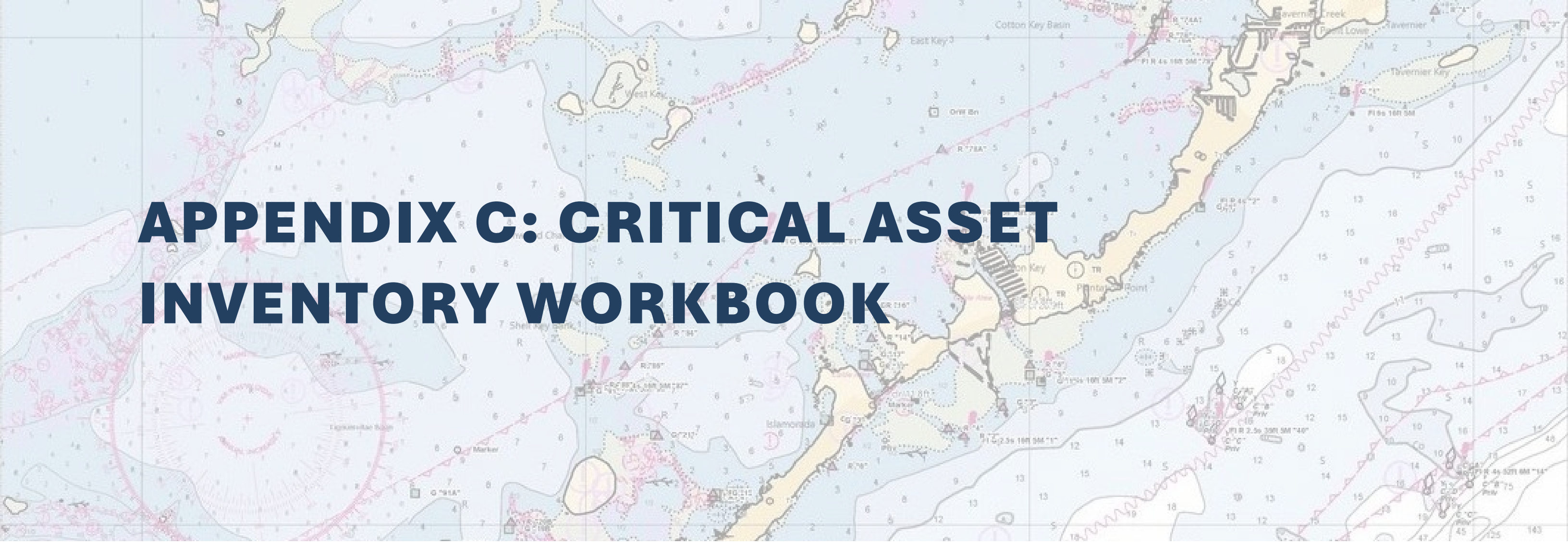
  - **Solution to Consider:** If the data is not available, consider commissioning targeted surveys or studies to gather the necessary data. The development of metadata, providing detailed information about each dataset, can be a great way to enhance understanding of data coverage. Consider including a percentage of total assets mapped under that specific data type as an element of this metadata to help outside consultants understand if they are working with a dataset that contains 25%, 50%, 75%, or some other percentage of that particular asset.

Considering these gaps, the project team utilized a range of strategies to fill as many data voids as practicable within the assessment timeline. This included tapping into additional data sources not previously considered, such as satellite imagery for geospatial data, government records for infrastructure and facilities data, conservation databases for natural, cultural, and historic resources data, and census data for socioeconomic data. Furthermore, the team may have leveraged methods like statistical estimation or modeling to fill in gaps when direct data collection was not feasible. This comprehensive approach ensures a robust, reliable, and inclusive vulnerability assessment.

Complete results are provided as an attachment, under a separate cover.

APPENDIX B: BASELINE ASSET INVENTORY MAPS

Under separate cover.



APPENDIX C: CRITICAL ASSET INVENTORY WORKBOOK

Critical Assets and Regionally Significant Assets

Subsection 380.093, F.S. Compliance

The assessment process aligns with Subsection 380.093, F.S., utilizing the Florida Department of Environmental Protection's Critical Asset List. The categories of data collected, organized into four primary categories, are directly correlated with statutory compliance:

- **Transportation Assets** and evacuation routes, including airports, bridges, bus terminals, ports, major roadways, marinas, rail facilities, and railroad bridges.

Layer Name	Asset Type	Geometry	Count	Regionally Significant	Source
Gas Stations FDACS	fuel stations	point	22	N	FDACS
Ports	port facility	point	1	Y	Homeland Security
Tavernaero Airport Park (Islamorada)	aviation facilities	polygon	1	Y	Village of Islamorada
Bus Route (Islamorada)	bus routes	line	164	N	Village of Islamorada
Bridges (County)	bridges	point	6	Y	Monroe County
Streets (Islamorada)	roadways	line	687	N	Village of Islamorada

- **Critical Infrastructure**, including wastewater treatment facilities and lift stations, stormwater treatment facilities and pump stations, drinking water facilities, water utility conveyance systems, electric production and supply facilities, solid and hazardous waste facilities, military installations, communications facilities, and disaster debris management sites.

Layer Name	Asset Type	Geometry	Count	Regionally Significant	Source
Electric Power Transmission Lines	electric production and supply	line	2	Yes	Homeland Security
Substations	electric production and supply	point	1	Yes	Homeland Security
Sectional Overhead	electric production and supply	line	6,834	No	FKEC
Primary Overhead	electric production and supply	line	2,945	Yes	FKEC
Primary Underground	electric production and supply	line	400	Yes	FKEC
Transformers	electric production and supply	point	1,427	No	FKEC
Substations Generators	electric production and supply	point	1	No	FKEC
Padmount Transformers	electric production and supply	point	130	No	FKEC
Solid Waste Disaster Debris Mgmt Sites	solid and hazardous waste facilities	point	91	Yes	FDEP
Waste Management of the Florida Keys	solid and hazardous waste facilities	point	1	Yes	Village of Islamorada
Broadband Radio Service Towers	communication facilities	point	12	No	Homeland Security
Cellular Towers	communication facilities	point	8	No	Homeland Security

FM Transmission Towers	communication facilities	point	4	No	Homeland Security
Microwave Service Towers	communication facilities	point	26	No	Homeland Security
FKAA Potable Critical Infrastructure	potable water facilities	point	1	Yes	FKAA
FKAA Buildings	potable water facilities	point	2	Yes	FKAA
Potable Water Tank	potable water facilities	polygon	2	Yes	FKAA
Islamorada Potable Water Facility	potable water facilities	point	1	Yes	Monroe County
Potable Water Pump Station	potable water facilities	point	1	No	FKAA
Potable Pressurized Main	potable water facilities	line	1,493	Yes	FKAA
Potable Control Valve	potable water facilities	point	157	No	FKAA
Potable System Valve	potable water facilities	point	840	No	FKAA
Potable Cathodic Protection	potable water facilities	point	95	No	FKAA
Stormwater Structures	stormwater infrastructure	point	206	Yes	Village of Islamorada
Stormwater Inlets	stormwater infrastructure	point	65	No	Village of Islamorada
Stormwater Gravity Main	stormwater infrastructure	line	422	No	Village of Islamorada
Stormwater Detention	stormwater infrastructure	polygon	12	Yes	Village of Islamorada
Sanitary Sewer Low Pressure Pumps	wastewater infrastructure	point	1	No	Village of Islamorada

Sanitary Sewer System Valve	wastewater infrastructure	point	450	No	Village of Islamorada
Sanitary Sewer Control Valve	wastewater infrastructure	point	384	No	Village of Islamorada
Sanitary Sewer Vacuum Vent	wastewater infrastructure	point	542	No	Village of Islamorada
Sanitary Sewer Vacuum Main	wastewater infrastructure	line	18,127	Yes	Village of Islamorada
Sanitary Sewer Pressurized Main	wastewater infrastructure	line	910	Yes	Village of Islamorada
Conveyance Force Main	wastewater infrastructure	line	44	Yes	Village of Islamorada
Sanitary Sewer Low Pressure Main	wastewater infrastructure	line	1	Yes	FKAA

- **Critical Community and Emergency Facilities**, including schools, colleges, universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelter inventory, and state government facilities.

Layer Name	Asset Type	Geometry	Count	Regionally Significant	Source
Evacuation Routes	disaster and emergency infrastructure	line	1	Yes	FDEM
Fire Stations	disaster and emergency infrastructure	point	3	Yes	Homeland Security
EMS Stations	disaster and emergency infrastructure	point	2	Yes	Homeland Security
Islamorada Emergency Facilities	disaster and emergency infrastructure	point	2	Yes	Monroe County
Publicly Owned Parcels	local government facilities	polygon	218	No	Monroe County

Islamorada Government Facilities	libraries	point	1	No	Monroe County
State Government Facilities	state government facilities	point	2	Yes	Village of Islamorada
Prisons	law enforcement and correctional facilities	polygon	1	No	Rest Services
Local Law Enforcement	law enforcement and correctional facilities	point	1	No	Homeland Security
Courthouses	law enforcement and correctional facilities	point	1	No	Homeland Security
Mobile Home Parks	housing	point	6	No	Homeland Security
Nursing Homes	housing	point	1	No	Homeland Security
Low Income Housing Tax Credits	housing	point	1	No	HUD
Pharmacies	health care facilities	point	2	No	Homeland Security
National Shelter System Facilities	disaster preparation and recovery	point	2	Yes	Homeland Security
Islamorada Disaster Facilities	disaster preparation and recovery	point	5	Yes	Monroe County

- **Natural, Cultural, Historical Resources**, including conservation lands, parks, shorelines, surface waters, wetlands, and historical and cultural assets.

Layer Name	Asset Type	Geometry	Count	Regionally Signficant	Source
Habitat	habitat classification	polygon	18	No	Village of Islamorada
Plantation Hammock Preserve	conservation lands	Polygon	2	No	Village of Islamorada

Southwinds Park	parks	Polygon	1	No	Village of Islamorada
Planatation Tropical Preserve	conservation lands	Polygon	3	No	Village of Islamorada
Green Turtle Hammock Nature Preserve	conservation lands	Polygon	5	No	Village of Islamorada
Key Tree Cactus Preserve	conservation lands	Polygon	2	No	Village of Islamorada
Florida State Parks	parks	Polygon	4	No	FDEP
ESI Habitat Regions	habitat classification	Polygon	18	No	FWC
Islamorada Conservation Lands	conservation lands	polygon	30	No	Village of Islamorada
Shorelines	shorelines	line	367	No	FWC
Municipal Parks Points	parks	point	2	No	Village of Islamorada
GPS Points	historical and cultural assets	point	449	No	Village of Islamorada
Historic Structure	historical and cultural assets	point	392	No	FDHR
Florida Wetlands	hydrological environment	polygon	241	No	USFWS

This tabulation informs the resulting asset lists generated within the hot spots within this vulnerability assessment. Collaboration with local government entities will facilitate further identification of critical and regionally significant assets, ensuring a comprehensive assessment of potential climate risks and effective planning for the Village's future.

APPENDIX D: EXPOSURE ANALYSIS - FLOOD VULNERABILITY MAPS

Under separate cover.

APPENDIX E: SENSITIVITY ANALYSIS SUMMARY TABLES AND MAPS

In this appendix, several tables summarize the results of the sensitivity analysis for Islamorada. These tables highlight the susceptibility of various community assets by:

1. **Asset Class:** Detailing the different types and scales of impact on assets at risk from flooding based on flood projections and planning horizons.

AssetClass	Asset Type	Total Features	Average Elevation
Critical Community and Emergency Facilities	USPSPostalOffice, AllPlacesOfWorship, Isla_Critical_Facilities, CountyCriticalFacilities, ChildCareCenters, PrivateSchools, PublicSchools, Isla_Disaster, NationalShelterSystemFacilities, LOWINCOMEHOUSINGTAXCREDITS, NursingHomes, MobileHomeParks, Courthouses, LocalLawEnforcement, StateGovernmentFacilities, Isla_Government, Isla_Emergency, EMSStations	313	2.05143692
Critical Infrastructure	MajorPowerTransmissionLines, PrimaryUnderground, PrimaryOverhead, SectionalOverhead, ElectricPowerTransmissionLines, ssVacuumMain, ssConveyanceForceMain, ssLPS_Main, ssLateral, wRetiredMain, wPressurizedMain, swGravityMain, BroadbandRadioServiceTowers, WasteManagementoftheFloridaKeys, PadmountTransformers, SubstationsGenerators, Substations, PrimaryPullboxes, PrimaryRisers, JunctionCabinets, Transformers, ssFitting, ssVacuumVent, ssVacuumAssetPoints, ssLPS_Pump, ssCleanOut, FKAAPotableCritical, FKAABuildings, FKAAAdminCritical, wTank, wSystemValve, wSamplingStation, wNetworkStructure, wMasterTap, wHydrant, wControlValve, wCathodicProtection, StormwaterStructures, swManhole, swInlet, GasStationsFDACS, DHLFacilities, SolidWasteDisasterDebrisMgmtSites	143963	1.747239553

Natural, Cultural, and Historical Resource	Shorelines, HistoircBridges, TrailHeritageTrail, EXISTINGTRAILS, MunicipalParksPoints, StandingStructures, GPSPoints, HistoricStructure, PublicBeachAccessSites, BoatRamps_County_	4778	1.20457996
Transportation and Evacuation Routes	MO03433OldHwy, EvacuationRoutes, BusRoute_FDOT_, Bridges_FDOT_, Streets_Islamorada_, AviationFacilities, Bridges_County_, MarineFacilities, Ports, Marinas	3472	1.205344893

AssetClass	Asset Type	Total Features	Average Elevation	Present_Day___25yr_24hr_Rainfall_tif	Present_Day___50yr_24hr_Rainfall_tif	Present_Day___100yr_24hr_Rainfall_tif	Present_Day___500yr_24hr_Rainfall_tif	Present_Day___1000yr_24hr_Rainfall_tif	NIH_Present_Day_SLR_HTF	F_2040___25yr_24hr_Rainfall_tif	F_2040___100yr_24hr_Rainfall_tif	NIH_2040_SLR_HTF	NIH_2040_100_Year_Storm_Surge	NIH_2040_500_Year_Storm_Surge	F_2070___25yr_24hr_Rainfall_tif	F_2070___100yr_24hr_Rainfall_tif	NIH_2070_SLR_HTF	NIH_2070_100_Year_Storm_Surge	F_2100___25yr_24hr_Rainfall_tif	F_2100___100yr_24hr_Rainfall_tif	NIH_2100_SLR_HTF	NIH_2100_100_Year_Storm_Surge	NIH_2100_500_Year_Storm_Surge	NIL_Present_Day_SLR_HTF
Critical Community and Emergency Facilities	USPSPostalOffice, Isla_Critical_Facilities, CountyCriticalFacilities, ChildCareCenters, PrivateSchools, PublicSchools, Isla_Disaster, LOWINCOMEHOUSINGTAXCREDITS, NursingHomes, MobileHomeParks, Courthouses, LocalLawEnforcement, StateGovernmentFacilities, Isla_Government, Isla_Emergency, EMSStations	296	2.078191113	25 (02%)	34 (03%)	33 (03%)	34 (03%)	53 (04%)	8 (01%)	25 (02%)	33 (03%)	10 (01%)	305 (0.23%)	306 (0.23%)	25 (02%)	33 (03%)	60 (05%)	306 (0.23%)	25 (02%)	33 (03%)	183 (0.14%)	306 (0.23%)	306 (0.23%)	8 (01%)
Critical Infrastructure	MajorPowerTransmissionLines, PrimaryUnderground, PrimaryOverhead, SectionalOverhead, ElectricPowerTransmissionLines, ssVacuumMain, ssConveyanceForceMain, wRetiredMain, wPressurizedMain, swGravityMain, BroadbandRadioServiceTowers, WasteManagementoftheFloridaKeys, PadmountTransformers, SubstationsGenerators, Substations, PrimaryPullboxes, PrimaryRisers, JunctionCabinets, Transformers, ssFitting, ssVacuumVent, ssVacuumAssetPoints, FKAAPotableCritical, FKAABuildings, FKAAAdminCritical, wTank, wSystemValve, wSamplingStation, wNetworkStructure, wMasterTap, wHydrant, wControlValve, wCathodicProtection, StormwaterStructures, swManhole, swInlet, GasStationsFDACS, SolidWasteDisasterDebrisMgmtSites	123672	1.703141141	12170 (9.29%)	13496 (10.31%)	14631 (11.17%)	18230 (13.92%)	66361 (50.68%)	4781 (3.65%)	13149 (104%)	16020 (12.23%)	19053 (14.55%)	120244 (91.82%)	120832 (92.27%)	13149 (104%)	16020 (12.23%)	66456 (50.75%)	120874 (92.30%)	13149 (104%)	16020 (12.23%)	95078 (72.61%)	121153 (92.52%)	121169 (92.53%)	1171 (0.89%)
Natural, Cultural, and Historical Resource	Shorelines, HistoircBridges, TrailHeritageTrail, MunicipalParksPoints, StandingStructures, GPSPoints, HistoricStructure, PublicBeachAccessSites, BoatRamps_County_	4056	1.20457996	373 (0.28%)	392 (0.30%)	466 (0.36%)	579 (0.44%)	1676 (1.28%)	214 (0.16%)	365 (0.28%)	552 (0.42%)	688 (0.53%)	3864 (2.95%)	3877 (2.96%)	365 (0.28%)	552 (0.42%)	1691 (1.29%)	3878 (2.96%)	365 (0.28%)	552 (0.42%)	2914 (2.23%)	3881 (2.96%)	3881 (2.96%)	133 (0.10%)
Transportation and Evacuation Routes	MO03433OldHwy, EvacuationRoutes, BusRoute_FDOT_, Bridges_FDOT_, Streets_Islamorada_, MarineFacilities, Marinas	2928	1.353224228	441 (0.34%)	450 (0.34%)	529 (0.40%)	654 (0.50%)	1932 (1.48%)	343 (0.26%)	432 (0.33%)	561 (0.43%)	754 (0.58%)	2882 (2.20%)	2892 (2.21%)	432 (0.33%)	561 (0.43%)	1849 (1.41%)	2893 (2.21%)	432 (0.33%)	561 (0.43%)	2443 (1.87%)	2895 (2.21%)	2903 (2.22%)	178 (0.14%)

2. **Hot Spot Area:** The tables associated with the prioritized asset lists identify the assets at risk within the identified hot spot areas detail the asset's risk to sea-level rise, storm surge, and rainfall.

Asset Type	# of Assets	Present_Day___25yr_24hr_Rainfall_tif	Present_Day___50yr_24hr_Rainfall_tif	Present_Day___100yr_24hr_Rainfall_tif	Present_Day___500yr_24hr_Rainfall_tif	Present_Day___1000yr_24hr_Rainfall_tif	NIH_Present_Day_SLR_HTF	F_2040___25yr_24hr_Rainfall_tif	F_2040___100yr_24hr_Rainfall_tif	NIH_2040_SLR_HTF	NIH_2040_500_Year_Storm_Surge	F_2070___25yr_24hr_Rainfall_tif	F_2070___100yr_24hr_Rainfall_tif	NIH_2070_SLR_HTF	NIH_2070_100_Year_Storm_Surge	NIH_2100_SLR_HTF	NIH_2100_100_Year_Storm_Surge	F_2100___100yr_24hr_Rainfall_tif
MajorPowerTransmissionLines	16	16	16	16	16	16	8	16	16	16	16	16	16	16	16	16	16	16
PrimaryUnderground	1520	330	349	357	599	1154	159	309	485	242	1699	309	485	1101	1699	1454	1707	485
PrimaryOverhead	8392	1196	1286	1437	1717	5663	547	1219	1586	1692	9793	1219	1586	5510	9794	8008	9819	1586
SectionalOverhead	19040	1796	1941	2149	2666	11406	777	1819	2384	3062	19230	1819	2384	11292	19260	16077	19334	2384
ElectricPowerTransmissionLines	16	16	16	16	16	16	8	16	16	16	16	16	16	16	16	16	16	16
ssVacuumMain	70688	6386	7228	7717	9857	31282	1997	7162	8469	9462	62290	7162	8469	31819	62297	47721	62409	8469
ssConveyanceForceMain	144	34	42	45	44	84	44	42	45	79	113	42	45	92	113	93	113	45
wRetiredMain	112	11	11	11	11	188	5	11	11	61	210	11	11	182	210	194	210	11
wPressurizedMain	4528	782	864	939	1063	3298	354	878	961	870	5371	878	961	3260	5371	4153	5372	961
swGravityMain	1992	0	6	6	13	460	104	6	6	104	1743	6	6	524	1743	1119	1743	6
Shorelines	832	35	43	46	56	192	92	43	56	139	183	43	56	174	183	182	183	56
HistoircBridges	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	8	8	0
MO03433OldHwy	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
EvacuationRoutes	8	8	8	8	8	8	0	8	8	8	8	8	8	8	8	8	8	8
BusRoute_FDOT_	8	0	0	0	8	8	0	0	0	8	8	0	0	8	8	8	8	0
Bridges_FDOT_	8	0	0	0	0	13	0	0	0	0	9	0	0	0	9	0	10	0
Streets_Islamorada_	2432	395	404	481	579	1366	199	386	503	493	2253	386	503	1325	2253	1848	2254	503
TrailHeritageTrail	80	34	42	50	50	76	17	42	50	27	95	42	50	62	95	85	98	50

BroadbandRadioServiceTowers	192	0	0	0	0	192	0	0	0	0	192	0	0	192	192	192	192	0
USPSPostalOffice	16	0	0	0	0	0	0	0	0	0	16	0	0	0	16	16	16	0
WasteManagementoftheFloridaKeys	16	0	0	0	0	0	0	0	0	0	16	0	0	0	16	16	16	0
PadmountTransformers	440	49	57	73	89	342	9	57	73	54	514	57	73	356	514	432	515	73
SubstationsGenerators	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	8	0
Substations	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	8	0
PrimaryPullboxes	176	17	17	17	42	98	16	9	25	18	192	9	25	99	192	166	200	25
PrimaryRisers	312	40	49	49	73	206	9	41	57	25	354	41	57	180	354	255	354	57
JunctionCabinets	16	0	0	0	0	17	0	0	0	0	19	0	0	8	19	18	19	0
Transformers	4024	481	513	555	626	2958	126	472	584	622	4934	472	584	2907	4936	3996	4947	584
ssFitting	2344	284	301	349	384	2016	207	285	366	868	2576	285	366	2008	2576	2193	2576	366
ssVacuumVent	1680	16	16	16	17	1686	78	8	16	539	2004	8	16	1693	2004	1876	2012	16
ssVacuumAssetPoints	2360	107	123	157	189	2119	145	123	158	610	2924	123	158	2097	2925	2505	2935	158
FKAAPotableCritical	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	8	0
FKAABuildings	16	0	0	0	0	0	0	0	0	0	16	0	0	0	16	0	16	0
FKAAAdminCritical	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	8	0
wTank	16	0	0	0	0	0	0	0	0	0	16	0	0	0	16	0	16	0
wSystemValve	3056	329	347	395	447	1667	75	363	419	352	3511	363	419	1639	3511	2359	3512	419
wSamplingStation	88	8	8	9	9	66	1	8	9	17	110	8	9	64	110	82	110	9
wNetworkStructure	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	8	0
wMasterTap	128	2	2	2	2	74	1	2	2	9	150	2	2	67	150	95	150	2
wHydrant	416	50	50	51	51	222	9	50	51	49	493	50	51	219	493	343	493	51
wControlValve	360	17	17	17	18	317	27	17	17	94	472	17	17	301	472	404	472	17
wCathodicProtection	200	0	0	2	2	115	9	0	2	30	234	0	2	119	235	159	248	2
StormwaterStructures	600	199	232	241	274	398	34	231	257	116	727	231	257	380	727	517	729	257
swManhole	248	0	0	0	0	80	8	0	0	8	250	0	0	72	250	209	250	0
swInlet	368	0	1	1	1	93	0	1	1	0	387	1	1	110	387	248	387	1
MunicipalParksPoints	8	0	0	0	0	8	0	0	0	0	8	0	0	0	8	8	8	0
StandingStructures	8	0	0	0	0	2	0	0	0	0	11	0	0	2	11	10	11	0
GPSPoints/HistoricStructures	1576	154	155	186	238	749	59	137	220	301	1825	137	220	767	1826	1366	1826	220
HistoricStructure	1520	141	143	175	226	624	29	134	217	204	1722	134	217	661	1722	1230	1722	217
Isla_Critical_Facilities	40	8	8	8	8	8	0	8	8	0	40	8	8	16	40	32	40	8
CountyCriticalFacilities	80	8	8	8	8	9	0	8	8	0	81	8	8	16	81	33	81	8
ChildCareCenters	8	0	0	0	0	0	0	0	0	0	9	0	0	0	9	9	9	0

PrivateSchools	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	8	8	0
PublicSchools	16	0	8	8	8	8	0	0	8	0	18	0	8	0	18	8	18	8
Isla_Disaster	40	8	8	8	8	8	0	8	8	0	40	8	8	16	40	32	40	8
LOWINCOMEHOUSINGTAXCREDITS	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	8	8	0
NursingHomes	8	0	0	0	0	8	0	0	0	0	8	0	0	0	8	8	8	0
MobileHomeParks	16	1	2	1	2	3	0	1	1	2	20	1	1	3	20	11	20	1
Courthouses	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	8	8	0
LocalLawEnforcement	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	8	0
StateGovernmentFacilities	8	0	0	0	0	9	8	0	0	8	9	0	0	9	9	9	9	0
Isla_Government	8	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	8	0
Isla_Emergency	16	0	0	0	0	0	0	0	0	0	16	0	0	0	16	0	16	0
EMSStations	8	0	0	0	0	0	0	0	0	0	9	0	0	0	9	1	9	0
GasStationsFDACS	72	1	1	1	1	55	0	1	1	0	85	1	1	54	85	64	85	1
PublicBeachAccessSites	8	0	0	0	0	8	0	0	0	0	8	0	0	8	8	8	8	0
MarineFacilities	264	29	29	31	42	309	111	29	33	173	346	29	33	295	347	326	347	33
BoatRamps_County_	16	9	9	9	9	17	17	9	9	17	17	9	9	17	17	17	17	9
Marinas	200	1	1	1	9	220	25	1	9	64	260	1	9	205	260	245	260	9
SolidWasteDisasterDebrisMgmtSites	56	3	3	3	3	73	24	3	3	38	135	3	3	79	135	98	140	3

The map series and additional summary tables are provided under separate cover.

APPENDIX F: GIS DATA STANDARDS - METADATA AND MODELING LIMITATIONS

Resilient Florida Planning Grants GIS Data Standards

Pursuant to Section 380.093 (3)(c), Florida Statutes, grantees who receive funding to complete a vulnerability assessment shall submit to the Florida Department of Environmental Protection (DEP) all electronic mapping data used to illustrate the flooding and sea level rise impacts identified in the assessment. The grantees shall also submit the associated metadata for each geospatial item. These items must be compatible with DEP's Geographic Information System (GIS) infrastructure and tools and mapping coordinate reference systems. To aid in the compliance with this requirement, the following list has been compiled of acceptable digital data formats, metadata standards and required mapping datums.

Digital File Formats:

- Vector Data Formats:
    - File Geodatabase Feature Class - Feature classes are homogeneous collections of common features, each having the same spatial representation, and containing both the geometric shape of each feature as well as descriptive attributes. Feature classes can only be stored inside a geodatabase. This is an Esri proprietary format.
    - Shapefile - A shapefile is a vector data storage format that stores the location, shape, and attributes of geographic features with the same geometry type and the same spatial reference. This is an Esri proprietary format.

    - KML - is an XML notation for expressing geographic annotation and visualization within two-dimensional maps and three-dimensional Earth browsers, initially developed for use with Google Earth. This in an open standard format.
    - GeoJSON - GeoJSON is a geospatial data interchange format designed to represent simple geographic features and their nonspatial attributes, based on JavaScript Object Notation (JSON). This in an open standard format.
- Raster Data Formats:
    - File Geodatabase Raster - Native data model for storing raster datasets inside a geodatabase. This is an Esri proprietary format.
    - TIFF/GeoTIFF - A TIFF is an image file format for storing raster graphic images. GeoTIFF is a is a metadata standard which allows georeferencing information to be embedded within a TIFF raster file. These are open standard formats.
    - Other - For a more detailed list of acceptable raster formats, please see *Supported Raster Formats* reference link.
- Data Package Formats:
    - Esri Project Package - A project package is a file that contains all maps and the data referenced by its layers, as well as folder connections, toolboxes, geoprocessing history, and attachments. This is an Esri proprietary format.
    - OGC GeoPackage - A GeoPackage is a platform-independent and standards-based data format for transferring geospatial information, implemented as an SQLite database container. This in an open standard format.

Datums and Coordinate Reference Systems:

- Geospatial data shall be delivered projected into the appropriate Florida State Plane Coordinate System.
- Horizontal Datum: North American Datum of 1983 with 1990 Adjustments (NAD83/90), or later.
- Vertical Datum: North American Vertical Datum of 1988 (NAVD88).

Metadata Standards:

- Metadata shall be compliant with the *Content Standard for Digital Geospatial Metadata* (CSDGM) developed by the Federal Geographic Data Committee (FGDC). Acceptable formats are:

- File Geodatabase FGDC-CSDGM Metadata - format for creating and editing the metadata of Esri items. The metadata is embedded in the item it describes. This is an Esri proprietary format.
- XML - Extensible Markup Language (XML) is a markup language and file format for storing, transmitting, and reconstructing arbitrary data. This in an open standard format.

- The Department encourages metadata to include the following information, as applicable:
  - Title - Name for the dataset.
  - Summary - Short summary of what the dataset represents.
  - Description - Basic information about the dataset and its purpose.
  - Process Summary - Steps in creating the dataset or layer.
  - Dates of Data Collection - Collection date of the dataset.
  - Date of Publication - Date of publishing or last update of the dataset.
  - Contact Person - Person responsible of the maintenance of the dataset.
  - Credits - Person or entity responsible for the compiling the dataset.
  - Use Limitation - Restrictions or legal prerequisites to using the dataset.

Critical Assets Attributes

- To standardize information for all the critical assets across the state, delivered critical asset datasets should have following attributes, as applicable:
  - Entity Name - Name of entity (i.e., County, Village, local government, etc).
  - Asset Name - Asset label or description (i.e., hydrant, stormwater pipe, cell tower, etc).
  - Asset Type - Statutory asset type (i.e., airports, bridges, roadways, marinas, etc).
  - Asset Class - Statutory asset group (i.e., transportation and evacuation route, critical infrastructure, critical community and emergency facilities, etc).
  - Asset Owner/Operator - The owner or maintainer of the asset.
  - Asset Elevation - Elevation of the asset.
  - Asset Size/Capacity Data (i.e., capacity for wastewater facilities, acres, etc.)

- <u>Asset Unique ID</u> - Unique identifier of the asset.

Pursuant to 380.093(2) Definitions, **Asset Type** refers to the individual asset, and **Asset Class** refers to the broader asset category. See classification table below:

Asset Type	**Asset Class**
Airports	Transportation and Evacuation Routes
Bridges	Transportation and Evacuation Routes
Bus Terminals	Transportation and Evacuation Routes
Ports	Transportation and Evacuation Routes
Major Roadways	Transportation and Evacuation Routes
Marinas	Transportation and Evacuation Routes
Rail Facilities	Transportation and Evacuation Routes
Railroad Bridges	Transportation and Evacuation Routes
Wastewater Treatment Facilities and Lift Stations	Critical Infrastructure
Stormwater Treatment Facilities and Pump Stations	Critical Infrastructure
Drinking Water Facilities	Critical Infrastructure
Water Utility Conveyance Systems	Critical Infrastructure
Electric Production and Supply Facilities	Critical Infrastructure
Solid and Hazardous Waste Facilities	Critical Infrastructure
Military Installations	Critical Infrastructure
Communications Facilities	Critical Infrastructure
Disaster Debris Management Sites	Critical Infrastructure
Schools	Critical Community and Emergency Facilities

Asset Type	Asset Class
Colleges and Universities	Critical Community and Emergency Facilities
Community Centers	Critical Community and Emergency Facilities
Correctional Facilities	Critical Community and Emergency Facilities
Disaster Recovery Centers	Critical Community and Emergency Facilities
Emergency Medical Service Facilities	Critical Community and Emergency Facilities
Emergency Operation Centers	Critical Community and Emergency Facilities
Fire Stations	Critical Community and Emergency Facilities
Health Care Facilities	Critical Community and Emergency Facilities
Hospitals	Critical Community and Emergency Facilities
Law Enforcement Facilities	Critical Community and Emergency Facilities
Local Government Facilities	Critical Community and Emergency Facilities
Logistical Staging Areas	Critical Community and Emergency Facilities
Affordable Public Housing	Critical Community and Emergency Facilities
Risk Shelter Inventory	Critical Community and Emergency Facilities
State Government Facilities	Critical Community and Emergency Facilities
Conservation Lands	Natural, Cultural, and Historical Resource
Parks	Natural, Cultural, and Historical Resource
Shorelines	Natural, Cultural, and Historical Resource
Surface Waters	Natural, Cultural, and Historical Resource
Wetlands	Natural, Cultural, and Historical Resource
Historical and Cultural Assets	Natural, Cultural, and Historical Resource

Critical Asset Inventory.gdb

Overview

Item Description

Title

Critical Asset Inventory(.gdb)

Tags

Sea Level Rise, Vulnerability Assessment, Transportation Assets, Evacuation Routes, Islamorada, Florida, environment, location, planningCadastre, society, structure, transportation, economy, utilities, Communication

Summary (Purpose)

This geodatabase focuses on critical community and emergency response assets to assess vulnerabilities related to sea level rise in Islamorada, FL.

Description (Abstract)

This specialized database is intended for Village planners, emergency services, and policymakers, offering targeted insights into the impact of sea level rise on critical community and emergency response facilities in Islamorada, FL.

Use Limitation

The data presented in this critical asset database are provided "as is" and based on the best available data, rigorous verification procedures, and in-depth research at the time of preparation. While the project exercised appropriate levels of due diligence, the project team cannot guarantee the accuracy, completeness, or applicability of this critical asset database to all situations. By utilizing the data and recommendations provided in this critical asset database, stakeholders and community members acknowledge and release the community, its partners, and consultants from any liability for damages, losses, or consequences that may arise from their use, interpretation, or implementation.

Topics and Keywords

Topic Categories

Economy, Environment, Location, Planning Cadastre, Society, Structure, Transportation, Utilities Communication

Theme Keywords

Sea Level Rise, Vulnerability Assessment, Transportation Assets, Evacuation Routes, Islamorada, FL

Thesaurus Citation

ISO 19115 Topic Categories

Citation

Title

Critical Asset Inventory

Publication Date

Published 2024-03-31 @00:00:00

Citation Contacts

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Organization:

Clearview Geographic, LLC.

Role:

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Metadata

Contacts:

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Role:

Point of Contact

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City:

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State:

FL

Postal Code:

32720

Country:

United States

Phone:

386-957-2314

Hours:

9 AM - 5 PM Eastern Time

Maintenance:

Update frequency

Not Planned

Constraints

Use **Limitation**

The data presented in this critical asset database are provided "as is" and based on the best available data, rigorous verification procedures, and in-depth research at the time of preparation. While the project exercised appropriate levels of due diligence, the project team cannot guarantee the accuracy, completeness, or applicability of this critical asset database to all situations. By utilizing the data and recommendations provided in this critical asset database, stakeholders and community members acknowledge and release the community, its partners, and consultants from any liability for damages, losses, or consequences that may arise from their use, interpretation, or implementation.

Resource

Details

Status **Code**:

Completed

Credit:

Data aggregated from relevant sources including the Department of Homeland Security, Florida Division of Emergency Management, Florida Department of Transportation, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, Florida Geographic Data Library, Florida Geographic Information Office, and other publicly available sources.

Description

Islamorada, FL

Temporal Instant Extent

2024-03-31, 00:00:00

Points of Contact:

Name:

Alex Zelenski, GISP

Organization:

Clearview Geographic, LLC.

Role:

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State:

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Postal Code:

32720

Country:

United States

Phone:

386-957-2314

Hours:

9 AM - 5 PM Eastern Time

Maintenance

Update **Frequency**:

Not Planned

Constraints

Use **Limitation**

The data presented in this critical asset database are provided "as is" and based on the best available data, rigorous verification procedures, and in-depth research at the time of preparation. While the project exercised appropriate levels of due diligence, the project team cannot guarantee the accuracy, completeness, or applicability of this critical asset database to all situations. By utilizing the data and recommendations provided in this critical asset database, stakeholders and community members acknowledge and release the community, its partners, and consultants from any liability for damages, losses, or consequences that may arise from their use, interpretation, or implementation.

Quality

Scope Level

Dataset

Report

Type: Conceptual Consistency

Measure, Description: Logical Consistency: Varies by original data provider but data was vetted to be applicable to planning study via comprehensive review.

Report

Type: Completeness Omission

Measure, Description:

Spatial Resolution: Varies by original data provider.

Attribute Accuracy: Varies by original data provider but data was vetted to be applicable to planning study via comprehensive review.

Depth Grids.gdb

Overview

Item Description

Title

Depth Grid - Exposure Analysis Inventory

Tags

Climate Change, Sea Level Rise, High Tide, Storm Surge, Rainfall-Induced Flooding, Compound Flooding, Vulnerability Assessment, Islamorada, Florida, Resilience Planning, Emergency Response, Flood Risk Management

Summary (Purpose)

This geodatabase is designed to encapsulate a comprehensive exposure analysis of Islamorada, FL, against the backdrop of climate change impacts. It integrates future high tide modeling, storm surge projections, rainfall-induced flooding evaluations, and compound flooding assessments to identify vulnerabilities across critical assets and infrastructure.

Description (Abstract)

Developed for urban planners, emergency managers, and decision-makers, this database provides an in-depth analysis of potential future flooding scenarios due to sea level rise, enhanced high tides, storm surges, and increased rainfall events. By leveraging advanced modeling techniques and a wide array of data sources, it offers a nuanced understanding of climate-induced risks, aiding in the development of targeted adaptation and resilience strategies.

Use Limitation

Data within this geodatabase are offered "as is," derived from extensive data collection, rigorous validation, and sophisticated modeling efforts. While comprehensive due diligence has been applied, accuracy, completeness, or suitability for all contexts cannot be guaranteed. Users acknowledge the inherent limitations and agree to absolve the creators of liability for any use or interpretation of the data.

Topics and Keywords

Topic Categories

Climate Change Adaptation, Flood Risk Management, Urban Planning, Emergency Preparedness, Infrastructure Resilience

Theme Keywords

Sea Level Rise, Future High Tide, Storm Surge, Rainfall-Induced Flooding, Compound Flooding Assessment, Islamorada, Climate Change Vulnerability, Critical Asset Protection

Thesaurus Citation

ISO 19115 Topic Categories

Citation

Title

Exposure Analysis Inventory/Depth Grids .tifs

Publication Date

Published 2024-03-31 @00:00:00

Citation Contacts

Name:

Alex Zelenski, GISP

Organization:

Clearview Geographic, LLC.

Role:

Originator

Metadata

Contacts:

Name:

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Role:

Point of Contact

Address Type:

Both

Address:

344 S. Woodland Blvd

City:

Deland

State:

FL

Postal Code:

32720

Country:

United States

Phone:

386-957-2314

Hours:

9 AM - 5 PM Eastern Time

Maintenance:

Update frequency

Not Planned

Constraints

Use Limitation

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Resource

Details

Status Code:

Completed

Credit:

Data aggregated from relevant sources including the Department of Homeland Security, Florida Division of Emergency Management, Florida Department of Transportation, Florida Department of Environmental Protection, Florida Fish and

Wildlife Conservation Commission, Florida Geographic Data Library, Florida Geographic Information Office, and other publicly available sources.

Description

Islamorada, FL

Temporal Instant Extent

2024-03-31, 00:00:00

Points of Contact:

Name:

Alex Zelenski, GISP

Organization:

Clearview Geographic, LLC.

Role:

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Quality

Scope Level

Dataset

Report

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Prioritized Asset Inventory.gdb

Overview

Item Description

Title

Prioritized Asset Inventory (.gdb)

Tags

Sea Level Rise, Vulnerability Assessment, Transportation Assets, Evacuation Routes, Islamorada, Florida, environment, location, planningCadastre, society, structure, transportation, economy, utilities, Communication

Summary (Purpose)

The Prioritized Asset Inventory geodatabase is crafted to highlight and assess the vulnerabilities of key community and emergency response assets within Islamorada, FL, in the face of sea level rise and associated climate change impacts. This database aims to prioritize assets based on their criticality, aiding in strategic planning and resource allocation for resilience efforts..

Description (Abstract)

Designed for use by Village planners, emergency services, and policymakers, this database provides a focused overview of how sea level rise may impact essential services and infrastructure. It facilitates a targeted approach to enhancing resilience, emphasizing the prioritization of assets critical to community safety and sustainability.

Use Limitation

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Topics and Keywords

Topic Categories

Economy, Environment, Location, Planning Cadastre, Society, Structure, Transportation, Utilities Communication

Theme Keywords

Sea Level Rise, Vulnerability Assessment, Transportation Assets, Evacuation Routes, Islamorada, FL

Theme Keywords

environment

location

planning Cadastre

society

structure

transportation

economy

utilities Communication

Thesaurus Citation

ISO 19115 Topic Categories

Citation

Title

Prioritized Asset Inventory

Publication Date

Published 2024-03-31 @00:00:00

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Role:

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Update frequency

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Resource

Details

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Modeling Limitations

The examination of the limitations inherent to modeling, encompassing considerations such as this project's timeline, budget, scale, and objectives, is crucial for understanding the scope of the project, approach to the assessment, and its applicability in other areas of planning.

Hydrological models, which are designed to provide a macroscopic overview of water movement, focus on general aspects like the location, quantity, and flow paths of water. These models operate within the spatial and temporal scales pertinent to the studied system, offering a broad-brush depiction that overlooks the complexities of detailed flow dynamics, such as eddies or turbulence. They are built on foundational assumptions about processes like runoff, infiltration, and evapotranspiration, which may lead to a lack of precision in capturing localized variations or swift alterations in water movement.

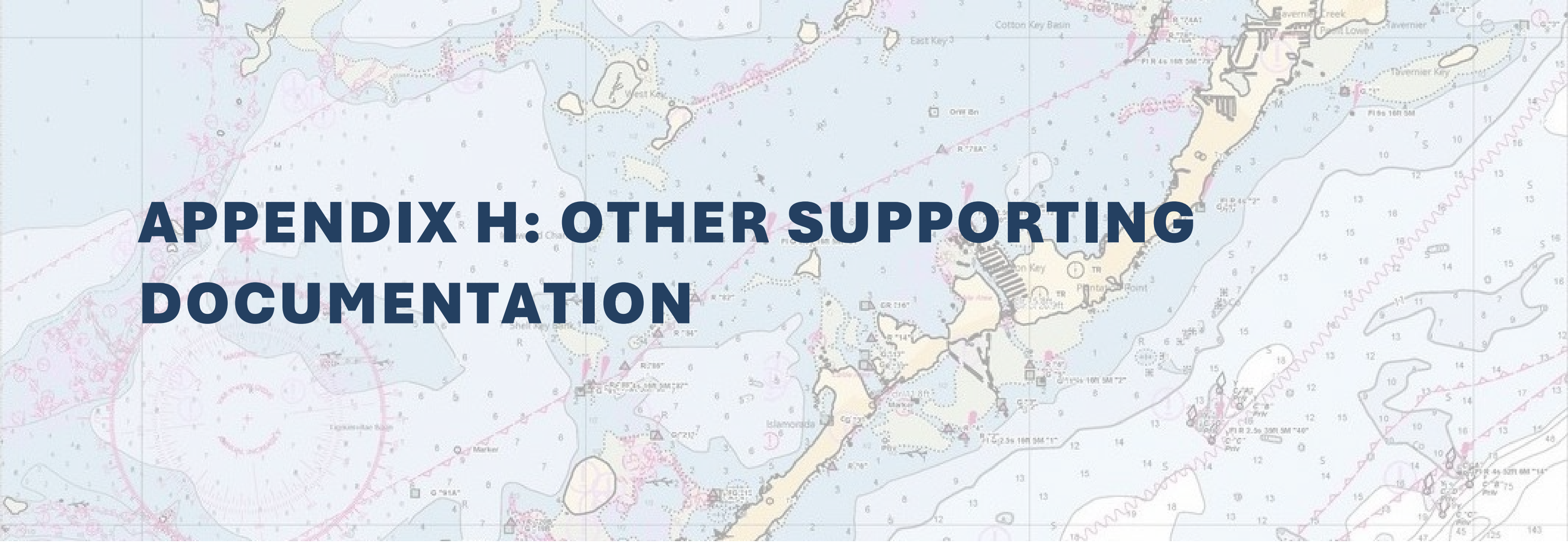
On the other hand, hydrodynamic models delve into the minutiae of water flow by directly solving the fundamental fluid dynamics equations, for instance, the Navier-Stokes equations. These models are distinguished by their capacity to simulate intricate flow behaviors, including turbulence, wave interactions, and sediment dynamics, necessitating significant computational resources due to their focus on fine-scale features. The accuracy of hydrodynamic models hinges on the precise definition of boundary and initial conditions, offering detailed insights at the expense of greater resource demands. The constraints of the current assessment's timeline, budget, and scope precluded the application of hydrodynamic models.

Hydraulic models are specialized for analyzing fluid movement within controlled environments like channels, pipes, or engineered structures, addressing aspects of water transport and hydraulic responses. These models presuppose certain conditions regarding the geometry of channels, surface roughness, and flow boundaries. Although many hydraulic models assume steady-state flow, this simplification may not adequately reflect the reality of transient phenomena. Additionally, the omission of sediment transport in some models can further limit their applicability. The reliability of hydraulic modeling is heavily dependent on the quality of input data, such as cross-sectional profiles of water bodies.

A notable challenge in this project was the scarcity of readily available hydrological and hydraulic modeling results that could certainly bolster efforts to provide accurate, precise, and reliability-tested flood depths for the analysis of potential future scenarios, particularly concerning rainfall-induced flooding and combined flood events. This gap underscores the need for a strategic approach to data gathering, model selection, multi-departmental and multi-consulting team collaborations, ensuring that the chosen models align with the Village’s resilience adaptation goals while acknowledging the inherent limitations of each modeling framework as work to merge and corroborate modeling outputs is conducted.

APPENDIX G: DRAFT AND FINAL LISTS OF CRITICAL ASSETS

Draft and final lists of critical assets are provided under separate cover.



APPENDIX H: OTHER SUPPORTING DOCUMENTATION