PUERTO RICO
PLANNING BOARD
GOVERNMENT OF PUERTO RICO

2026

LOCAL HAZARD MITIGATION PLAN

Municipality of Utuado

CIUDAD DEL VIVÍ

LOCAL HAZARD MITIGATION PLANS

Protect Through Planning

PROFESSIONAL LICENSED PLANNER CERTIFICATION

As per Act 160-1996 as amended (20 L.P.R.A § 3501 - 20 L.P.R.A § 3515), I _____, who bears Puerto Rico professional planning license number ___, certify that this document was prepared using the best available sources and in accordance with the best practices of the planning profession as of _____, 2026. I certify this document herewith my professional seal.

FEMA APPROVAL

This Local Hazard Mitigation Plan for the Municipality of Utuado was approved by FEMA on

_____

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Statement of Funding

This Local Hazard Mitigation Plan was prepared for the Municipality of Utuado and the Puerto Rico Planning Board by the consulting firm AtkinsRéalis Caribe, LLP as per the stipulations of contract number 2026-000032 and any amendment thereof, duly registered in Puerto Rico's Office of the Comptroller.

Language Requirement

In accordance with Presidential Executive Order #14224, the 2026 version of the Utuado Local Hazard Mitigation Plan has been prepared in English for submission to FEMA and FEMA's review.

A non-certified Spanish translation of the final draft for public discussion and of the final approved LHMP was prepared for the benefit of the population with limited English proficiency.

Should any discrepancy arise between the English and the Spanish text, the English version shall prevail.

Statement on Maps

The maps presented in this document are related to a planning exercise. These maps are not intended to establish any regulatory requirement, procedure, or benefit.

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List of Acronyms

ABFE	Advisory Base Flood Elevation
ACS	American Community Survey
AMMED	Municipal Agency for Disaster and Emergency Management, by its Spanish acronym
BFE	Base Flood Elevation
BLE	Base Flood Engineering
BRIC	Building Resilient Infrastructure and Communities
CDBG-DR	Community Development Block Grant - Disaster Recovery
CDBG-MIT	Community Development Block Grant - Mitigation
CEACC	Committee of Experts and Advisors on Climate Change
COR3	Central Office for Recovery, Reconstruction and Resiliency
CRS	Community Rating System
DEM	Digital Elevation Model
DHS	Department of Homeland Security
DNER	Department of Natural and Environmental Resources
DPS	Department of Public Safety
DTOP	Department of Transportation and Public Works
EAL	Expected Annual Loss
EOP	Emergency Operation Plan
EPA	Environmental Protection Agency

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FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
HMGP	Hazard Mitigation Grant Program
HUD	U.S. Department of Housing and Urban Development
IFRC	International Federation of the Red Cross
IRRM	Interim Risk Reduction Measures
LHMP	Local Hazard Mitigation Plan
LUMA	Luma Energy
MHHW	Mean Higher High Water
mph	Miles per hour
MSL	Mean Sea Level
NCEI	National Centers for Environmental Information
NDRF	National Disaster Recovery Framework
NID	National Inventory Dams
NIMS	National Incident Management System
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NTHMP	National Tsunami Hazard Mitigation Program
OMME	Municipal Emergency Management Office
OPM	Municipal Public Works, by its Spanish acronym
PRASA	Puerto Rico Aqueduct and Sewers Authority
PREMB	Puerto Rico Emergency Management Bureau
PREPA	Puerto Rico Electric Power Authority
PRHTA	Puerto Rico Highway and Transportation Authority
PRPB	Puerto Rico Planning Board
PRSN	Puerto Rico Seismic Network
PT	Territorial Plan, by its Spanish acronym
PUT-PR	Puerto Rico Land Use Plan, by its Spanish acronym
SHMO	State Hazard Mitigation Officer
SFLA	Southern Federal Land Assessment

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UHI	Urban Heat Island
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
USGS	United States Geological Survey
VSL	Value of Statistical Life

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Executive Summary

This document is the 2026 update of the Local Hazard Mitigation Plan (LHMP) for the Municipality of Utuado, Puerto Rico. It identifies the natural hazards that may affect the municipality, evaluates risks to people, housing, infrastructure, natural and cultural resources, and FEMA Community Lifelines, and establishes mitigation strategies intended to reduce future losses and strengthen long-term resilience. The plan was prepared in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the Disaster Mitigation Act of 2000, and 44 CFR Part 201 through a coordinated process involving the Municipality of Utuado, the Puerto Rico Planning Board, the Planning Committee, stakeholders, and the public. The update was funded through the Puerto Rico Planning Board and prepared by AtkinsRéalis Caribe, LLP.

Introduction and Background

The Municipality of Utuado and the Puerto Rico Planning Board undertook this update to provide a coordinated framework for reducing hazard-related risks and protecting residents, property, infrastructure, natural and cultural resources, and essential services. The 2026 LHMP incorporates current planning requirements, updated technical information, the 2020–2024 American Community Survey (ACS) Five-Year Estimates, FEMA Community Lifelines, and consideration of changing future conditions. Adoption and FEMA approval of the plan will maintain the municipality's eligibility for applicable federal hazard-mitigation assistance.

The primary objectives of the plan are to identify and evaluate the natural hazards that threaten Utuado; establish actions that reduce risks to life, property, infrastructure, and essential services; integrate mitigation into municipal planning and investment decisions; and promote interagency coordination and meaningful community participation.

Public Policy

The LHMP is guided by federal laws, regulations, and programs governing mitigation planning, floodplain management, disaster recovery, earthquake risk reduction, dam safety, and incident management. Principal authorities include the Stafford Act, the Disaster Mitigation Act of 2000, the National Flood Insurance Act, 44 CFR Part 201, FEMA's Local Mitigation Planning Policy Guide and Local Mitigation Planning Handbook, the

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National Disaster Recovery Framework, the National Earthquake Hazards Reduction Program, the National Dam Safety Program, the National Flood Insurance Program, and the National Incident Management System.

Puerto Rico Policies

The plan also recognizes Puerto Rico laws and planning instruments that affect mitigation, land use, permitting, resilience, and municipal authority. These include Act No. 161-2009, as amended; Act No. 33-2019, as amended; Act No. 107-2020, as amended, known as the Puerto Rico Municipal Code; the Puerto Rico Land Use Plan; the 2021 Puerto Rico State Natural Hazard Mitigation Plan; the Puerto Rico Mitigation Action Plan for CDBG-MIT funds; applicable permitting and flood-hazard regulations; and the municipality's existing plans, regulations, emergency-management procedures, and capital-investment mechanisms.

Planning Process

The 2026 LHMP update follows FEMA guidance and was developed through coordination among the Municipality of Utuado, the Puerto Rico Planning Board, the Planning Committee, stakeholders, and the public. Public participation included notifications, online and printed outreach, opportunities to submit comments, and three planned community meetings. Input received during the first public meeting identified concerns involving deteriorated bridges, clogged drainage, limited emergency access, flooding, runoff, landslides, erosion, fallen trees and utility poles, wildfire risk, and community isolation. The plan also applies to the FEMA Lifelines framework to evaluate essential services and potential cascading impacts.

Municipal Profile

Utuado is in Puerto Rico's west-central mountainous interior within the Cordillera Central. The municipality contains approximately 115 square miles of land and is bordered by Arecibo, Hatillo, Ciales, Jayuya, Ponce, Adjuntas, and Lares. Its physical setting includes steep slopes, high elevations, deeply incised river valleys, forested areas, volcanic formations, and portions of the northern karst region. The Río Grande de Utuado and tributaries such as the Guaonica, Viví, Caguana, Caonillas, Limón, and Tanamá rivers form an extensive hydrographic network. The municipality also contains the Caonillas, Dos Bocas, Viví, and Jordán reservoirs. These conditions shape development patterns and contribute to exposure to landslides, flooding,

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earthquakes, tropical cyclones, drought, wildfire, and dam-related emergencies.

Demographics

According to the 2020–2024 ACS Five-Year Estimates, Utuado has 27,621 residents, including 13,303 males and 14,318 females. This represents a decline of 1,055 residents, or 3.68 percent, from the 2015–2019 ACS estimate of 28,676. The population is aging: 7,020 residents are age 65 or older, and the oldest age cohorts increased while most younger cohorts declined. The plan identifies 12,140 residents age 19 or younger or age 65 or older, representing 43.95 percent of the municipal population and indicating a substantial group that may require additional support during preparedness, evacuation, response, and recovery.

Socioeconomic Conditions

Utuado's socioeconomic conditions may limit the ability of some households to prepare for and recover from disasters. The 2020–2024 ACS identifies a median household income of $20,800 and estimates that 13,833 residents, or 50.3 percent of the population measured in the poverty dataset, lived below the poverty level. Of the population age 16 and older, 42.4 percent participated in the labor force, while 57.6 percent were not in the labor force. The data also identify 5,711 residents living with a disability, 7,088 households receiving food assistance, and 1,430 residents without health-insurance coverage. These conditions reinforce the need for accessible communication, continuity of medical and social services, transportation assistance, and mitigation programs that account for limited household financial capacity.

Housing

Utuado has 13,624 housing units, of which 11,311 are occupied and 2,313 are vacant. Among occupied units, 7,391 are owner-occupied and 3,920 are renter-occupied. The housing stock is predominantly older: only 56 units were built in 2020 or later, while most units were constructed before the adoption of more recent building codes. In addition, 1,400 occupied households have no vehicle available. Older construction, steep terrain, dispersed settlement, limited transportation access, and household economic constraints can increase vulnerability to earthquake shaking, tropical-cyclone winds, flooding, landslides, and prolonged utility disruptions. Mitigation should emphasize code-compliant improvements, structural resilience, safe access, floodplain management, and protection of homes in hazard-prone areas.

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Critical Infrastructure and FEMA Lifelines

The LHMP assesses municipal infrastructure in alignment with FEMA Lifelines, including safety and security; food, hydration, and shelter; health and medical services; energy; communications; transportation; hazardous materials; and water systems. Critical facilities such as hospitals, police facilities, emergency centers, shelters, and related assets are mapped and evaluated to understand their exposure and role in supporting emergency response and community recovery. This lifeline-based approach helps identify where mitigation investments can protect essential services and reduce cascading impacts during hazard events.

Recent Development

Recent development in Utuado includes residential, commercial, infrastructure, and public-facility investments documented through approved construction permits from 2020 through 2026. Exposure maps indicate that new development occurs throughout the municipality and may be exposed to earthquake hazards, landslide susceptibility, flooding, tropical-cyclone winds, and potential inundation associated with the Caonillas and Viví High Hazard Potential Dam impact areas. Continued integration of hazard data into permitting, land-use planning, infrastructure design, and capital investment decisions will help reduce future vulnerability and avoid the creation of new risks.

Hazard Profiles and Risk Assessment

The 2026 LHMP evaluates nine hazards: earthquakes, landslides, flooding, tropical cyclones and other extreme weather events, extreme heat, drought, wildfire, pandemic and epidemic, and high hazard potential dams. Each hazard profile addresses the nature of the hazard, affected areas, magnitude, previous occurrences, probability of future events, exposure and potential losses, social vulnerability, critical infrastructure and Community Lifelines, natural and cultural resources, recent development, and future conditions, as applicable. The assessment uses the best available data, including ACS information, geographic information systems, FEMA datasets, HAZUS 6.1 outputs where applicable, and other federal, Puerto Rico, and municipal sources.

Earthquake

Puerto Rico's location near the boundary of the Caribbean and North American

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tectonic plates makes earthquake risk a continuing concern for Utuado. The 2026 assessment evaluates spectral acceleration, spectral displacement, building exposure, population exposure, critical infrastructure, and recent development using current seismic data and HAZUS 6.1 outputs.

Earthquake shaking may affect the entire municipality, including buildings, roadways, utilities, public facilities, and essential services. Potential impacts may be amplified by older construction, steep terrain, transportation constraints, poverty, and residents who may require additional assistance. Because earthquake events can disrupt multiple FEMA Lifelines simultaneously, priorities include structural resilience, emergency preparedness, protection of critical facilities, and continuity of essential services.

Recent seismic activity, including the significant 2020 southwestern Puerto Rico earthquake sequence, demonstrates that earthquake hazards remain an ongoing concern for the municipality. Because of Puerto Rico's tectonic setting, future earthquake risk is expected to remain high, requiring continued attention to structural resilience, emergency preparedness, critical facility protection, and mitigation measures that reduce potential damages and service disruptions.

Landslides

Landslides are a major concern in Utuado because of its steep mountainous terrain, highly weathered and fractured materials, intense rainfall, road cuts, drainage conditions, and development along slopes and narrow transportation corridors. Landslides can damage homes, roads, bridges, water and power infrastructure, isolate communities, and delay emergency responses. Mitigation priorities include slope stabilization, drainage improvements, inspection and maintenance of roads and bridges, debris-management planning, land-use controls, monitoring of unstable areas, protection of utilities, emergency-access planning, and public education.

Flooding

Flooding in Utuado includes riverine flooding and rapid-onset flooding associated with intense rainfall and tropical weather systems. Risk is concentrated along the Río Grande de Utuado and its tributaries, including the Guaonica, Viví, Caguana, Caonillas, Limón, Tanamá, Arenas, Júa, and Felipa river systems, as well as smaller channels and low-lying areas. Utuado's steep watershed conditions can produce rapid runoff, while flood impacts may damage buildings, roads, bridges, utilities, and critical facilities or

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isolate communities. Tropical Storm Eloise produced 33.29 inches of rainfall at Dos Bocas over three days in September 1975, illustrating the municipality's potential for extreme rainfall. Continued NFIP participation, floodplain management, drainage and bridge improvements, protection of essential facilities, warning systems, and safe evacuation and access planning are key priorities.

The flood assessment identifies exposed structures, estimated building losses, critical infrastructure, population, and recent development using FEMA flood data and HAZUS 6.1. Both the 1% annual-chance and 0.2% annual-chance flood scenarios may damage buildings, interrupt transportation and utilities, isolate communities, and affect emergency response. Continued NFIP participation, drainage improvements, bridge and roadway projects, floodplain management, and protection of essential facilities are central mitigation priorities.

Social vulnerability to flooding is especially high among low-income residents, mobility-limited populations, and households with limited access to transportation or financial resources. These conditions can affect the ability of residents to evacuate, protect property, obtain insurance, or recover after flood events. As a result, flood mitigation remains a central priority for reducing losses, protecting public health, and strengthening community resilience.

Tropical Cyclones/Extreme Winds

Tropical cyclones and extreme winds are among the most widespread hazards affecting Utuado. The entire municipality is exposed to tropical-storm and hurricane winds, and related rainfall may also trigger flooding, landslides, debris accumulation, utility failures, and transportation disruptions.

Hurricanes Irma and María in 2017 demonstrated the municipality's vulnerability to severe wind, prolonged power and communications outages, damaged roads and structures, and extended recovery needs. The risk assessment uses HAZUS 6.1 to evaluate building damage and economic losses for 100-year and 500-year tropical-cyclone scenarios. Because these events can affect every FEMA Lifeline, mitigation requires coordinated improvements to buildings, utilities, communications, transportation, shelters, water systems, and emergency operations.

Social vulnerability is considered widespread due to the municipality-wide exposure of residents, housing, infrastructure, and essential services.

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Extreme Heat

Extreme heat consists of prolonged periods of abnormally high temperatures, often combined with high humidity. Although Utuado has a mountainous setting, developed areas and locations with limited vegetation or shade may experience increased heat exposure. Heat can affect public health, energy demand, transportation, communications, water systems, and outdoor work.

Older adults, children, people with chronic health conditions or disabilities, outdoor workers, low-income households, and residents with limited access to cooling, healthcare, or transportation may face greater risk. Mitigation priorities include public information, accessible cooling strategies, urban greening and shade, protection of critical facilities, and coordination with health and emergency-management partners.

Future projections indicate that temperatures and the frequency of extreme heat events are expected to rise, reinforcing the need for mitigation actions such as public outreach, urban greening, shade improvements, cooling strategies, and infrastructure adaptation. These measures can reduce exposure, improve preparedness, and protect vulnerable residents during periods of excessive heat.

Drought

Drought in Utuado may result from prolonged precipitation deficits and can affect potable-water supplies, agriculture, ecosystems, public health, household finances, and continuity of essential services. The municipality experienced severe drought conditions and water rationing during the 2014–2016 drought period identified in the previous LHMP.

Drought conditions can lead to water rationing, affect economic and agricultural activities, increase stress on households and businesses, and contribute to increased wildfire potential. Previous drought events have been documented through federal declarations, demonstrating that the hazard has affected Puerto Rico in the past and remains relevant to local mitigation planning.

Future drought conditions may increase pressure on regional water systems and contribute to wildfire potential. Priorities include water conservation, emergency water-supply planning, infrastructure resilience, public outreach, and coordination

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with regional water providers. Older adults, low-income households, and people with health-related needs may require additional support during prolonged service interruptions.

Wildfire

Wildfire includes uncontrolled fires in vegetated areas and at the wildland-urban interface. In Utuado, risk may be influenced by drought, dry vegetation, forested and agricultural land, steep terrain, limited access, and the proximity of homes and infrastructure to vegetated areas. Wildfire can threaten residents, structures, ecosystems, utilities, communications, and transportation access while complicating emergency response. Mitigation priorities include public education, defensible-space practices, vegetation and fuel management, reliable emergency access, water availability, protection of critical infrastructure, and coordination among municipal, Puerto Rico, and federal response partners.

Pandemic/Epidemic

Pandemic and epidemic hazards include localized disease outbreaks and widespread events that may affect residents, workplaces, schools, healthcare providers, government operations, and essential services throughout Utuado. The entire municipality is considered exposed because infectious diseases are not confined to a specific geographic area.

Puerto Rico has experienced outbreaks including cholera, measles, influenza, polio, dengue, chikungunya, Zika, and COVID-19. The COVID-19 pandemic demonstrated the potential for substantial health, social, and economic disruption. Utuado residents without health insurance may face additional barriers to preventive care and treatment; ACS data indicate that young adults account for the largest uninsured age group identified in the plan.

During pandemic and epidemic events, the healthcare lifeline is typically the most directly affected; however, other FEMA Lifelines may also experience disruptions, including communications, transportation, food supply, shelter operations, public safety, and continuity of government functions. Future pandemic risk remains elevated due to changing environmental conditions, population characteristics, travel patterns, and the continued emergence of infectious diseases. Mitigation and preparedness efforts should therefore emphasize public health coordination, risk communication, continuity planning, support for vulnerable populations, and

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sustained emergency management capacity.

High Hazard Potential Dams

The 2026 update evaluates high hazard potential dam risk in recognition of Utuado's reservoir and hydroelectric infrastructure and the potential consequences of a dam-related emergency. The municipal hydrographic system includes the Caonillas, Dos Bocas, Viví, and Jordán reservoirs. A dam incident or emergency release could affect downstream populations, roads, bridges, utilities, critical facilities, natural and cultural resources, and multiple Community Lifelines. Mitigation priorities include coordination with dam owners and Puerto Rico and federal dam-safety agencies; review and integration of emergency action plans; evacuation, warning, and communication planning; public awareness; protection of exposed infrastructure; and use of dam-risk information in emergency management, land-use planning, and capital investment.

Hazard Prioritization

The Planning Committee used hazard profiles and risk assessment to establish mitigation priorities for Utuado. As documented in Table 45, prioritization considers the likelihood of future events, potential impacts on people and property, disruption of critical infrastructure and FEMA Lifelines, and the needs of socially vulnerable populations. These results guide the selection and sequencing of mitigation actions in Chapter 6 and should be revisited as new data, projects, and community concerns emerge.

Municipal Capabilities

Utuado relies on a combination of federal, Puerto Rico, and municipal authorities, plans, regulations, programs, and administrative practices to support mitigation. Relevant mechanisms include the Joint Regulation for Permits, the Special Flood Hazard Areas Regulation, the Puerto Rico Building Code, stormwater and environmental requirements, the Utuado Territorial Plan, the Emergency Operation Plan, participation in the National Flood Insurance Program, and municipal capital-investment and recovery-planning processes. These mechanisms provide opportunities to integrate hazard information into land use, permitting, infrastructure maintenance, emergency management, and long-term investment decisions.

Municipal technical and administrative capacity is distributed among offices responsible for permits and territorial planning, emergency management, federal

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programs, public works, finance, and related functions. Implementation capacity may be strengthened through staff training, interagency agreements, updated data and procedures, and continued pursuit of FEMA, HUD, and other federal or Puerto Rico funding sources, including HMGP, FMA, BRIC, CDBG-DR, and CDBG-MIT.

Public outreach and capacity development are integral to the LHMP. Utuado uses municipal meetings, social media, printed notices, online resources, surveys, and stakeholder correspondence to share information and receive input. Continued outreach should be accessible, inclusive, and responsive to local conditions, including residents with disabilities, limited transportation, limited internet access, or other barriers to participation. Community concerns documented during the planning process should continue to inform mitigation implementation and future updates.

Mitigation Action Plan

The Mitigation Action Plan establishes goals, objectives, and actions to reduce hazard impacts, protect life and property, strengthen critical infrastructure and community lifelines, improve public knowledge, and enhance emergency response and recovery. Strategies are organized under prevention, property protection, structural projects, natural-resource protection, emergency services, and community awareness and information. Actions include integrating risk information into plans and permits, improving drainage, roads, bridges, slopes, utilities, and warning systems, supporting resilient buildings and critical facilities, addressing extreme heat and wildfire, and maintaining preparedness for public-health and dam-related emergencies.

Overall, the 2026 Utuado LHMP integrates updated hazard and risk information, municipal capabilities, public and stakeholder input, and an actionable mitigation strategy into a single planning framework. Its implementation will help Utuado reduce future losses, protect vulnerable residents and essential services, guide development and public investment, and strengthen the municipality's capacity to prepare for, withstand, and recover from natural hazards and public-health emergencies.

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1. Introduction and Background

The Municipality of Utuado and the Puerto Rico Planning Board (PRPB) are dedicated to protecting the well-being of Puerto Ricans by fostering cultural, social, and economic growth while prioritizing public health and safety. In this effort, the Municipality and the PRPB have agreed to undertake a joint effort to update the Municipality's Local Hazard Mitigation Plan (LHMP). The LHMP provides a structured and comprehensive approach to reducing risks associated with natural hazards and strengthening overall community resilience. In recent years, Utuado has faced considerable impacts from natural disasters, emphasizing the urgent need for proactive actions to reduce vulnerabilities and safeguard critical infrastructure. These experiences highlight the importance of implementing a coordinated and systematic hazard mitigation strategy that is consistent with federal, state, and local policies.

An LHMP identifies and evaluates potential natural hazards and defines actions designed to reduce or eliminate risks to people, property, and the environment. The plan supports the municipality's land use planning efforts by establishing measures that assist Utuado in achieving its long-term sustainability and resilience objectives.

This LHMP complies with the requirements set forth by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) and the federal regulations derived from it. Under this legislation, local governments in states and territories are required to develop and formally adopt a hazard mitigation plan as a condition for eligibility to receive certain types of funding administered by the Federal Emergency Management Agency (FEMA).

Risk mitigation plays a critical role in guiding future development and enhancing existing municipal infrastructure. To ensure an effective mitigation strategy, the LHMP is regularly updated to reassess natural hazards that may threaten the lives and property of residents and to incorporate appropriate and responsive mitigation measures.

This document represents the 2026 update of the Local Hazard Mitigation Plan (LHMP) for the Municipality of Utuado. The original LHMP was approved by FEMA in October 2005 and subsequently updated in 2012 and 2020. This update reflects changes in conditions, updated data, and current regulatory requirements since the 2020 plan. Through this effort, the Municipality seeks to maintain eligibility for federal hazard

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mitigation assistance and ensure that the plan remains consistent with current FEMA guidance and best practices

The development of this plan was conducted through a coordinated process that incorporated input from state and local agencies, non-governmental organizations, and the public. The overarching goal is to enhance the municipality's capacity to anticipate, reduce, and effectively respond to natural hazards that may affect its jurisdiction.

1.1 Applicable Public Policies

This section outlines the relevant federal and state public policies that guide the development of the 2026 Utuado LHMP. The overview provided is not intended to be comprehensive. Additional public policies are referenced throughout the document, particularly in Section 5.1.

1.1.1 Federal Policies

The following federal policies establish the framework for hazard mitigation planning and resilience efforts.

1.1.1.1 Federal Laws

Stafford Act

The Stafford Act is primarily aimed at reducing loss of life and property, alleviating human suffering, minimizing economic impacts, and lowering the costs associated with disaster assistance. In 1988, Congress amended the Act to create the Hazard Mitigation Grant Program (HMGP), which became the principal source of federal mitigation funding following a disaster declaration by the President of the United States. Through this program, funds are made available to states and territories to implement cost-effective measures that reduce the risk of damage and losses from future hazard events.

Disaster Mitigation Act of 2000

Enacted on October 30, 2000, the Disaster Mitigation Act of 2000 (DMA 2000) further amended the Stafford Act to enhance disaster planning, response, and recovery at all

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levels of government. This legislation establishes eligibility requirements for municipalities to access federal mitigation funding, including the preparation and adoption of a Local Hazard Mitigation Plan (LHMP). An LHMP demonstrates a jurisdiction's commitment to reducing risks associated with natural hazards and serves as a decision-making tool for implementing preventive and mitigation actions. It also provides a framework for the State to deliver technical assistance and establish funding priorities.

In accordance with DMA 2000 requirements, this LHMP is comprehensive and coordinated, incorporating the participation of state, local, and regional agencies, non-governmental organizations, and members of the public.

National Flood Insurance Act

The National Flood Insurance Act established the National Flood Insurance Program (NFIP) to provide affordable flood insurance coverage to homeowners, businesses, and renters located in flood-prone areas. The program was designed to reduce the financial burden on individuals and the federal government in the aftermath of flood-related disasters.

The Act also encourages participating communities to adopt and enforce minimum floodplain management standards aimed at reducing future flood risks. Communities that comply with these requirements become eligible for NFIP benefits and programs.

Access to flood insurance enables property owners to recover more rapidly following flood events without relying solely on federal disaster assistance. Supporting legislation, such as the Flood Disaster Protection Act of 1973, further requires federally regulated lenders to mandate flood insurance coverage for properties located in high-risk flood zones and financed through federally backed mortgages.

The Federal Emergency Management Agency (FEMA) has recognized the Municipality as part of the region that is within the PRPB's coverage within the National Flood Insurance Program. The municipality can request updates and amendments to flood hazard maps utilized by the NFIP through the PRPB.

Additionally, through participation in the Flood Mitigation Assistance Program, the municipality has identified specific mitigation strategies to reduce flood-related risks. Funding has also been allocated for the acquisition of structures located in high-risk flood areas as part of ongoing efforts to decrease vulnerability and exposure to future flood events.

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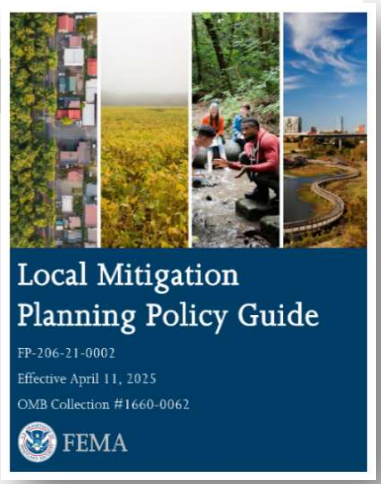
1.1.1.2 Federal Regulations

Mitigation Planning - 44 CFR Part 201

This section of the Code of Federal Regulations describes the rules and procedures governing hazard mitigation planning as mandated under the Stafford Act. It outlines the requirements for the preparation and adoption of mitigation plans, which serve as the primary tool for reducing risks posed by natural hazards at the local level. Additionally, this section establishes the policies and planning processes that guide hazard mitigation efforts, underscoring the role of mitigation plans in directing the effective allocation of resources for disaster risk reduction.

FEMA Local Hazard Mitigation Planning Guide

Figure 1: Cover of FEMA's Local Mitigation Planning Policy Guide



The Local Hazard Mitigation Planning Policy Guide published by FEMA establishes the official framework and guidance that local governments are required to follow when preparing, reviewing, and updating their Local Hazard Mitigation Plans (LHMPs). This guidance is designed to ensure compliance with the requirements set forth in the Code of Federal Regulations (44 CFR Part 201).

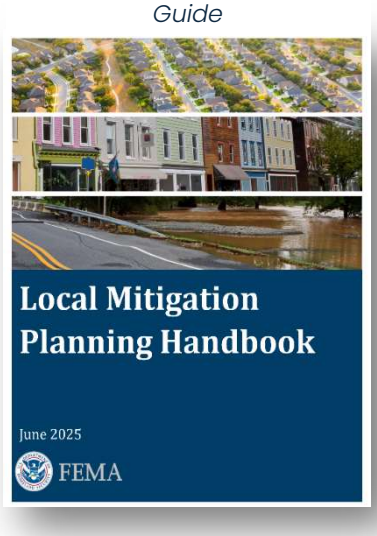
The policy guide emphasizes data-driven planning tailored to local capacities while prioritizing equity and inclusive stakeholder participation. It encourages communities to integrate hazard mitigation into broader planning and decision-making processes, thereby strengthening long-term resilience and reducing vulnerability to natural hazards (FEMA, Local Mitigation Planning Policy Guide, 2025).

The guide identifies the essential components that every mitigation plan is required to address. In addition, it provides practical resources such as resolution templates, checklists, and plan review criteria to support local governments throughout the planning process. The guide also explains FEMA's plan review and approval process, which may result in full approval, conditional approval pending formal adoption, or return of the plan for revisions and corrections.

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Local Mitigation Planning Handbook

Figure 2: Cover of FEMA's Local Mitigation Planning Policy Guide



The *Local Mitigation Planning Handbook* is an operational resource developed by FEMA to assist local governments, including municipalities and special districts, in developing or updating their Local Hazard Mitigation Plans. This handbook serves as a companion to FEMA's mitigation planning policy guidance and offers a detailed, step-by-step methodology for complying with the requirements outlined in Title 44 of the Code of Federal Regulations, Part 201.

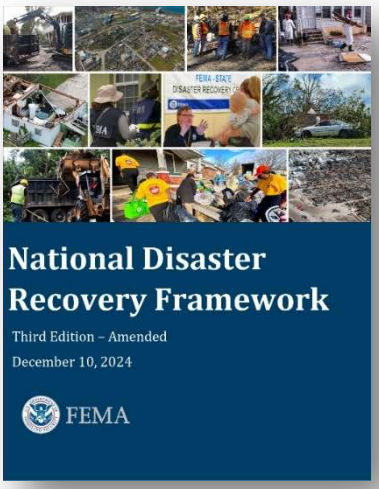
The primary purpose of the handbook is to support communities in identifying the natural hazards they face, evaluating institutional and administrative capabilities, and formulating effective strategies to reduce disaster-related impacts (FEMA, 2025). Ultimately, the handbook promotes the creation of safer and more resilient communities that are better prepared to anticipate, withstand, and recover from adverse events.

National Disaster Recovery Framework

The National Disaster Recovery Framework (NDRF) is a guide created by FEMA in the United States that establishes how recovery should be organized and coordinated after a disaster. Its main objective is to help affected communities rebuild in a stronger, more equitable, and more resilient way, involving all levels of government—local, state, tribal, territorial, and federal—along with private and community organizations.

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Figure 3: National Disaster Recovery Framework Cover



This framework promotes recovery that not only restores what was lost but also improves pre-disaster conditions. To achieve this, the NDRF defines guiding principles, specific roles for the actors involved, and coordination structures that facilitate collaboration among agencies. It also emphasizes the importance of planning before a disaster occurs and ensuring that recovery goals are defined by the affected communities themselves.

National Flood Insurance Program

The National Flood Insurance Program (NFIP), administered by FEMA, provides affordable flood insurance coverage to property owners, renters, and businesses while encouraging effective floodplain management practices to reduce future flood risks. Established in 1968, the NFIP supports communities in minimizing flood-related losses by requiring the adoption and enforcement of local floodplain management regulations. The program also offers insurance coverage for both structures and their contents in more than 22,000 participating communities nationwide.

Because most standard homeowners' insurance policies do not cover flood damage, the NFIP plays a critical role in protecting lives and property while reducing long-term disaster recovery costs. Additional information regarding the Municipality of Utuado participation in the NFIP is provided in Section 6.5 of this plan.

National Earthquake Hazards Reduction Program

The National Earthquake Hazards Reduction Program (NEHRP) was established under the Earthquake Hazards Reduction Act of 1977 to advance the development, dissemination, and application of knowledge, tools, and practices that reduce risks associated with seismic events. This objective is achieved through coordinated, multidisciplinary, and interagency collaboration among NEHRP's participating federal agencies and partners, including local jurisdictions such as the municipality of Utuado.

The National Institute of Standards and Technology (NIST), within the U.S. Department of Commerce, serves as the lead agency for NEHRP. The program is further supported

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by three cooperating federal agencies: the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), and the United States Geological Survey (USGS). Each agency contributes expertise and complementary activities related to research, preparedness, mitigation, and public safety.

National Dam Safety Program

The National Dam Safety Program (NDSP), administered by FEMA, works collaboratively with states, federal agencies, tribal governments, and other partners to improve dam safety and reduce risks to people, property, and the environment. Created in 1996, the program provides grants, technical assistance, research, and training to strengthen state dam safety programs and support the rehabilitation of high-hazard potential dams.

The NDSP also emphasizes public education, emergency preparedness, and risk communication. In support of these efforts, FEMA maintains resources such as the National Inventory of Dams, which assists in monitoring dam conditions and enhancing resilience to prevent catastrophic dam failures nationwide.

National Incident Management System

The National Incident Management System (NIMS) is a standardized framework developed by the U.S. Department of Homeland Security and administered by FEMA to guide incident management across the nation. Its purpose is to enable effective coordination and cooperation among governmental agencies, private sector organizations, and community-based entities at all jurisdictional levels during the prevention, preparedness, response, and recovery phases of emergencies and disasters.

NIMS establishes a common organizational structure, terminology, and set of processes to ensure seamless coordination regardless of the incident's type, size, or complexity. Core components of the system include resource management, interoperable communications, ongoing preparedness activities, and the Incident Command System (ICS), which defines clear roles, responsibilities, and command structures during emergency operations.

Implementation of NIMS is also a prerequisite for jurisdictions seeking access to certain federal preparedness and response funding. By adopting NIMS, jurisdictions enhance operational efficiency, reduce duplication of efforts, and promote the effective and coordinated use of available resources.

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1.1.2 Government of Puerto Rico Policies

The following Government of Puerto Rico policies provide guidance for the development and implementation of the 2026 Utuado LHMP.

1.1.2.1 Puerto Rico Laws

Act No. 161-2009, as Amended

Act No. 161-2009, known as the *Puerto Rico Permits Reform Act*, establishes a modern legal and administrative framework designed to comprehensively restructure the Commonwealth's permitting system. The primary goal of the Act is to create a transparent, efficient, and streamlined process for the submission, evaluation, approval, or denial of permits issued by the Government of Puerto Rico.

To accomplish this objective, Act No. 161-2009 established the Office of Permit Management (Oficina de Gerencia de Permisos, OGPe) as the agency responsible for administering and overseeing the permitting process in Puerto Rico. This centralization reduced procedural delays and improved consistency in the application of permitting standards. The Act also introduced specialized roles—including Authorized Professionals, Permit Managers, Service Representatives, and Permit Officers—each with defined responsibilities intended to expedite reviews and professionalize the permitting process.

A further objective of Act No. 161-2009 is to enhance oversight, accountability, and transparency within the permitting system. By strengthening internal controls and standardizing procedures, the Act seeks to ensure compliance while reducing administrative inefficiencies.

From a public policy perspective, the Act aims to promote economic development while safeguarding environmental protection. Legislative intent emphasizes that an efficient permitting system is essential to attract investment, encourage construction activity, support long-term job creation, and eliminate bureaucratic barriers that previously hindered economic growth. Analyses of the Act also highlight its role in centralizing governmental functions and implementing an Integrated Permitting System to reduce fragmentation, improve interagency coordination, and ensure regulatory uniformity throughout Puerto Rico.

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Act No. 33-2019, as Amended

Act No. 33-2019 establishes the public policy of the Government of Puerto Rico regarding mitigation, adaptation, and resilience in response to observed variations in temperature and precipitation patterns. The legislation formally recognizes the need for integrated governmental action, including at the municipal level, to address the impacts of environmental instability.

This Act calls for the incorporation of concrete mitigation, adaptation, and resilience measures into territorial and land use planning instruments. By doing so, it promotes a proactive approach that strengthens communities' capacity to withstand environmental stressors and reduces long-term risks to public safety, infrastructure, and natural resources.

Act No. 107-2020, as Amended

Act No. 107-2020, as amended, known as the *Puerto Rico Municipal Code*, significantly expands the authority, responsibilities, and operational autonomy of municipal governments. The Code promotes local self-governance and enhances municipalities' capacity to manage their own affairs, including disaster preparedness and risk reduction.

Among the responsibilities granted to municipalities is the authority to design and implement programs and measures to prevent, respond to, and recover from emergencies, natural disasters, catastrophic accidents, and other hazardous events. This expanded role reinforces the importance of municipal governments in protecting public safety and community well-being.

The Municipal Code also grants municipalities enhanced autonomy over land use regulation within their jurisdictions. This authority includes the application of tools such as the transfer of development rights and the evaluation and issuance of construction permits, enabling municipalities to incorporate hazard mitigation principles directly into development decisions. These powers are essential for reducing exposure to natural hazards and safeguarding lives and property.

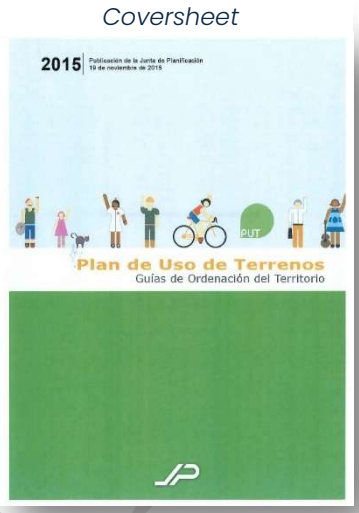
Overall, the Municipal Code recognizes territorial planning as a critical instrument for risk mitigation and establishes a legal framework that enables municipalities to take proactive, locally tailored actions to protect their communities from natural hazards and other adverse events.

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1.1.2.2 Puerto Rico Regulations

Puerto Rico Land Use Plan (PUT-PR by its Spanish acronym) - 2015

Figure 4: Puerto Rico PUT Coversheet



In compliance with Act No. 550-2004, as amended, the Puerto Rico Land Use Plan (PUT, by its Spanish acronym) constitutes the primary territorial planning instrument prepared by the Puerto Rico Planning Board. The Plan is intended to direct land use, development, and conservation activities throughout the island in a coordinated, sustainable, and resilient manner, guided by a long-term planning horizon of ten (10) years (PRPB, 2015).

One of the primary functions of the Puerto Rico Land Use Plan (PUT) is to classify land throughout the Commonwealth into specific land use categories. Land classification serves as a land administration framework that establishes the types of zoning districts and allowable uses that may be applied to individual parcels. Under the PUT, land is classified according to the following scheme:

- Urban Land (SU, by its Spanish acronym):
  This category includes areas that are already developed and served by the necessary infrastructure and public services.

- Land for Development:
  This classification applies to land identified as suitable for future development and is subdivided into two categories:
  - Programmed Development Land (SUP, by its Spanish acronym): Land scheduled for development under established programs or plans.
  - Non-Programmed Development Land (SUNP, by its Spanish acronym): Land available for development that has not yet been assigned to a specific development program.

- Rustic Land:
  Rustic lands are designated for protection, conservation, or limited use due to their environmental, agricultural, or ecological value. This classification is further subdivided into:

- Common Rustic Land (SRC, by its Spanish acronym): Areas suitable for limited, low-intensity uses.
- Specially Protected Rustic Land (SREP, by its Spanish acronym): Areas subject to heightened protection due to their environmental, natural, or cultural significance.

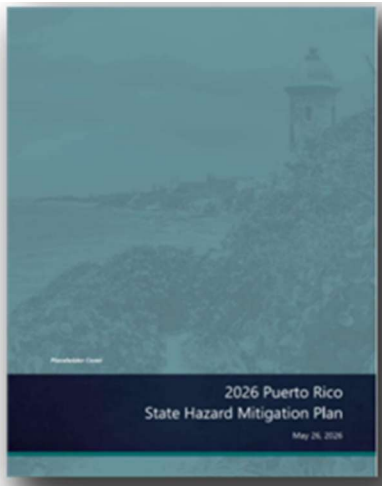
The PUT-PR aims to coordinate and harmonize land use planning efforts among state agencies and municipalities. It serves as the foundation for the preparation of municipal Land Use Plans (Planes de Ordenación Territorial, POT, by its Spanish acronym), which are adopted for an eight-year planning period (PRPB, 2015).

Currently, the PUT-PR is in the process of being updated for the 2026-2032 planning cycle. This revision will incorporate robust citizen participation, clearly defined compliance and performance metrics, and an inclusive planning approach that integrates economic development, green infrastructure, sustainable transportation systems, and the conservation of natural resources.

Puerto Rico State Natural Hazard Mitigation Plan (2026)

Like requirements for local jurisdictions, the Stafford Act mandates that states and territories develop a hazard mitigation plan covering their entire jurisdiction. In the case of Puerto Rico, the most recent State Hazard Mitigation Plan was completed in 2026. The Puerto Rico 2026 State Hazard Mitigation Plan outlines long-term strategies to address natural hazards that have the potential to disrupt daily activities, damage property, and threaten human life. These hazards—which in many cases are intensified by changing environmental conditions—can escalate into disasters that affect not only individuals, but entire communities, with wide-ranging impacts on public health, infrastructure, economic stability, and natural ecosystems(NMEAD, 2026).

Figure 5: Puerto Rico SHMP Cover



This plan provides a comprehensive framework for identifying risks and implementing actions aimed at reducing vulnerability to these hazards. Through its emphasis on mitigation, the plan seeks to increase community resilience, protect critical infrastructure and systems, and promote sustainable development throughout Puerto

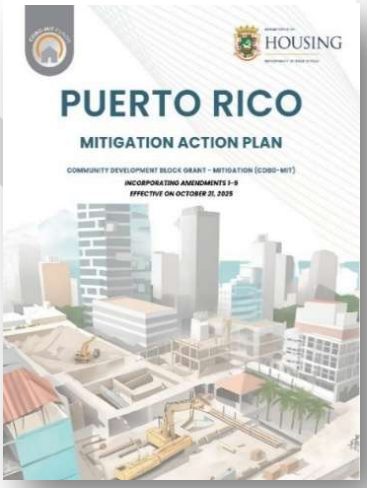
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Rico (NMEAD, 2026).

The Municipality of Utuado reviewed the 2026 Puerto Rico State Hazard Mitigation Plan during the preparation of this LHMP update. The relevant risk profiles, state capabilities, mitigation goals, and state actions were considered during the risk assessment, capability assessment, and development of the municipal mitigation strategy.

Puerto Rico Mitigation Action Plan, CDBG-DR MIT (2021, 2025)

Figure 6: Puerto Rico Mitigation Action Plan Cover



Originally approved by the U.S. Department of Housing and Urban Development (HUD) in 2021 and subsequently amended in August 2025, the Puerto Rico Mitigation Action Plan for the Community Development Block Grant–Mitigation (CDBG-MIT) Program is a strategic planning document prepared by the Puerto Rico Department of Housing (PRDOH). The plan establishes the framework for the administration and management of federal mitigation funds allocated by HUD under the CDBG-MIT program.

Its primary objective is to reduce risks and vulnerabilities to future disasters by enhancing the resilience of infrastructure, communities, and critical systems. Although these funds were appropriated to Puerto Rico following Hurricanes Irma and María in 2017, CDBG–MIT funding differs from CDBG–Disaster Recovery (CDBG-DR) in that it is specifically focused on preventing and mitigating future impacts. Accordingly, CDBG-MIT resources are directed toward sustainable, high-impact mitigation projects and are not required to be directly linked to disaster recovery activities associated with those hurricanes (PRDOH, 2025). This plan is designed to reduce exposure to hazards, safeguard lives and property, and enhance emergency response capabilities through targeted investments in infrastructure, housing, and land-use planning (PRDOH, 2025).

Other relevant planning regulations will be discussed as part of section 4.16.

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1.1.3 Municipal Policies

Utuado Local Hazard Mitigation Plan (2020)

Adopted by the Municipal Legislature on November 18, 2020, through Resolution No. 14, Series 2020–2021, this is the most recent Hazard Mitigation Plan for the Municipality of Utuado. FEMA, the Governor's Authorized Representative, and the State Hazard Mitigation Officer approved the plan on November 30, 2020, for a five-year period.

Figure 7: Utuado Hazard Mitigation Plan Cover



Some of the highest-priority hazards proposed by this plan are:

- **Flooding:** Flooding is classified as a high-priority hazard for Utuado. The plan includes measures related to stormwater runoff control, hydrologic evaluations, improvements to bridges and roadways, maintenance and improvement of drainage systems, enforcement of floodplain management standards, and continued participation in the National Flood Insurance Program (NFIP).

- **Hurricanes/Strong Winds:** The entire municipality and its critical facilities are exposed to strong winds associated with tropical storms and hurricanes. The plan classifies strong winds as a high-priority hazard and notes the significant effects of Hurricanes Irma and María on the municipality in 2017.

- **Landslides:** Utuado is in Puerto Rico's mountainous interior and contains steep terrain susceptible to rainfall-induced landslides. The plan classifies landslides as a high-priority hazard and identifies areas of high or maximum susceptibility, as well as important roadways that cross landslide-prone areas, including PR-10, PR-111, and PR-123.

- **Earthquakes:** Puerto Rico is located near the boundary between the Caribbean and North American tectonic plates. The plan classifies earthquakes as a moderate-priority hazard for Utuado and evaluates potential impacts associated with ground shaking, liquefaction, and earthquake-induced landslides.

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- **Droughts:** The plan classifies drought as a low-priority hazard and states that it is not considered a significant hazard for Utuado based on the conditions evaluated. Nevertheless, the plan recognizes that future droughts could become more intense or prolonged due to climate change and could affect agriculture, water availability, municipal operations, and natural resources.

- **Extreme Heat:** The plan evaluates climate change and extreme heat as municipality-wide concerns. It identifies children, older adults, outdoor workers, agricultural workers, and other vulnerable populations as groups that may experience greater effects from extreme heat. It also recognizes that climate change may increase temperatures and contribute to more intense droughts, flooding, landslides, and severe storm events.

1.2 Scope and Previous Versions

1.2.1 Primary Objectives

The primary objectives of the LHMP are to:

- Identify and assess natural hazards that pose a risk to the municipality.
- Develop strategies and actions to reduce or eliminate long-term risks to life, property, and essential services.
- Promote interagency coordination and community engagement in disaster preparedness and mitigation efforts.

1.2.2 Previous FEMA Comments

The following recommendations and requirements were made by FEMA upon approving the previous 2020 LHMP for Utuado:

Element B4

- FEMA Comment - Update NFIP repetitive loss information. FEMA recommended that the Municipality update the Repetitive Loss (RL) and Severe Repetitive Loss (SRL) information, as well as National Flood Insurance Program (NFIP) data, as soon as updated information becomes available. At the time of the review, the plan acknowledged limitations in the available NFIP data.

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- Municipality Response – The NFIP data has been updated with the latest information provided by the PRPB.

Element C5

- FEMA Comment - Improve documentation of cost-benefit considerations. FEMA recommended providing a more detailed explanation of how the anticipated benefits of mitigation actions compare to implementation costs. Although a formal Benefit-Cost Analysis (BCA) was not required, FEMA noted that future updates should better describe the economic justification for mitigation projects and explain how proposed actions are expected to reduce future damages and losses. FEMA also suggested identifying the number of structures, facilities, or residents expected to benefit from proposed mitigation actions whenever possible.

- Municipality Response – Many projects are not developed enough to determine number of residents that could benefit. However, each mitigation strategy has a qualitative benefit assessment.

Element D1

- FEMA Comment - Expand the analysis of development trends and vulnerability changes. FEMA recommended that future updates include a more comprehensive evaluation of development and construction activities in hazard-prone areas for the entire period since the previous plan approval. FEMA noted that the 2020 plan primarily analyzed available development data from 2015 through 2019, while the previous LHMP had been approved in 2012. Future updates should document all available permit and construction activity from the prior plan approval and clearly identify any data limitations. This information will help provide a more complete assessment of how development patterns may have influenced community vulnerability to natural hazards.

- Municipality's Response – Construction permits given for the period of 2020 - 2025 have been incorporated for those hazards where the affected area can be mapped put either by using HAZUS 6.1 or alternative GIS analysis. Data for 2026 is only up to date to the end of the Puerto Rico Fiscal Year (June 3o, 2026).

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Element E1

- FEMA Comment - Include the adopted municipal resolution in the final plan. FEMA noted that the Municipality approved Resolution No. 14, Series 2020-2021, on November 18, 2020, formally adopting the mitigation plan. FEMA recommended incorporating the signed municipal resolution into the final approved version of the plan submitted to FEMA.

- Municipality's Response – The corresponding Resolution was included as part of Appendix A of the 2020 LHMP.

1.3 LHMP Organization

Table 1 shows the organization of the 2026 Utuado LHMP. To help LHMP reviewers and the public understand compliance, the table includes a column specifying which FEMA-required element (FEMA, 2025) is addressed by each section.

Table 1: LHMP Organization

Chapter #	Title	Description	Review Tool Elements met
N/A	Executive Summary	This section summarizes the principal findings of the planning process, including the hazards affecting the Municipality of Utuado, the results of the risk assessment, and the mitigation priorities established through the LHMP update.	Local Element
Chapter 1:	Introduction and Background	This chapter presents the purpose, scope, organization, and regulatory context of the 2026 Utuado LHMP. It also summarizes the significant changes made since the 2020 Plan and explains how the updated plan addresses applicable federal, state, and municipal planning requirements.	E2-a
Chapter 2	Planning Process	This chapter describes the process followed to update the LHMP, including the organization of the	A1-a, A1-b, A2-a, A3-a, A4-a

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Chapter #	Title	Description	Review Tool Elements met
		Planning Committee, coordination with stakeholders, opportunities for public participation, review of existing plans and technical information, and documentation of the meetings and activities conducted during the planning process.	
Chapter 3	Municipal Profiles	This chapter describes the Municipality of Utuado, including its geographic and physical characteristics, land use, population, housing, socioeconomic conditions, infrastructure, community lifelines, and other characteristics relevant to hazard mitigation planning.	A1-a, A1-b, A2-a, A3-a, E1-a
Chapter 4	Hazard Profiles and Risk Analysis	This chapter identifies and profiles the hazards affecting Utuado and evaluates their location, extent, previous occurrences, probability of future events, and potential effects on people, structures, infrastructure, community lifelines, and other municipal assets.	B1-a, B1-b, B1-c, B1-d, B1-e, B2-a, B2-b, HHPD1-a, HHPD1-b, HHPD2-a, HHPD2-b
Chapter 5	Municipal Capacities	This chapter evaluates the municipality's existing authorities, policies, plans, programs, personnel, technical resources, and financial capabilities to implement hazard mitigation measures. It also identifies opportunities to strengthen local mitigation capabilities.	C1-a, C1-b
Chapter 6	Mitigation Action Plan	This chapter establishes the municipality's mitigation goals and presents the actions proposed to reduce or avoid long-term risks associated with the identified hazards. It also documents the	C2-a, C3-a, C4-a, C4-b, C5-a, C5-b, E2-b

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Chapter #	Title	Description	Review Tool Elements met
		status of mitigation actions from the 2020 Plan and explains how the updated actions were evaluated, prioritized, and incorporated into the 2026 LHMP.	
Chapter 7	Plan Maintenance	This chapter establishes the procedures for monitoring, evaluating, and updating the LHMP. It also explains how the municipality will continue public participation and incorporate the plan's requirements and mitigation actions into other municipal planning mechanisms and programs.	D1-a, D2-a, D2-b, D2-c, D3-a
Chapter 8	Adoption and Approval	This chapter documents the municipality's formal adoption of the LHMP, FEMA's approval of the plan, and the effective and expiration dates of the 2026 Utuado LHMP.	F1-a, F1-b
N/A	References	This section presents the sources used in updating the plan.	A4-a
N/A	Appendixes	This section includes all appendices and supplementary information related to the planning process of the Plan.	

1.4 Changes to the Utuado LHMP (E2-a)

Table 2 shows the most significant changes between the 2026 and 2020 versions.

Table 2: Changes to the Utuado LHMP

Element	Justification
Plan Language	In accordance with the Presidential Executive Order #14224, the 2026 version of Utuado LHMP was prepared in English for submission and review by FEMA. A non-certified Spanish translation of the final draft for public discussion

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Element	Justification
	and the final approved LHMP will be prepared for the benefit of individuals with limited English proficiency.
Plan organization	The organization and chapters of the document follow the template used in local mitigation plans prepared by the Puerto Rico Planning Board. However, some additions have been made to comply with current FEMA LHMP guidance.
Discussion of FEMA Lifelines	In accordance with FEMA's local hazard mitigation policy, FEMA Lifelines are discussed as well as the strategies to mitigate hazard impacts on them.
Elimination of non-applicable public policy	For clarity and better readability, references to redundant public policy gaps have been removed.
Change to the name of extreme winds	The hazard identified in the 2020 Plan as Extreme Winds has been changed to Tropical Cyclones and Extreme Winds because, unlike previous versions HAZUS 6.1 can model hurricane impacts.
Update of census data	The municipality and PRPB have chosen to use the most recent version of the American Community Survey for evaluating demographic data. In this case, the PRPB have chosen to evaluate the data sets from the 202-2024 Five-Year American Community Survey. The five-year survey was selected because it provides more information than the one-year survey. If any other dataset is used, it will be indicated in a footnote.
New Hazard: High Hazard Potential Dams	Given the age of dams upstream from the municipality and the experience with the partial failure of the Guajataca dam after Hurricane María, the municipality considers it appropriate to include the assessment of this hazard.
Action Plan	The Mitigation Strategies Table in Chapter 6 has been redesigned to allow for more detailed information.
Throughout the LHMP	Attention has been given to ensure that the content of the Plan does not reveal any personally identifiable information (PII).

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2. Planning Process

2.1 Overview and Organization of the Plan

This Local Hazard Mitigation Plan (LHMP) was updated in accordance with the applicable policies, regulatory requirements, and procedures identified in Chapter 1. Its purpose is to support the Municipality's efforts to reduce the loss of life and property resulting from natural hazards.

The Plan is organized as follows:

- Chapter 1 – Introduction: Presents the Plan's purpose, scope, regulatory framework, and general organization.
- Chapter 2 – Planning Process: Documents the methodology used to update the Plan, including stakeholder coordination and public participation.
- Chapter 3 – Municipal Profile: Summarizes the Municipality's demographic, socioeconomic, housing, and related characteristics.
- Chapter 4 – Risk Assessment: Evaluates applicable natural hazards and their potential effects on people, property, community lifelines, natural resources, and other municipal assets.
- Chapter 5 – Capability Assessment: Identifies the Municipality's existing authorities, programs, resources, and institutional capabilities for hazard mitigation.
- Chapter 6 – Mitigation Strategy: Establishes the mitigation goals and actions to be implemented during the Plan's five-year cycle.
- Chapter 7 – Plan Maintenance: Defines the procedures for monitoring, evaluating, updating, and maintaining the LHMP.
- Chapter 8 – Plan Adoption and Approval: Documents the formal adoption and approval of the Plan.
- Appendices: Provide supporting records, technical information, and documentation of the planning process.

2.2 History of the LHMP

The original LHMP for the Municipality of Utuado was approved by FEMA in October 2005. The plan was subsequently updated in July 2012 and again in November 2020. This 2026 update reflects changes in conditions, development patterns, hazard information, and regulatory requirements that have affected the municipality since

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the previous planning cycle. It also incorporates updated FEMA guidance and planning requirements, including those established in the 2025 Local Mitigation Planning Policy Guide and Local Mitigation Planning Handbook.

2.3 Plan Preparation, Revision Schedule and Methodology (A1-a)

The Municipality in accordance with the Planning Board followed the natural hazard mitigation planning process established by FEMA in the *Local Mitigation Planning Policy Guide* and the *Local Mitigation Planning Handbook*, as well as recommendations provided by COR3's mitigation planning staff.

The planning process for the 2026 update of the Utuado Local Hazard Mitigation Plan (LHMP) officially began with the execution of a Letter of Agreement between the Municipality of Utuado and the Puerto Rico Planning Board (PRPB), which was signed on December 16, 2025. A copy of the signed agreement is included in Appendix B. Subsequently, a kickoff meeting was held on February 9, 2026, bringing together representatives from the Municipality and the PRPB to discuss the planning process, project objectives, and coordination efforts. Later a consulting firm, AtkinsRéalis Caribe LLP, was retained by the PRPB to support the mitigation planning efforts.

The revision phase concluded with the formal submission of the final draft to the State Hazard Mitigation Officer within the Central Office for Recovery, Reconstruction, and Resiliency (COR3) on **[date]**. From December 16, 2025 kickoff meeting through the submission of the final draft, the planning and revision process lasted **[number] days**.

Planning Process Methodology

This section outlines the six-phase process for updating, reviewing, adopting, and implementing the Local Hazard Mitigation Plan (LHMP). The process integrates municipal coordination, public and stakeholder participation, hazard and risk assessment, mitigation strategy development, and state and federal review to produce a compliant and locally informed plan. Figure _ below details the sequential order of the LHMP development phases.

Phase 1 – Initiation and Committee Formation

- Execute the agreement between the municipality and the Puerto Rico Planning Board (PRPB).

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- Establish the Municipal Planning Committee.
- Conduct the initial Planning Committee meeting. During this meeting, begin reviewing and updating the mitigation strategies included in the 2020 Local Hazard Mitigation Plan (LHMP).

Phase 2 – Public and Stakeholder Engagement[1]

- Conduct an initial public meeting to announce the LHMP update process and provide an opportunity for community input.
- Notify stakeholders of the LHMP update process and issue requests for information.

Phase 3 – Municipal and Hazard Assessment

- Update the municipal profile.
- Review the natural hazards evaluated in the previous LHMP and determine whether they remain relevant to the municipality.
- Determine whether additional hazards or updated analyses should be included.
- Prepare the revised hazard profiles and risk analyses.

Phase 4 – Mitigation Strategy Review

- Apply the STAPLEE methodology to evaluate and update the mitigation strategies.
- Identify any mitigation strategies that should be withdrawn and document the reasons for their withdrawal.
- Identify new mitigation strategies that should be added, including appropriate recommendations received from the public and stakeholders.

Phase 5 – Draft Preparation and Public Review

- Prepare the initial LHMP update draft for public and stakeholder review. The draft, considered approximately 90 percent complete, must include a non-certified Spanish translation.
- Publish digital English and Spanish versions on the PRPB website. Make Spanish

[1] Note that for the 2020 revision the Municipality and the PRPB used the roundtable discussion methodology mainly for data gathering from stakeholders. For the 2026 revision both municipality and PRPB decided not to use roundtables because in comparison to 2020 data from stakeholders was more available and forthcoming.

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hard copies available at designated municipal facilities and at the PRPB's main office. Include the location and availability of all digital and printed copies in the public meeting notice.

- Submit a digital courtesy copy of the initial draft to the State Hazard Mitigation Officer (SHMO). During this review period, the SHMO functions are administered through the Central Office for Recovery, Reconstruction and Resiliency (COR3).
- Coordinate a public meeting to discuss the LHMP and publish notice of the meeting in a local newspaper at least 15 days before the meeting.
- Provide additional notice through the municipality's social media platforms. The municipality and PRPB must also send notification letters to stakeholders.
- Conduct the public meeting. Provide participants with an opportunity to validate local conditions and the hazard analysis prepared by the technical team and to prioritize hazards using the planning-poker technique.
- Provide the public and stakeholders with a seven-calendar-day period to submit written comments.
- Review all comments received and determine whether changes to the LHMP draft are necessary.
- Incorporate approved revisions and prepare the final draft.

Phase 6 – State and Federal Review, Adoption, and Implementation

- Submit the final draft to the SHMO for review.
- Address any changes or clarifications requested by the SHMO before the plan is forwarded to the Federal Emergency Management Agency (FEMA).
- Obtain FEMA's Approved Pending Adoption (APA) determination, subject to any additional revisions or clarifications requested by FEMA.
- After receiving the APA determination, formally adopt the LHMP through a resolution of the Municipal Legislature or an executive order issued by the mayor. Submit proof of adoption to FEMA.
- Obtain FEMA's final LHMP approval letter.
- Prepare the final administrative record, including the final English version, FEMA's approval letter, documentation of municipal adoption, and the final Spanish version. Submit the required English-language record to FEMA; publish the English and Spanish versions on the PRPB website; provide digital copies to the municipality; and retain Spanish hard copies at the municipality and PRPB.
- Implement the monitoring, evaluation, public-participation, and revision procedures established in Chapter 7 until the next five-year comprehensive update.

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Completion of these six phases results in a formally adopted and federally approved LHMP that reflects local conditions, community priorities, and applicable planning requirements. Continued monitoring, evaluation, and public engagement will support implementation of the mitigation strategy and keep the plan current until the next five-year update.

Figure 8 Mitigation Planning Process



2.4 Planning Committee (A1-a, A1-b)

To support the revision of the Utuado LHMP, a Planning Committee was established, composed of representatives from several municipal dependencies who were designated to guide the process. The members of the committee are:

Table 3: LHMP Planning Committee

Name	Position
Israel Maldonado	Program Coordinator
Arcenio Vélez Pérez	OMME Director
Hector Cruz Cruz	Reconstruction Coordinator
Yahaira Maestre Ruiz	Chief Financial Officer

The function of this Planning Committee is to support and coordinate the update, implementation, and monitoring of the Municipality of Utuado's Hazard Mitigation Plan, while providing guidance on risk reduction strategies, ensuring compliance with mitigation requirements, and promoting community participation to strengthen municipal resilience.

The designation letter for the Planning Committee is included in Appendix B. This appendix also compiles the meeting minutes, documentation of the materials discussed throughout the process, and accompanying photographic evidence.

The details of the official meetings are:

First official meeting

- Place: Roberto Sánchez Vilella Government Center San Juan, PR
- Date: February 9, 2026
- Purpose – Initiate Mitigation Committee Activities. Provide update on status of mitigation strategies, prioritize hazards using "planning poker" technique

Second official meeting

- To be completed after the second meeting

2.5 Citizen Participation (A3-a)

2.5.1 Community Outreach and Public Participation Strategies

The public participation approach selected for this LHMP revision incorporated the following activities:

- Distribution of notification letters to agencies, neighboring municipalities, community leaders, nonprofit organizations, neighborhood associations, business or industrial groups, and other interested stakeholders, informing them that the LHMP revision process had commenced and inviting their input. Documentation of these communications is included in Appendix C.

- Publication of notices on the Municipality's website and official social media platforms to inform the public that the LHMP revision was underway. These postings also provided an email address for submitting comments and made a virtual survey to gather information regarding the community's experiences with natural hazards. Evidence of these public notices is included in Appendix C.

- Holding an initial community meeting to introduce the LHMP revision process. This step involved:

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- Issuing a public announcement in a newspaper, on the Municipality's website, and across official social media channels at least 15 days before the meeting.
- Providing notice of a 15-day period for the public to submit comments or suggestions via email or in person at a specified location.

- Holding a second community meeting to present the draft LHMP for public review and discussion. This stage included:

  - Publishing a newspaper announcement and posting notices on the Municipality's website and official social media outlets at least 15 days before the meeting.
  - Confirming in the announcement that the draft plan was available for review in printed and online versions.
  - Providing an additional 15-day comment window for the community to offer feedback, either by email or by visiting the designated address.

- Holding a third community meeting to discuss the draft LHMP and the proposed mitigation strategies. This stage included the following:
  - Publishing a newspaper announcement and posting notices on the Municipality's website and official social media outlets at least 15 days before the meeting.
  - Confirming in the announcement that the draft plan was available for review in printed and online versions.
  - Providing an additional 15-day comment window for the community to offer feedback, either by email or by visiting the designated address.

2.5.2 Community Outreach and Public Participation Results

First Public Meeting Results

A public meeting notification announcing the initiation of the LHMP update process was published on February 24, 2026, in the local newspaper called "El Vocero." The notification informed the public that the meeting would be held on March 12, 2026, Legislatura Municipal, Utuado, Puerto Rico, at 6:00pm. Based on the community comment forms gathered from this meeting, the following is a summary of the comments.

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Public comments received during the planning process identified flooding, landslides, drainage deficiencies, and vegetation management as primary community concerns. Residents reported recurring roadway and residential flooding associated with overflowing rivers, inadequate drainage systems, clogged culverts, and unchanneled streams. Multiple comments highlighted landslide hazards and slope instability affecting residential areas and transportation corridors. Community members also expressed concerns regarding the availability of emergency shelters for vulnerable populations and the presence of large trees that may pose risks to nearby structures and public facilities. These comments were reviewed by the planning team and considered during the risk assessment and mitigation strategy development process.

In response, the Municipality incorporated these concerns into the hazard identification, risk assessment, and mitigation strategy development process. Community comments were evaluated as part of the assessment of landslide hazards and post-disaster debris management challenges. Input received during the meeting also supported the consideration of mitigation actions related to slope stabilization, reduction of landslide risks, emergency preparedness, infrastructure resilience, and debris removal following future disaster events.

Appendix C includes the notes prepared by the planning consulting firm during the activity, along with supporting evidence. All documentation complies with PII protection requirements.

Second Public Meeting Results

A public meeting notification to present the draft LHMP was published on Click or tap to enter a date. via _____. The notification informed the public that the meeting would take place on Click or tap to enter a date. in _____ at _____. It also stated that a printed copy of the draft LHMP would be available at_____ during regular work hours. Additionally, the public had the option of accessing the draft LHMP through the website _____. Copies of the public notification are included in Appendix C.

During this meeting, participants expressed the following concerns: _____

The Municipality took the following measures to address these concerns: _____.

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Appendix D includes the notes documented by the planning consulting firm during the activity, along with supporting evidence. All documentation complies with PII protection requirements.

2.6 Stakeholder Involvement (A2-a)

The Municipality carried out outreach efforts to external stakeholders, including government agencies and neighboring municipalities, through formal correspondence addressed to agency heads and mayors. Copies of these invitation letters are provided in Appendix D. Stakeholders were encouraged to submit input either via email or through participation in the public involvement process.

Input from internal stakeholders was obtained through the Planning Committee. Appendix D also includes any written correspondence received from stakeholders during this outreach process.

[This section shall be expanded in the final draft**]**

2.7 Hazard Analysis Data Sources

The following table presents the datasets utilized for the evaluation of each hazard. Table 4 identifies the hazards considered in this LHMP and the corresponding data sources used to support their assessment.

Table 4: Hazard and Risk Assessment of Data Sources

Hazard	Data Sources	Comments
Earthquake	United States Geological Survey (USGS), FEMA	HAZUS 6.1 was used
Landslides	USGS	
Flooding	FEMA	HAZUS 6.1 was used
Tropical Cyclones/Extreme Winds	FEMA	HAZUS 6.1 was used
Extreme Heat	National Oceanic and Atmospheric Administration (NOAA)	
Drought	National Drought Index Monitor (NDIM)	
Wildfires	Puerto Rico Fire Bureau	

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Hazard	Data Sources	Comments
Pandemic/Epidemic	Puerto Rico Department of Health	
High Hazard Potential Dams	NID	

2.8 FEMA Lifelines

The Local Mitigation Planning Handbook and the Local Hazard Mitigation Planning Policy Guide highlight the importance of integrating critical lifelines into the hazard mitigation planning process. FEMA defines lifelines as essential services that sustain public safety, economic stability, and the continuity of government and daily life before, during, and after an emergency or disaster. These lifelines serve as a framework for prioritizing resources and actions that are essential to reducing loss of life and property and to support efficient and rapid recovery following hazard events (FEMA, 2023).

FEMA identifies eight primary lifelines:

- Safety and Security: Includes law enforcement, fire services, search and rescue operations, government services, and community safety functions.
- Food, Hydration, and Shelter: Encompasses food systems, water access, emergency shelter, and agricultural resources.
- Health and Medical: Includes medical care, public health services, patient movement, medical supply chains, and healthcare facility management.
- Energy: Covers the electrical power grid and fuel supply systems.
- Communications: Includes communications infrastructure, responder communications, alert and warning systems, financial services, 911 operations, and emergency dispatch.
- Transportation: Encompasses highways, motor vehicle systems, mass transit, railways, aviation, and maritime transportation.
- Hazardous Materials: Includes facilities and systems associated with hazardous materials, pollutants, and contaminants.
- Water Systems: Includes potable water infrastructure and wastewater collection and treatment systems.

Each of these lifelines is supported by sub-lifelines that allow jurisdictions to more precisely identify vulnerabilities and prioritize recovery actions. Together, they enable emergency managers and decisionmakers to rapidly assess conditions, focus response operations on the most critical needs, and coordinate actions that directly

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affect human life and community stability.

By monitoring the status and functionality of lifelines, jurisdictions can respond more effectively during emergencies, minimize cascading impacts, and accelerate a more resilient recovery. A detailed discussion of lifelines and their relevance to the Municipality of Utuado is provided in Section 3.5.

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3. Municipal Profile

Utuado was officially founded on October 12, 1739, by Sebastián de Morfi on behalf of sixty families residing in the area. According to the agreement establishing the municipality, Morfi acquired the Hato de Otoao for 569 pesos and 5 reales from its owners, Manuel Natal and Felipa Román. At the time of its founding, the settlement had a population of 239 inhabitants. Utuado is home to the most significant archaeological site in the Antilles the Caguana Indigenous Ceremonial Park which stands as the most representative example of prehistoric engineering in the region. The Taíno constructed this ceremonial complex around 1100 CE.

By 1771, the primary economic activity in Utuado consisted of raising cattle, horses, and mules. Although agricultural practices were present, the community produced only enough tobacco and coffee for local consumption. Toward the late eighteenth and early nineteenth centuries, Utuado experienced population growth driven by the increasing importance of coffee cultivation. Coffee growers recognized the advantages of higher elevations and mountainous terrain for producing high-quality coffee beans, leading to expanded settlement and agricultural activity in the region. The municipality also developed successful livestock operations, including beekeeping and hog farming.

Industrial activity in Utuado has historically included textile production, paper manufacturing, and the processing of stone materials. Today, the municipality benefits from a modern and competitive communications infrastructure that supports both economic development and community resilience.

3.1 Data Sources for Municipal Profiles

The Utuado LHMP has been updated using the most current demographic and socioeconomic data available. The municipal profile and its demographic and socioeconomic analyses rely primarily on the 2020–2024 Five-Year American Community Survey (ACS). When specific information is not available through the ACS, alternative data sources are identified and cited in the corresponding footnotes.

In addition, the plan reflects the most up-to-date knowledge on hazards and mitigation practices. References to relevant plans, studies, and technical reports are provided in page-level footnotes and consolidated in the References section.

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Most Geographic Information System (GIS) layers included in Chapter 3 were provided by the PRPB's GIS Office.

3.2 Brief Historical Background

Utuado was founded on October 12, 1739, by Sebastián de Morfi on behalf of sixty local families. The agreement establishing the town states that he purchased the Hato de Otoao for 569 pesos and 5 "reales" from its owners, Manuel Natal and Felipa Román. At the time of its founding, Utuado had 239 inhabitants. The Caguana Indigenous Ceremonial Park is the most representative example of prehistoric engineering in the region. The Taíno constructed this ceremonial complex around 1100 CE (Municipio de Utuado).

3.3 Geography

The Municipality of Utuado is in the west-central mountainous region of Puerto Rico, within the Central Mountain Range, and covers approximately 115 square miles (297.83 km²). Its name derives from the Taíno term *Otoao*, meaning "among the mountains," reflecting its predominantly mountainous terrain (Municipio de Utuado).

The municipality's topography is characterized by steep slopes exceeding 50% and prominent elevations such as Cerro Morales (988 m), La Chorrera (900 m), and Roncador (800 m). Nearly 32% of Utuado's territory is forested, including portions of the Río Abajo State Forest, known for its karst landscape and extensive cave systems; Utuado contains the highest number of documented caves in Puerto Rico (23) (Municipio de Utuado).

The hydrography of Utuado is dominated by the Río Grande de Utuado and its tributaries, including the Guaonica, Viví, Caguana, Caonillas, Limón, and Tanamá rivers. The municipality also contains four principal reservoirs Caonillas, Dos Bocas, Viví, and Jordán—primarily used for hydroelectric power generation (Municipio de Utuado).

Geologically, Utuado is composed mostly of highly fractured Mesozoic volcanic rocks, interspersed with limestone formations from the Karst Region in its northern zone. Predominant soil series include Pellejas, Humata, Soler, and San Sebastián (Municipio de Utuado).

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The climate is humid and moderate, with annual precipitation ranging from 64 to 73 inches and average temperatures between 63 ºF and 87 ºF. These conditions contribute to the municipality's susceptibility to flooding and landslides (Municipio de Utuado).

Map 1 shows the geographic location and municipal boundary of Utuado in the central interior region of Puerto Rico. Utuado is bordered by the municipalities of Arecibo to the north, Ciales to the east, Jayuya to the southeast, Adjuntas to the south, Lares to the west, and Hatillo to the northwest. The map also illustrates the municipality's mountainous terrain and its position within the island, highlighted in the inset map of Puerto Rico.

Map 2 illustrates the ward (barrio) boundaries within the Municipality of Utuado. The municipality is divided into multiple wards, including Ángeles, Santa Isabel, Caguana, Santa Rosa, Río Abajo, Caniaco, Sabana Grande, Don Alonso, Limón, Mameyes Abajo, Tetuán, Caonillas Abajo, Caonillas Arriba, Las Palmas, Paso Palma, Viví Arriba, Viví Abajo, Arenas, Guaonica, Roncador, Salto Arriba, Salto Abajo, Barrio Pueblo, and Consejo. Ward boundaries are shown within the municipal boundary, and neighboring municipalities are displayed surrounding Utuado.

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Map 1: Geographic Area

Geographic Area



Source: Puerto Rico Planning Board

SPCS PR & VI NAD83

Municipality of Utuado

Neighboring Municipalities



N

Scale: 1:175,000

0 2,000 4,000

Meters

Map 2: Wards Boundaries



3.3.1 PHYSIOGRAPHY

As in the rest of Puerto Rico and other countries, the most populated areas of the Municipality of Utuado are located near rivers and their floodplains. This pattern is more pronounced in locations where the steep topography offers limited opportunities for construction, leaving the mountainous areas primarily for agricultural use. Therefore, Utuado's topography is a key factor in understanding the distribution of its population (Municipio de Utuado).

Utuado is part of the central interior mountainous region. Its terrain is mountainous, with steep slopes, many exceeding 50 percent. Approximately 32 percent of its land area is forested. The highest elevations are found in the south, within the Central Mountain Range. Cerro Morales rises where the Caonillas Arriba and Tetuán wards of Utuado border the Jayuya Abajo ward of the municipality of Jayuya, reaching 988 meters (3,241 feet) above sea level. La Chorrera Mountain and the Roncador Hill measure 900 and 800 meters respectively (equivalent to 2,953 and 2,624 feet) and are located between the Guaonica ward of Utuado and the Tanamá ward of Adjuntas. Prieto Hill reaches 838 meters (2,749 feet) above sea level in the ward Viví Arriba. The Cuchilla Buena Vista, east of the Caonillas reservoir, reaches 500 meters (1,640 feet). Lomas de Lares, located in the northern part of the Ángeles ward and in the Santa Rosa ward, consist of gentler hills (Municipio de Utuado).

The Municipality of Utuado has the highest number of caves on the island. A total of twenty-three (23) caves is known, distributed as follows: four (4) in the Caguana ward, one (1) in the Don Alonso ward, five (5) in the Santa Rosa ward, and the remaining caves in the Ángeles ward (Municipio de Utuado).

The municipality is also home to a forest area it shares with the municipality of Arecibo, known as the Río Abajo State Forest. It is located to the west of the Dos Bocas reservoir and covers an area of approximately 2,280 hectares. Elevations range from 200 to 424 meters (656.1 to 1,391 feet). The forest contains limestone hills known as "mogotes", as well as sinkholes and caves feature typical of the karst region in which it is located (Municipio de Utuado).

Map 3 depicts the physiography of the Municipality of Utuado using elevation data ranging from approximately 85 to 1,051 meters. Lower elevations are shown primarily across the northern and central portions of the municipality, while higher elevations are concentrated in the southern areas, particularly within the wards of Consejo, Viví

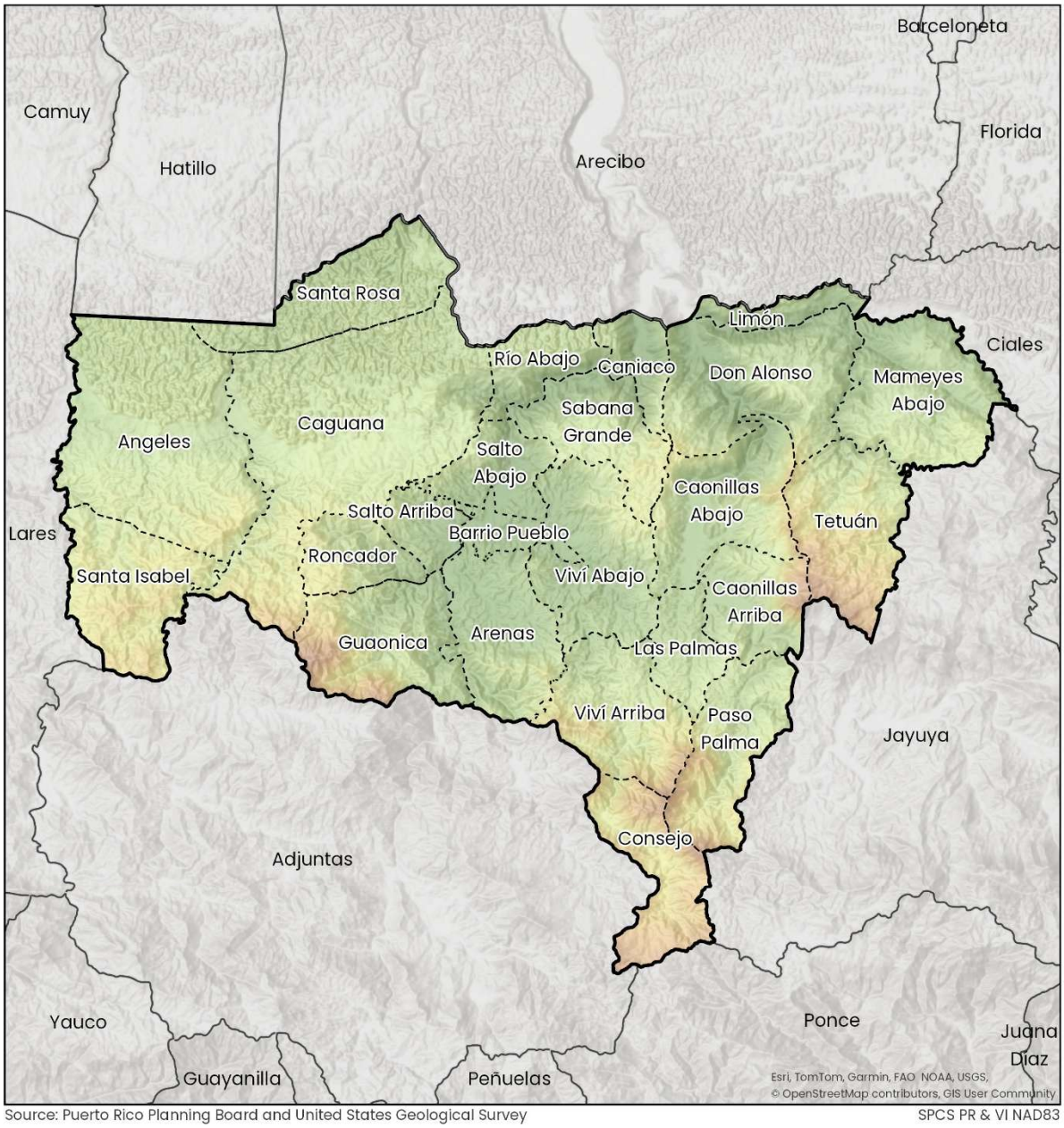
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Arriba, Paso Palma, Las Palmas, and portions of Caonillas Arriba. Ward boundaries and neighboring municipalities are also displayed.

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Map 3: Physiography

PHYSIOGRAPHY



Source: Puerto Rico Planning Board and United States Geological Survey

SPCS PR & VI NAD83

Elevation (Meters)
1051.38
85.0166

Wards
Municipality of Utuado
Neighboring Municipalities



N

Scale: 1:150,000

0 1,500 3,000

Meters

3.3.2 Geology

The geology of Puerto Rico is a key factor that influences the availability and quality of water resources. It is diverse for such a small area, containing a variety of consolidated and unconsolidated formations and deposits. In general, the island can be divided into three geographic areas in which the predominant geological formations affect hydrology (Municipio de Utuado).

The central mountainous region of Puerto Rico is composed of volcanic rocks and is understudied, with high complexity due to the substantial number of fractures. These volcanic rocks date back to the Mesozoic Era, approximately 250 million years ago. Portions of the northern area of the Municipality of Utuado fall within the northern Karst region specifically the Ángeles, Caguana, and Santa Rosa wards, as well as areas within the Caniaco, Limón, and Mameyes Abajo wards (Municipio de Utuado).

The surface geology of the Río Grande de Arecibo consists of volcanic rocks from the Central Mountain Range, characterized by low permeability, steep slopes, and partial forest cover. Along one of its branches, rocks from the Utuado Batholith intrude an extensive mass covering several square miles of volcanic debris, composed primarily of granodiorite, a siliceous mineral that, when weathered, produces substantial amounts of sand. Approximately 497.3 km² (192 mi²) of the watershed surface area consists of volcanic rock, with the remaining 212.4 km² (82 mi²) composed of limestone from the Karst region. The predominant soil series in the higher elevations of the watershed include the Pellejas and Humatas soils. The Soler, San Sebastián, and mixed marine deposit series dominate the rest of the municipality's soils (Municipio de Utuado).

3.3.3 Hydrography

The Río Grande de Arecibo enters the municipality from the south, between the Arenas and Guaonica wards, flowing northward until it empties into the Atlantic Ocean (Municipio de Utuado). Several of its tributaries irrigate the municipality, including the following:

- The Guaonica River (8.6 km), which crosses the ward of the same name, along with its tributaries: the Roncador River (9.9 km) and the Colorada (10.4 km) and Conchita (9.3 km) creeks (Municipio de Utuado).
- The Viví River (7.9 km), which receives water from several creeks, including the Utuado Creek (Municipio de Utuado).

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- The Caguana and Caguanita Rivers, both originating in the Caguana ward (Municipio de Utuado).
- The Caonillas River, along with its tributaries, the Río Grande de Jayuya (6.4 km) and the Jauca River, which originate in the Paso Palma ward (Municipio de Utuado).
- The Limón River, together with its tributaries the Naranjito, Palmarejo, La Venta, and Yunes Rivers and the Charco del Muerto Creek, all originating in the Tetuán ward (Municipio de Utuado).
- The Tanamá River and its tributaries, the Coabey River and the Palma and Pasto creeks (Municipio de Utuado).

Other tributaries of the Río Grande de Arecibo include the Arenas River (8.3 km) and the Júa and Felipa Rivers (5.2 km). The Viví, Caonillas, and Limón Rivers are each approximately 16.9 km (10.5 mi) long (Municipio de Utuado).

The hydrographic system of Utuado also includes four (4) reservoirs: Caonillas, Viví, Dos Bocas, and Jordán (Municipio de Utuado).

The Caonillas Reservoir is fed by the river of the same name and was built in 1948 east of the Utuado Pueblo ward. It sits at an elevation of 250 m (802 ft) above sea level and originally had a capacity of 60.440 million cubic meters (m^3), making it the second-largest reservoir in Puerto Rico by storage capacity. Its drainage basin covers 130 km^2 (50.4 mi^2), and it is owned by the Puerto Rico Electric Power Authority (PREPA). The dam is used for hydroelectric power generation, and the reservoir contains several fish species, including catfish, sunfish, and bass (Municipio de Utuado).

The Viví Dam, located in the southern part of the Municipality of Utuado on the basin of the river of the same name, reaches a maximum elevation of 322 m (1,060 ft) above sea level. It originally held 341,700 m^3 of water, with a drainage area of 17 km^2 (6.5 mi^2), and is used for hydroelectric power generation (Municipio de Utuado).

The Dos Bocas Reservoir was constructed at the confluence of the Río Grande de Utuado, Caonillas, and Limón Rivers, between the municipalities of Utuado and Arecibo. It reaches a maximum elevation of 89 m (295 ft) above sea level and originally had a capacity of 40,000,000 m^3. It is the third-largest reservoir in Puerto Rico in terms of drainage area, covering approximately 440 km^2 (170 mi^2), and it is also used for hydroelectric power production (Municipio de Utuado).

The Jordán Dam is a small reservoir located alongside the Viví River. It is situated

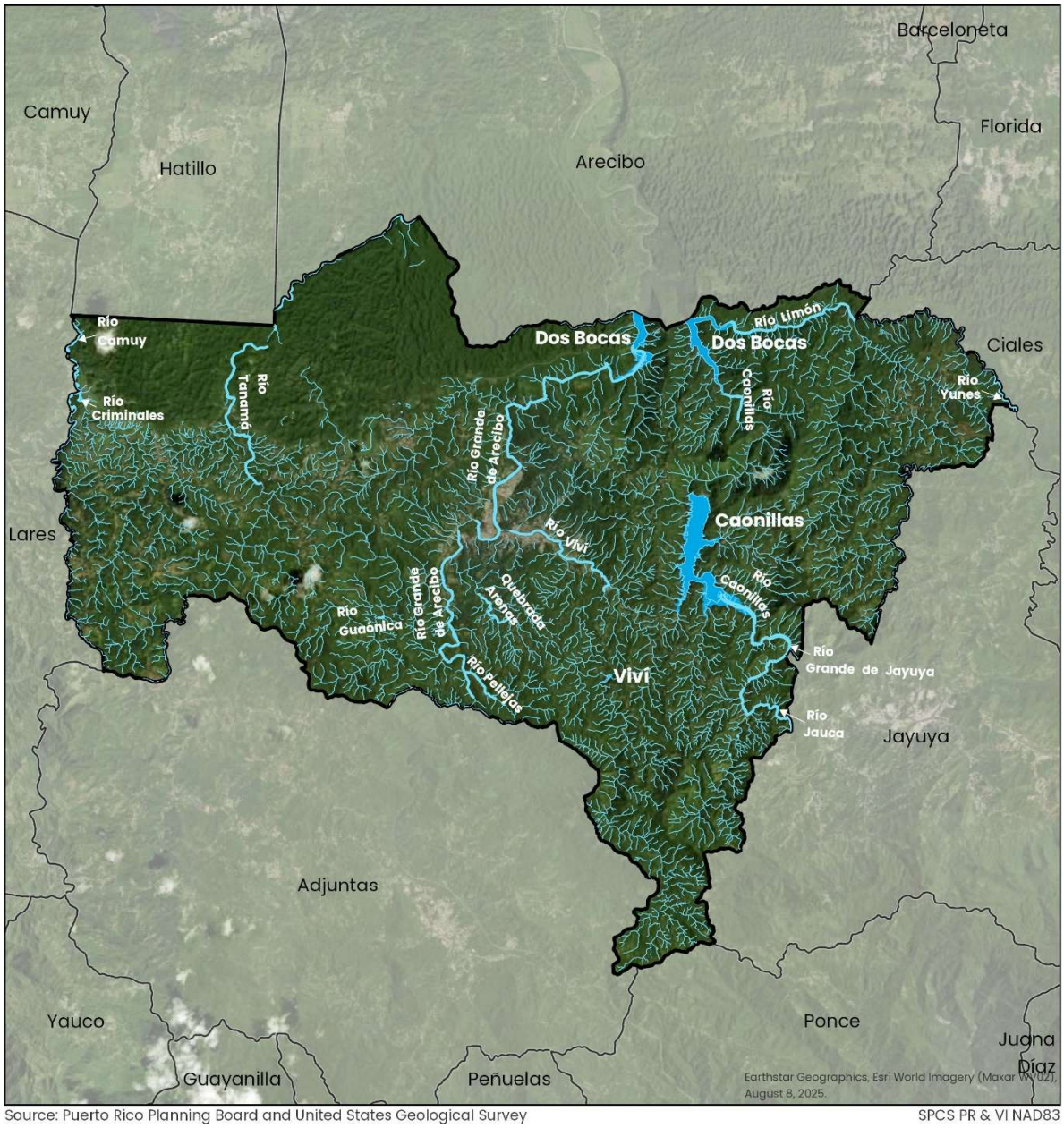
northeast of the Viví Reservoir and is used to generate hydroelectric power (Municipio de Utuado).

Map 4 displays the hydrography of the Municipality of Utuado, including an extensive network of rivers and streams distributed throughout the municipality. Major water features shown on the map include the Río Grande de Arecibo, Río Viví, Río Caguana, Río Tanamá, Río Limón, Río Yunes, Río Camuy, Río Criminales, and Río Grande de Jayuya. The map also identifies the Dos Bocas and Caonillas reservoirs located in the northern and eastern portions of the municipality.

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Map 4: Hydrography

HYDROGRAPHY



Source: Puerto Rico Planning Board and United States Geological Survey

SPCS PR & VI NAD83

Hydrography
Reservoirs
Municipality of Utuado
Neighboring Municipalities



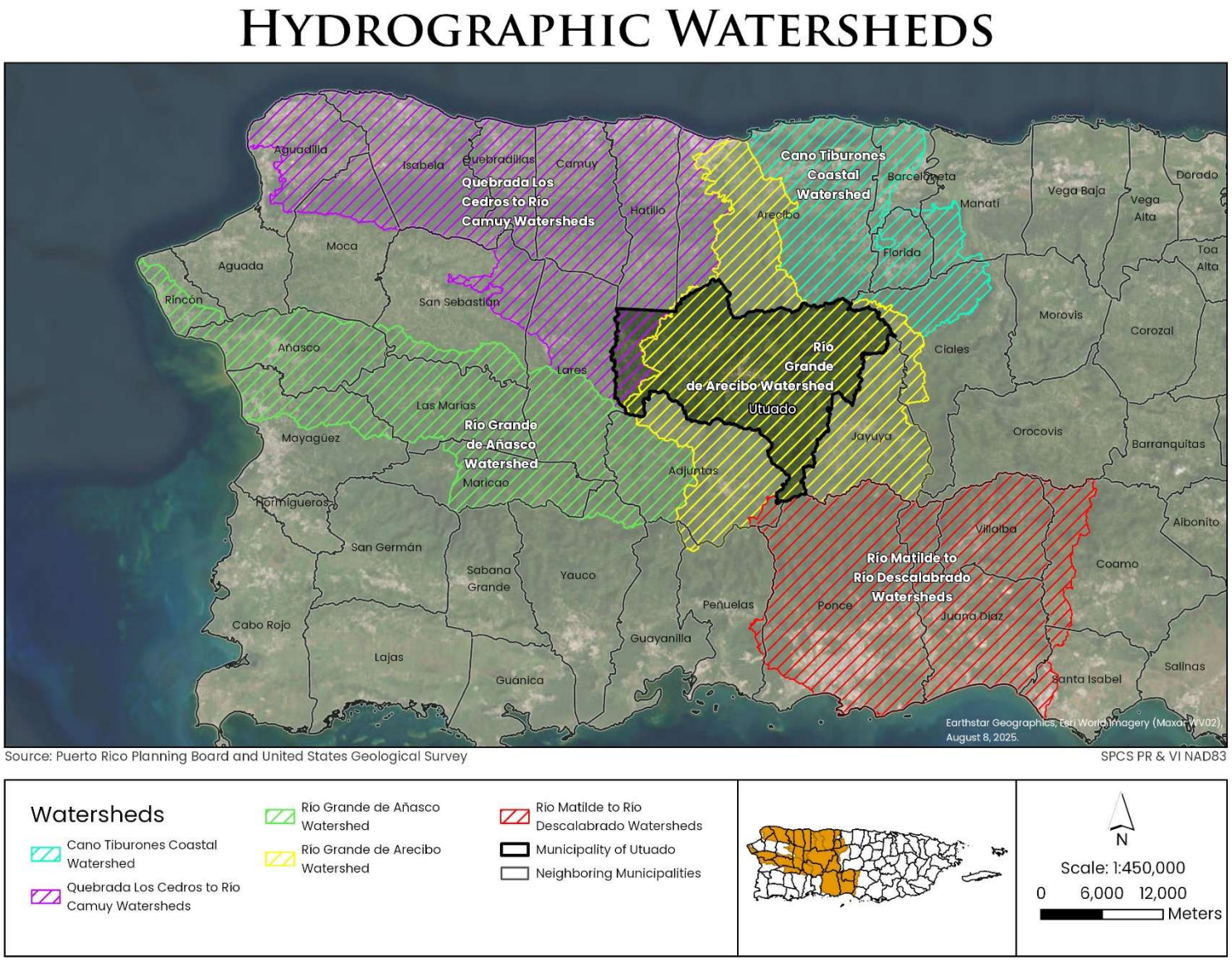
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Scale: 1:150,000

0 1,500 3,000

Meters

Map 5: Hydrographic Watersheds

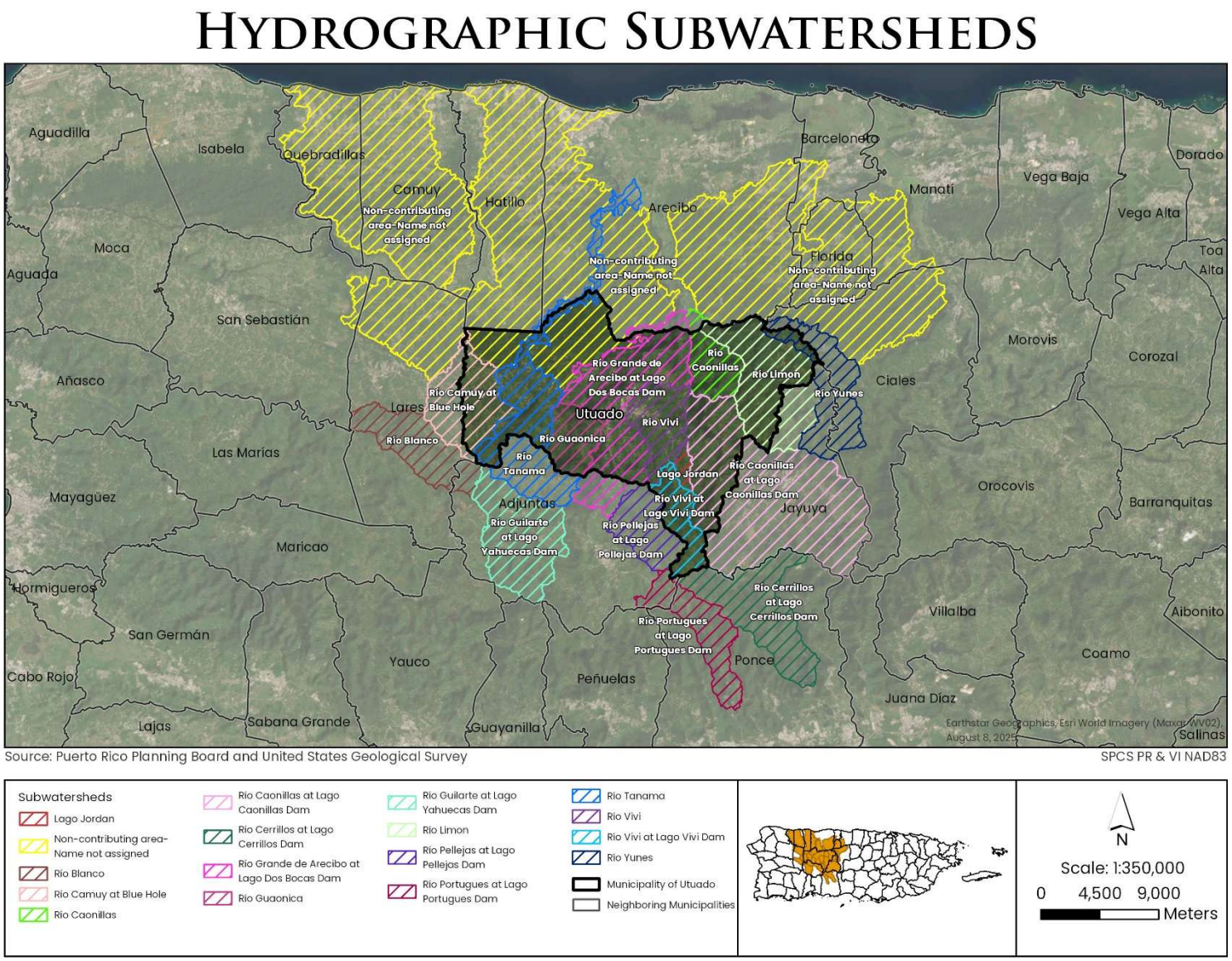


Source: Puerto Rico Planning Board and United States Geological Survey

SPCS PR & VI NAD83

The map shows that the municipality is located primarily within the Río Grande de Arecibo Watershed. Smaller portions of the municipality extend into the Quebrada Los Cedros to Río Camuy Watersheds, the Río Grande de Añasco Watershed, and the Río Matilde to Río Descalabrado Watersheds. The municipality is outlined and displayed in relation to surrounding watershed boundaries and neighboring municipalities across Puerto Rico.

Map 6: Hydrographic Sub-Watersheds



Source: Puerto Rico Planning Board and United States Geological Survey

SPCS PR & VI NAD83

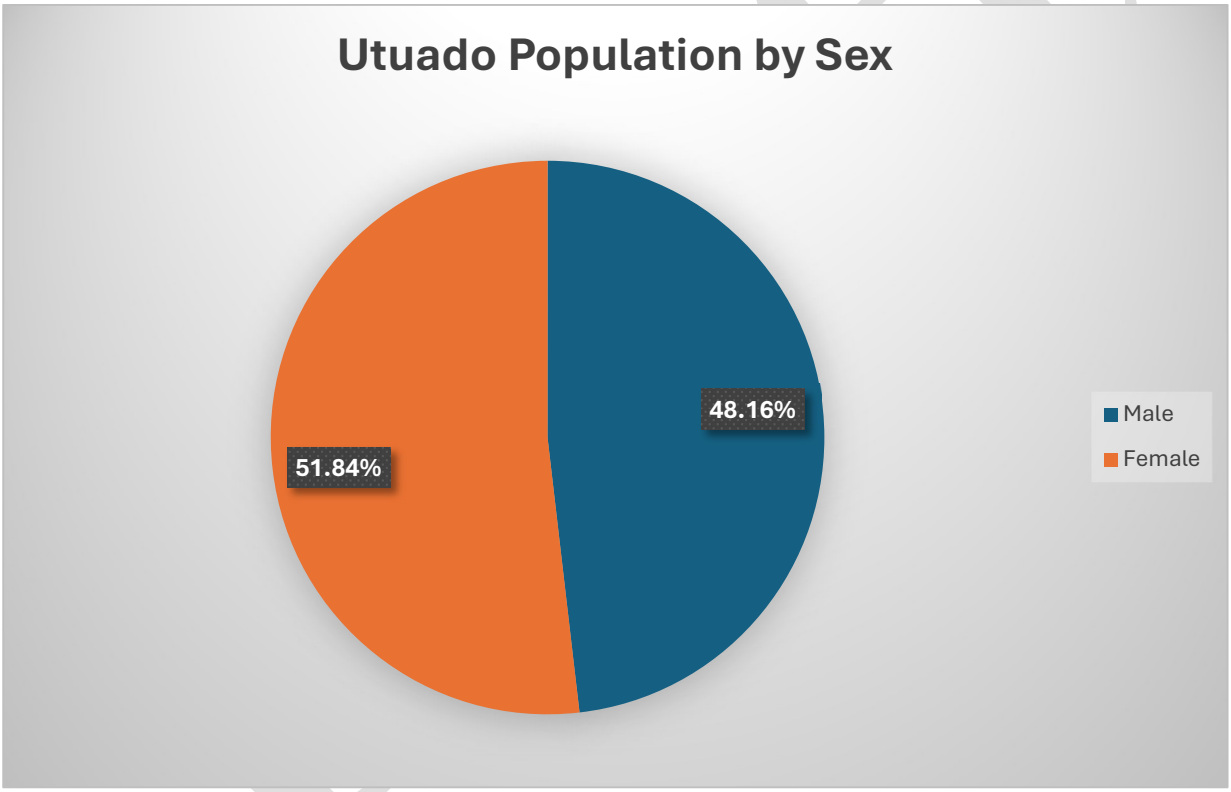
The map shows that the municipality is divided among multiple hydrologic subwatersheds. The largest portions of the municipality are located within the Río Grande de Arecibo at Lago Dos Bocas Dam, Río Viví, Río Caonillas, Río Limón, Río Yunes, Río Guaonica, and Río Tanamá subwatersheds. Smaller areas of the municipality extend into the Río Blanco, Río Camuy at Blue Hole, Río Viví at Lago Viví Dam, and Río Caonillas at Lago Caonillas Dam subwatersheds. Surrounding subwatersheds and neighboring municipalities are also displayed.

3.4 Demographics

3.4.1 Current Population

According to the 2020-2024 American Community Survey, Five-Year Estimates (ACS 2024) [2] the total population of Utuado is 27,621. Of these, 13,303 persons are male and 14,318 are female. The percentage split is 48.16 percent male, 51.84 percent female. The sex ratio is 92.9 males per 100 females (US Census Bureau, 2025).

Figure 9: Utuado Population by Sex (2024 ACS)



3.4.2 Age

According to the 2024 ACS a total of 7,020 people in Utuado were 65 or older. This constitutes little more than a quarter of the total population of Utuado. While 3,278 people (11.58%) of the population are 75 years old or older.

On the younger age groups, Utuado has 5,120 persons (18.54%) that are 19 years old or younger. Of those, 1,872 (6.78%) are 9 years old or younger. This LHMP considers people

[2] Unless otherwise stated, all data and analysis are from the 2024 Five-Year American Community Survey (ACS) Data Set for Utuado.

younger than 19 and older than 65 as vulnerable. As such we find that 12,140 residents of Utuado (43.95% of the population) are especially vulnerable to the effects of a natural disaster.

Table 5 distributes the current population of Utuado by age groups in cohorts of four years as established in the ACS Demographic and Housing Estimates. Table 4 compares the data of the 2024 ACS with that of the 2015-2019 ACS (2019 ACS).

Table 5: Population by Age Group 2024 ACS vs 2019 ACS

Age Cohort	Population 2024	Percentage 2024	Population 2019	Percentage 2019	Net Change	Rate of Change
Under 5 years	830	3.00%	1,235	4.30%	-405	-32.79%
5 to 9 years	1,042	3.80%	1,498	5.20%	-456	-30.44%
10 to 14 years	1,685	6.10%	1,811	6.30%	-126	-6.96%
15 to 19 years	1,563	5.70%	1,872	6.50%	-306	-16.51%
20 to 24 years	1,621	5.90%	1,843	6.40%	-222	-12.05%
25 to 29 years	1,645	6.00%	1,845	6.40%	-200	-10.84%
30 to 34 years	1,710	6.20%	1,570	5.50%	140	8.92%
35 to 39 years	1,387	5.00%	1,500	5.20%	-113	-7.53%
40 to 44 years	1,704	6.20%	1,688	5.90%	16	0.95%
45 to 49 years	1,602	5.80%	1,771	6.20%	-169	-9.54%
50 to 54 years	1,785	6.50%	1,979	6.90%	-194	-9.80%
55 to 59 years	1,901	6.90%	2,088	7.30%	-187	-8.96%
60 to 64 years	2,126	7.70%	2,000	7.00%	126	6.30%
65 to 69 years	1,909	6.90%	1,764	6.20%	145	8.22%
70 to 74 years	1,833	6.60%	1,687	5.90%	146	8.65%
75 to 79 years	1,554	5.60%	1,088	3.80%	466	42.83%
80 to 84 years	896	3.20%	698	2.40%	198	28.37%
85 years and over	828	3.00%	739	2.60%	89	12.04%
Total	27,621		28,676		-1,055	-3.68%

Source: US Census ACS 2020-20245

The demographic analysis indicates that Utuado experienced its largest population decline among the youngest age groups. The population under 5 years of age decreased by 32.79%, followed by the 5 to 9 age group (-30.44%) and the 15 to 19 age group (-16.51%). In contrast, the most significant increases occurred among older residents, with the 75 to 79 age group increasing by 42.83% and the 80 to 84 age group increasing by 28.37%. Overall, the municipality's population declined by 1,055 residents, representing a 3.68% decrease.

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Figure 10 shows the same age group distribution in a bar chart form. Figure 11 shows an irregular population pyramid that the municipality's aging population, with larger older-age cohorts than younger age cohorts.

Figure 10: Utuado Population by Age Group (ACS 2024)

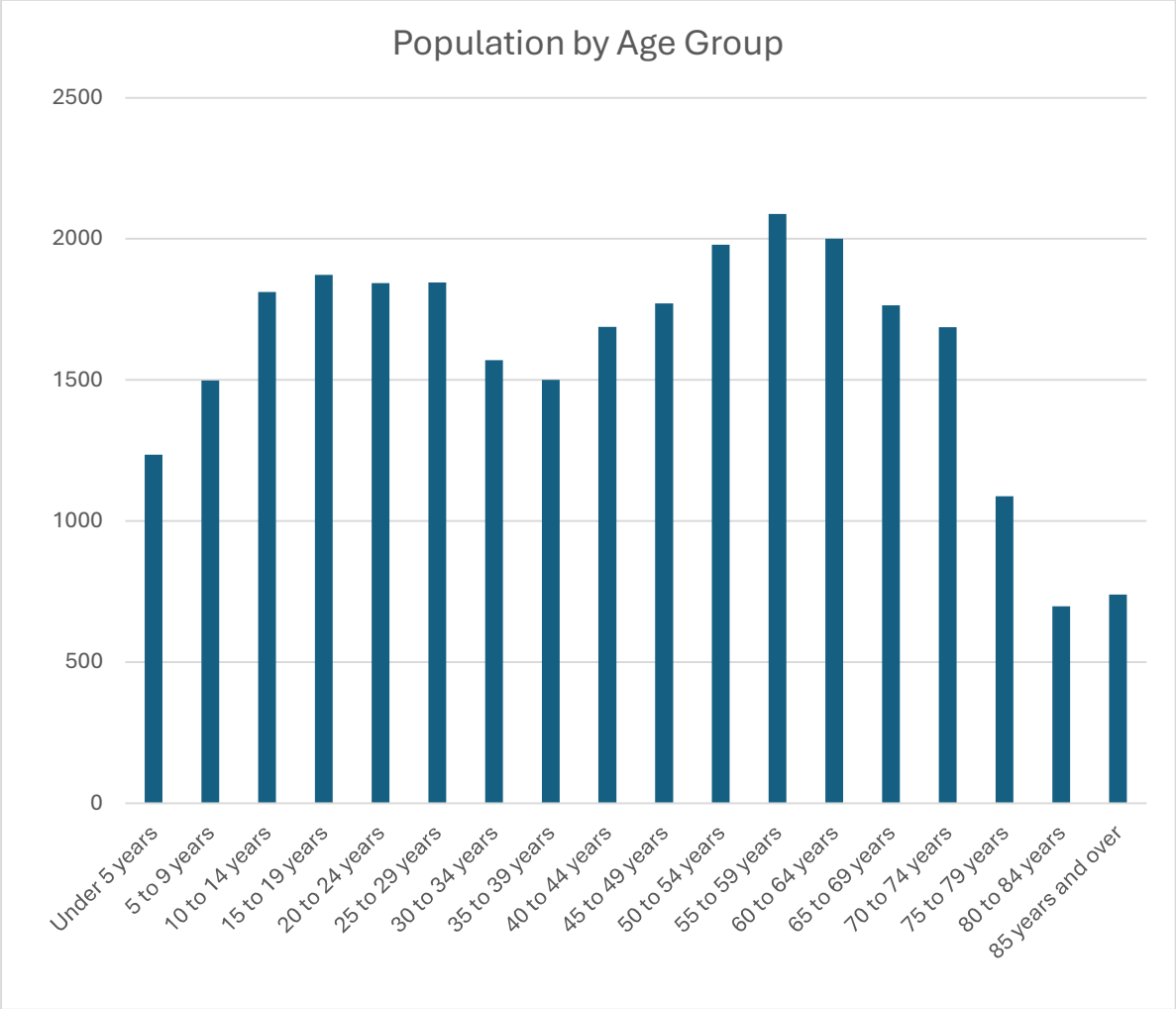
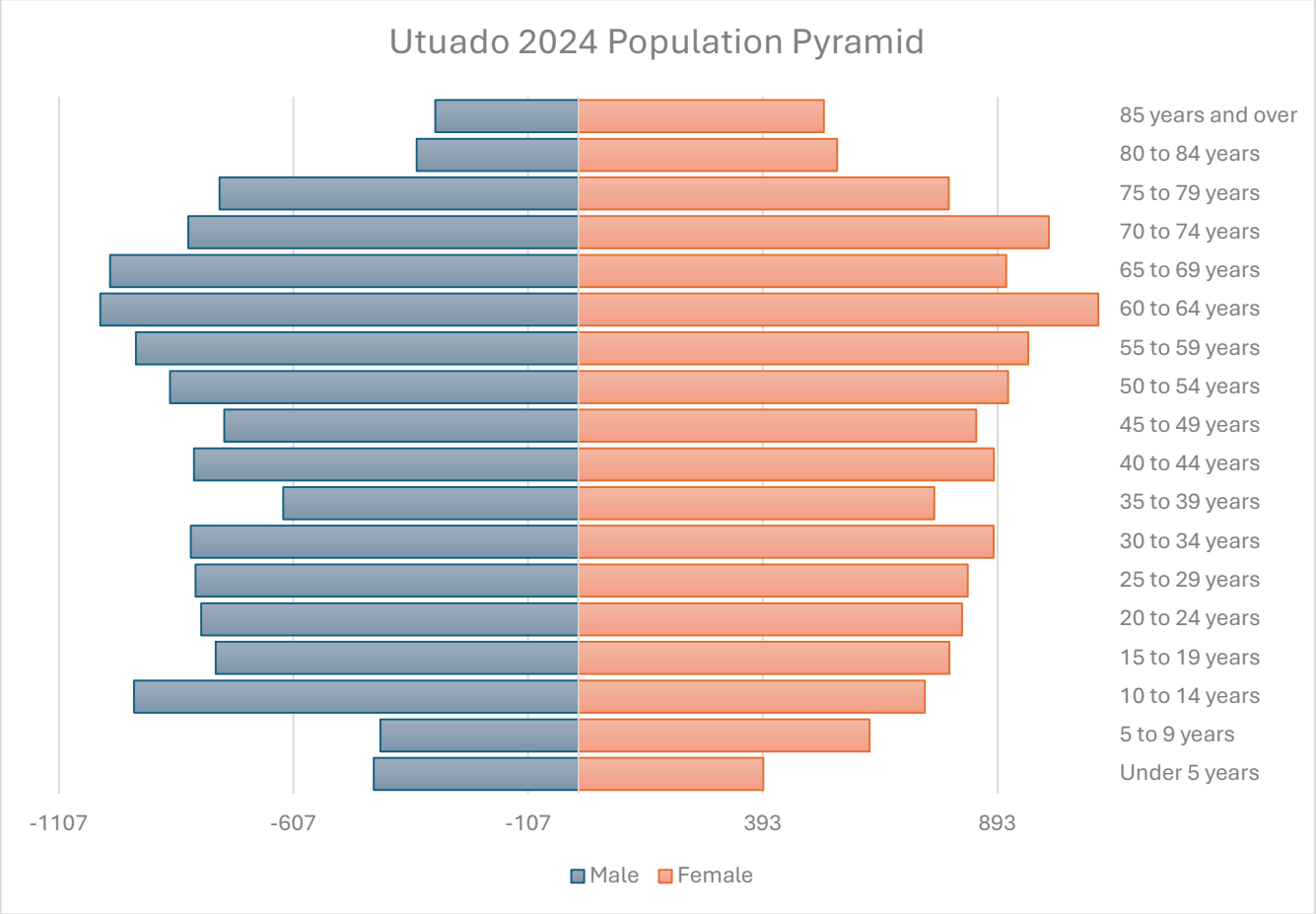
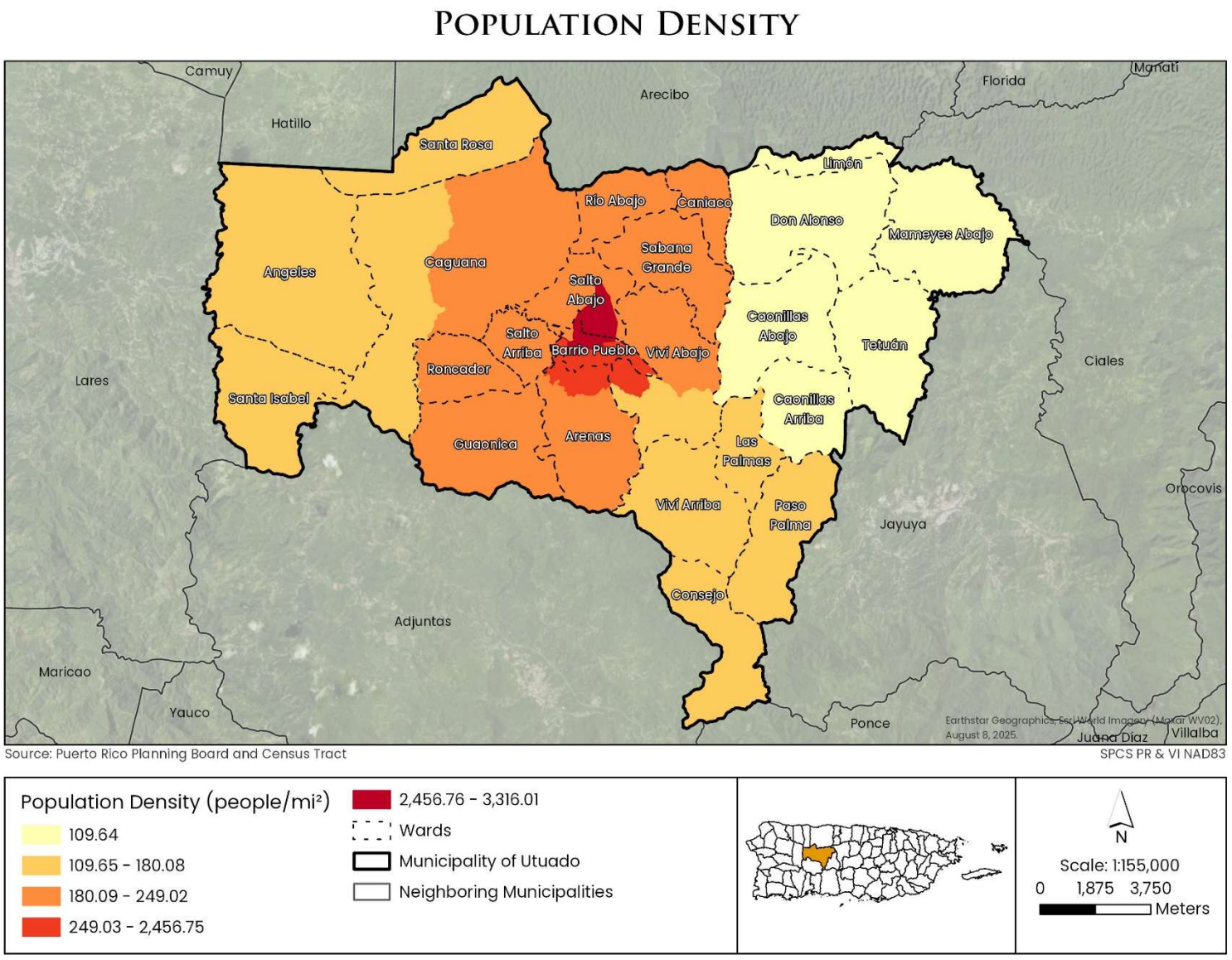


Figure 11: Utuado Population Pyramid (2024 ACS)



Map 7: Population Density by Census Tract



The population density map shows that the highest population densities are concentrated within Barrio Pueblo, located near the center of Utuado. Surrounding barrios, including Salto Arriba, Salto Abajo, Caguana, Roncador, Guanico, Arenas, Sabana Grande, and Vivi Abajo, display moderate population densities. Lower population densities are generally found in the eastern and northeastern portions of the municipality, including Limón, Mameyes Abajo, Don Alonso, Caonillas Abajo, and Tetuán, as well as parts of the southern sector. Overall, the map illustrates a pattern of decreasing population density away from the central urban area toward the municipal periphery.

3.4.3 Socio-economic Characteristics

3.4.3.1 Employment

Table 6 shows the employment status for the municipality according to the 2020-2024 Five-Year ACS.

Table 6: Current Labor Force Statistics[3]

Variable[4]	Estimate 2024	Percentage 2024
Population 16 years and over	23,824	
In Labor Force	10,091	42.40%
Civilian Labor Force	10,091	42.40%
Employed	7,951	33.40%
Unemployed	2,140	9.00%
Armed Forces	0	0.00%
Not in Labor Force	13,733	57.60%
Unemployment rate		21.20%

Source: US Census ACS 2020-2024

The census data shows that the population in the labor force for Utuado is lower than the population that is not in the labor force (42.40% in labor force vs 57.60% not in labor force). Compared with the 2019-2024 Five-Year ACS the percentage of population in the labor force has increased (42.40% in 2024 vs 37.90% in 2019). In comparison with the whole Commonwealth of Puerto Rico, the municipal population in the labor force is lower (42.40% for Utuado vs 46.40% for Puerto Rico).

The 2024 ACS showed an unemployment rate for the municipality of 22.4%. This

[3] US Census Table DP03: Selected Economic Characteristics. The civilian labor force includes non-institutionalized civilians aged 16 years and older who are either employed or actively seeking employment. The labor force is broader, as it includes both the civilian labor force and members of the Armed Forces on active duty. Institutionalized individuals, such as those residing in prisons or nursing homes, are not included in either category.

[4] According to the U.S. Census Bureau and the American Community Survey (ACS), the terms labor force and civilian labor force are related but not identical: Civilian Labor Force consists of all noninstitutionalized civilians aged 16 years and older who are either employed (working or temporarily absent from a job), or unemployed (not working but actively seeking work and available to work). The labor force is broader than the civilian labor force. It includes everyone in the civilian labor force (employed, unemployed civilians), plus active-duty members of the U.S. Armed Forces. Institutionalized populations are people in prisons or nursing facilities.

represents an decrease regarding the 2015-2019 Five-Year ACS (22.4% in 2024 vs 31.0% in 2019). In comparison to the whole Commonwealth of Puerto Rico the unemployment rate is higher (21.20% for Utuado vs 10.70% for Puerto Rico).

3.4.3.2 Employment by Industry

The following table presents employment by industry within the municipality, comparing data from the ACS 2020-2024 Five-Year Estimates with the 2015-2019 Five-Year Estimates. The final column reflects the percentage change in employment by industry between the two survey periods.

Table 7: Employment by Industry 2024 ACS vs 2019 ACS

Industry	ACS 2024 Five Year	Percentage 2024	ACS 2019 Five Year	Percentage 2019	Net Change between 2024 and 2019[5]	Rate of Change
Agriculture, forestry, fishing and hunting and mining	355	4.50%	230	3.70%	125	54.35%
Construction	594	7.50%	448	7.20%	146	32.59%
Manufacturing	559	7.00%	574	9.20%	-15	-2.61%
Wholesale Trade	108	1.40%	109	1.80%	-1	-0.92%
Retail Trade	1,204	15.10%	976	15.70%	228	23.36%
Transportation and warehousing, and utilities	313	3.90%	200	3.20%	113	56.50%
Information	82	1.00%	91	1.50%	-9	-9.89%
Finance and Insurance, and real estate and rental and leasing	313	3.90%	219	3.50%	94	42.92%
Professional, scientific, and management, and administrative and waste management services	685	8.60%	484	7.80%	201	41.53%
Educational services, health care and social assistance	2,185	27.50%	1,490	24.00%	695	46.64%

[5] Rate of percentage change is calculated as $Percentage\ Change = \frac{2024\ Employment - 2019\ Employment}{2019\ Employment} \times 1$

Industry	ACS 2024 Five Year	Percentage 2024	ACS 2019 Five Year	Percentage 2019	Net Change between 2024 and 2019[5]	Rate of Change
Arts, entertainment, recreation, and accommodation and food services	419	5.30%	438	7.00%	-19	-4.34%
Other services, except public administration	378	4.8%	208	3.30%	170	81.73%
Public administration	756	9.50%	753	12.10%	3	0.40%
Total employee population 16 years and over	7,951	-	6,220	-	1,731	27.83%

Source: US Census ACS 2020-2024 5 years Estimates

Table 7 shows the following employment characteristics for Utuado:

- The industry with the highest level of employment in Utuado in 2024 is the "Educational services, healthcare and social assistance" industry with 2,185 individuals, representing 27.50% of the municipality's workforce.
- This sector also held the largest share of employment in the 2019 ACS, confirming its continued dominance in Utuado's labor market.
- Other major industries with substantial employment levels in 2024 include:
  - "Retail Trade" (1,204 individuals or 15.10%).
  - "Professional, scientific, and management, and administrative and waste management services" (685 individuals or 8.60%).
  - "Construction" (594 individuals or 7.50%).
  - "Manufacturing" (559 individuals or 7.00%).
- A comparison between the 2024 and 2019 ACS datasets shows that the industries experiencing negative percentage growth were:
  - "Manufacturing" (–2.61%).
  - "Wholesale Trade" (–0.92%).
  - "Information" (–9.89%).
  - "Arts, entertainment, recreation, and accommodation and food services" (–4.34%).
- The industry with the highest positive rate of percentage change was Other Services, which increased by 81.73% between 2019 and 2024. Other industries that experienced positive percentage growth include:
  - Transportation and warehousing, and utilities (56.50%)

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- Agriculture, forestry, fishing and hunting, and mining (54.35%)
- Construction (32.59%)
- Finance and Insurance, and real estate and rental and leasing (42.92%)
- Professional, scientific, management, administrative, and waste management services (41.53%)
- Educational services, health care, and social assistance (46.64%)

- Overall, the distribution of employment by industry indicates that several service-oriented sectors experienced notable employment growth between 2019 and 2024, particularly health care, professional services, transportation, and other services. In contrast, employment declined in the information, manufacturing, wholesale trade, and accommodation and food services sectors. Despite these declines, the municipality's employed population increased by 1,731 workers, representing an overall growth rate of 27.83% during the period.

3.4.3.3 Poverty Level

According to the U.S. Census Bureau, 13,833 nresidents of Utuado (50.30%) live in poverty over the past 12 months[6], as determined by income thresholds that vary according to household size and composition. This information is used to evaluate the economic well-being of individuals and families. The table is essential for understanding the economic conditions of different groups and for guiding the development and implementation of policies aimed at reducing poverty as well as the vulnerability of the population.

Table 8: 2024 ACS Poverty Level

Total Population[7]	Number of Individuals below the poverty level during the last 12 months	Percentage of the Population below the poverty level in the last twelve months
27,496	13,833	50.30%

Source: US Census ACS 2020-2024

[6] The U.S. Census Bureau determines poverty status by comparing a family's income during the previous 12 months with federal poverty thresholds that vary according to family size, composition, and age of the householder. Individuals with incomes below the applicable threshold are classified as living in poverty. The poverty threshold for 2024 can be found in http://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-threshold.html

[7] Note that the census data has a slight discrepancy in the number of total populations reported in this dataset and other data sets.

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3.4.3.4 Income

According to the 2024 ACS, the median household income for Utuado was $20,800, while the mean household income was $29,655. The following table shows the estimated income and benefits for households in the municipality.

Table 9: 2024 ACS Income and Benefits per Household

Category	Number of Households	Percentage
Less than $10,000	2,887	25.50%
$10,000 to $14,999	1,311	11.60%
$15,000 to $24,999	2,604	23.00%
$25,000 to $34,999	1,447	12.80%
$35,000 to $49,999	1,304	11.50%
$50,000 to $74,999	1,020	9.00%
$75,000 to $99,999	429	3.80%
$100,000 to $149,999	127	1.10%
$150,000 to $199,999	92	0.80%
$200,000 or more	90	0.80%
Total Households	11,311	100%

Source: US Census ACS 2020-2024

Table 9 shows that a total of 25.5% of households in Utuado earn less than $10,000 per year. While 60.10% of households earn less than $25,000 per year. In comparison for 2019-2024 ACS 35.60% of households earned less than $10,000 and 67.30% of households earned less than $25,000.

3.4.3.5 Population with disabilities

Table 10 presents data on individuals living with disabilities based on the 2020–2024 and 2015–2019 American Community Survey Five-Year Estimates. Overall, the population living with a disability in Utuado increased slightly by 36 people, from 5,675 in 2019 to 5,711 in 2024, representing a 0.63% rate of change. The largest numerical decrease occurred among individuals ages 35 to 64, with a net decline of 993 people (-36.78%), while the population ages 5 to 17 decreased by 21 people (-5.38%). Conversely, increases were recorded among individuals ages 18 to 34, with 158 additional people (51.30%); ages 65 to 74, with an increase of 410 people (49.00%); and ages 75 years and over, with an increase of 482 people (33.47%). No change was

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reported among children under five years of age. These data are particularly relevant to the LHMP update because individuals living with disabilities may face additional challenges before, during, and after natural hazard events, underscoring the importance of inclusive emergency planning, accessible communications, and appropriate evacuation and recovery measures.

Table 10: Population Living with Disabilities

Age Group	2024	2019	Net change	Rate of change
Under 5 years	0	0	0	0.00%
5 to 17 years	369	390	-21	-5.38%
18 to 34 years	466	308	158	51.30%
35 to 64 years	1,707	2,700	-993	-36.78%
65 to 74 years	1,247	837	410	49.00%
75 years and over	1,922	1,440	482	33.47%
Total Population living with a disability	5,711	5,675	36	0.63%

Source: US Census ACS 2020-2024 and 2015-2019 5-years Estimates

3.4.3.6 Population Receiving Supplemental Nutritional Support

Table 11 provides information on households in Utuado that receive food assistance, based on data from the 2020–2024 and 2015–2019 American Community Survey (US Census Bureau, 2025).

Table 11: Population Receiving Food Aid

Data Set	2024	2019	Net Change	Rate of Change
Total Households in the municipality	11,311	9,563	1,748	18.28%
Households receiving food assistance	7,088	4,582	2,506	54.69%
Percent of Households receiving food assistance	62.7%	47.8%	-	31.17%
Households with children under 18	2,763	2,660	103	3.87%
Married Couple	1,167	1,372	-205	-14.94%
Male Householder, no spouse present	850	353	497	140.79%
Female Householder, no spouse present	2,106	913	1,193	130.67%
Households with one or more people 60 years and over	6,378	5,231	1,147	21.93%

Source: US Census ACS 2020-2024 and 2015-2019 5-years Estimates

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As shown in the table above, a total of 7,088 households in the municipality receive food assistance, representing a significant increase of 2,506 households since the 2019 ACS. This reflects a 54.69% rise in households receiving food assistance. Additionally, the proportion of households relying on food assistance increased from 47.80% in 2019 to 62.70% in 2024, a growth of 14.9 percentage points. These figures indicate that food insecurity has intensified, with nearly two-thirds of all households now depending on supplemental nutritional support.

3.4.3.7 Health Insurance Coverage

The following table shows the 2020-2024 ACS health insurance coverage for the municipality.[8]

Table 12: 2024 ACS Health Insurance Data

Variable	Estimate 2024	Percentage 2024
Civilian noninstitutionalized population	27,583	
With health insurance coverage	26,153	94.80%
With private health insurance	6,824	24.70%
With public coverage	20,602	74.70%
No health insurance coverage	1,430	5.32%

Source: US Census ACS 2020-2024

The data shows that 1,430 people (5.32%) in Utuado have no health insurance at all. While almost three quarters (74.70%) depend on public health coverage. This data will be revisited when discussing the hazard of pandemic/epidemic.

[8] Private and public health insurance categories are not mutually exclusive. Some individuals are covered by both types of insurance; therefore, the totals and percentages do not sum to the total population with health insurance coverage.

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3.4.4 Housing Stock and other Related Details

According to the 2024 ACS, Utuado had 13,624 housing units of which 2,313 were vacant. This constitutes less than a quarter or (16.98%) of the total housing stock of the municipality. As reported by the 2024 ACS of the 11,311 occupied housing units, 7,391 (65.30%) units were occupied by owners and 3,920 (34.70%) by renters.

The next table shows the year of construction of the housing units by range.

Table 13: 2024 ACS- Housing Units by Year of Construction

Year Structure Built	Housing Units	Percentage
Built 2020 or later	56	0.40%
Built 2010 to 2019	631	4.60%
Built 2000 to 2009	1,926	14.10%
Built 1990 to 1999	2,505	18.40%
Built 1980 to 1989	2,703	19.80%
Built 1970 to 1979	2,553	18.70%
Built 1960 to 1969	1,678	12.30%
Built 1950 to 1959	911	6.70%
Built 1940 to 1949	399	2.90%
Built 1939 or earlier	262	1.90%
Total	13,624	100%

Source: US Census ACS 2020-2024

The 2024 ACS shows that Utuado's housing stock reflects an aging pattern, with most structures built several decades ago. Of the 13,624 total housing units, only 56 units (0.40%) were constructed in 2020 or later, and 4.60% were built between 2010 and 2019. The latest Building Code was adopted by the government of Puerto Rico in 2018, before that the most recent version of the Building Code was adopted in 2011. This means that at least 95.00% of the housing stock was built before the current and immediately previous building code. This suggests that a significant portion of Utuado's housing stock may not comply with current building codes, making many structures more vulnerable to natural hazards such as earthquakes and tropical cyclones.

A combined 52.90% of all housing units were built between 1970 and 1999, representing the bulk of the municipality's residential development. Additionally, 19.80% of units were constructed during the 1980s, and 18.7% during the 1970s. Older housing is also present in substantial numbers, with 12.30% built in the 1960s, 6.70% in the 1950s, and

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2.90% in the 1940s. Notably, 1.90% of the units were built in 1939 or earlier. These figures indicate that more than 93.00% of Utuado's housing stock predates the 2011 and 2018 building codes, highlighting potential structural vulnerabilities, particularly in the face of natural hazards.

The following table shows the vehicles available per occupied housing units.

Table 14: 2024 ACS Vehicles per Occupied Housing Unit

Variable	Occupied Housing Units	Percentage
No vehicles available	1,400	12.40%
1 vehicle available	4,826	42.70%
2 vehicles available	2,919	25.80%
3 or more vehicles available	2,166	19.10%
Total	11,311	

Source: US Census ACS 2020-2024

The 2024 ACS shows that there are 1,400 housing units that do not have available vehicles. This represents a critical matter since the development pattern in the municipality is rural and/or suburban, where vehicular transportation is necessary for mobility.

3.5 Critical Infrastructure

Infrastructure refers to the essential physical and organizational systems that support the effective functioning of a society or economy. It includes critical networks such as transportation systems (roads, bridges, railways), energy generation and distribution, water supply, telecommunications, and other services that sustain economic activity and daily life. Collectively, infrastructure serves as the foundational framework that enables communities and economies to operate reliably and efficiently (NIST, n.d.). Infrastructure is commonly classified into two categories: hard infrastructure and soft infrastructure.

- Hard infrastructure refers to the physical facilities and networks that underpin the functioning of a modern society and economy. This includes transportation systems such as roads, bridges, railways, and airports, as well as water systems, electrical grids, and telecommunications networks. These tangible assets

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enable the movement of people and goods, the distribution of energy and water, and the transmission of information.

- Soft infrastructure refers to the institutions, services, and systems that support economic stability, public health, social order, and cultural development. This category includes educational institutions, healthcare systems, law enforcement agencies, emergency response services, parks, and recreational facilities. Unlike hard infrastructure, soft infrastructure is characterized by organizational frameworks and human-centered services that contribute to community well-being and effective governance.

Appendix F below contains a table with the infrastructure assets that are considered critical for Utuado.

As described in Section 2.8, FEMA defines Community Lifelines as the most essential services and systems necessary to sustain the uninterrupted operation of critical government and business functions, while also protecting public health, safety, and economic security. These lifelines constitute the fundamental components of a community and once stabilized, enable all other sectors of society to function effectively. During disaster events, any disruption to these lifelines requires immediate and coordinated action to restore stability and reduce cascading impacts. Accordingly, the assessment of existing infrastructure will be conducted in alignment with FEMA's Community Lifelines framework.

3.5.1 Lifeline: Safety and Security



The purpose of the Safety and Security Lifeline is to protect life and property while maintaining social stability during emergency situations. This lifeline focuses on reducing immediate risks to public safety and personal security through the operation of public safety agencies, controlled access to affected areas, and the prevention of crime, civil unrest, and violence. It also encompasses ensuring safety and security at emergency shelters, distribution centers, and other critical facilities during disaster response and recovery operations.

FEMA indicates that disruption of this lifeline can result in social disorder and heightened community vulnerability, making rapid restoration a critical priority. Response actions require close coordination among federal, state, and local agencies,

the deployment of security personnel, the implementation of traffic control measures, and the protection of critical infrastructure.

Map 8 illustrates the Safety and Security Lifeline facilities primarily concentrated in and around Barrio Pueblo, where several safety and security sites are in close proximity. Additional safety and security facilities are distributed throughout other sectors of the municipality, including western, central, and eastern barrios. The map also shows the relationship between these facilities and the primary and secondary transportation routes that provide access throughout the municipality.

3.5.2 Lifeline: Food, Hydration and Shelter



The Food, Hydration, and Shelter Lifeline is intended to ensure that disaster-affected populations have prompt access to essential necessities, including food, potable water, and safe shelter. This lifeline encompasses the provision of ready-to-eat meals, water distribution, the establishment of temporary shelters, and coordination with governmental and volunteer organizations to meet basic human needs. Disruptions to this lifeline pose an immediate threat to life; therefore, rapid response actions are prioritized to restore food availability and housing stability as quickly as possible.

Map 8 shows the distribution of Food, Hydration, and Shelter lifeline facilities throughout the Municipality of Utuado. These facilities are concentrated primarily in and around Barrio Pueblo, with additional facilities located in the western, central, and eastern portions of the municipality. The map also illustrates the proximity of these facilities to the primary and secondary transportation network, including routes that connect the urban center with surrounding barrios.

3.5.3 Lifeline: Health and Medical



The purpose of this lifeline is to ensure the continuity of essential medical services and the protection of public health during emergencies and disasters. It focuses on stabilizing healthcare delivery, ensuring access to hospitals, clinics, medications, and healthcare personnel, and maintaining the capacity to respond effectively to life-threatening conditions

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FEMA indicates that disruption of this lifeline can have serious consequences; therefore, priority actions focus on restoring medical facilities, deploying emergency response teams, ensuring the availability of critical medical supplies, and coordinating efforts among federal, state, and local agencies.

Map 8 shows that health and medical facilities are concentrated in Barrio Pueblo, with additional facilities located throughout the municipality along major transportation corridors. Their distribution supports access to emergency sheltering and essential resources, helping to meet residents' basic needs during and after hazard events.

3.5.4 Lifeline: Energy



The Energy Lifeline is designed to ensure the reliable and safe delivery of electricity, gas, and essential fuels during emergencies and disaster events. This lifeline is vital to sustaining the operation of critical facilities and services, including hospitals, water and wastewater systems, telecommunications, and other infrastructure that depend on uninterrupted energy supply.

FEMA recognizes that disruptions to energy services pose a direct threat to life safety and community stability. Accordingly, priority response actions include the rapid restoration of the electrical grid, the deployment of generators to critical facilities, coordination with fuel suppliers, and the implementation of temporary measures to maintain service continuity.

Map 8 shows that the Energy Lifeline facilities are primarily in and around Barrio Pueblo, with limited facilities located in other areas of the municipality. The map also illustrates their location in relation to the primary and secondary transportation network, highlighting access routes that connect the central urban area with surrounding barrios.

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3.5.5 Lifeline: Communications



The purpose of this lifeline is to ensure the availability and reliability of essential communication systems during emergencies and disaster events. These systems include telephone networks, internet services, radio, television, and public alert and warning platforms, all of which are critical for coordinating response activities, disseminating timely information, and maintaining communication between authorities and the public.

FEMA indicates that disruption of the Communications Lifeline can severely impair life-saving operations and effective resource management. Accordingly, priority actions include the restoration of telecommunications infrastructure, deployment of temporary communication solutions such as satellite systems, ensuring redundancy within critical networks, and maintaining accessible communication channels for the public.

Map 8 shows that the Communications Lifeline facilities are dispersed across multiple barrios, with several located near Barrio Pueblo and additional sites in the northern, western, eastern, and southern portions of the municipality. The map also illustrates the relationship between communications facilities and the primary and secondary transportation network that spans the municipality.

3.5.6 Lifeline: Transportation



The purpose of the Transportation Lifeline is to ensure the safe and efficient movement of people, goods, and essential services during emergencies and disaster events. This lifeline supports the continued operation or rapid restoration of land, air, and maritime transportation routes, enabling access to critical resources such as food, potable water, medical care, and emergency response equipment.

FEMA indicates that disruptions to transportation systems directly affect the ability to save lives and distribute essential supplies. Accordingly, priority actions include reopening roadways, repairing damaged bridges, restoring airport and port operations, and coordinating with state and private entities to maintain the logistics chain. Map 9 illustrates the roadway network of the Municipality of Utuado. The primary transportation corridors within the municipality are described below.

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Map 9 illustrates the primary, secondary, and tertiary transportation network within the municipality. Primary routes are concentrated around Barrio Pueblo and extend north, south, and east through the municipality. Secondary routes are distributed throughout multiple barrios, including Ángeles, Caguana, Limón, Mameyes Abajo, Las Palmas, Paso Palma, and Consejo. Tertiary roads provide additional connections between barrios across the municipality, forming an extensive roadway network that links the urban center with surrounding areas.

Connectivity and Development Patterns

North-South

The municipality's primary north-south transportation corridor is PR-10 (Félix Ramón "Moncho" Estévez Datis Expressway). PR-10 is the principal access route to Utuado and provides a direct connection between the municipality and the northern coastal region, including the PR-22 (José de Diego Expressway) corridor through Arecibo. This route is generally the fastest and most heavily traveled roadway serving Utuado and is the primary corridor used by residents, visitors, and commuters traveling to employment centers outside the municipality. The highway also serves as a major tourism route due to its scenic mountainous and karst landscapes.

In addition to PR-10, PR-123 functions as an important north-south route through the urban center, linking Utuado with Adjuntas to the south and Arecibo to the north. Historically, PR-123 was the principal roadway connecting these municipalities prior to the construction of PR-10 and continues to provide access to rural communities and commercial establishments located outside the expressway corridor.

East-West

The principal east-west corridor is PR-111 (Enrique Laguerre Street), which extends westward toward Lares and ultimately Aguadilla. Within Utuado, PR-111 serves as the municipality's primary commercial corridor, as a significant concentration of businesses, services, industrial uses, and residential development is located along this roadway. The corridor intersects PR-10, PR-123, and PR-140, making it a critical transportation spine for local and regional mobility.

Secondary Regional Connections

PR-140 is another key roadway that provides access to the eastern portions of the

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municipality, including communities near Caonillas Lake. The route also serves as an important connection between Utuado and the municipalities of Ciales to the north and Jayuya to the south. As a result, PR-140 plays a significant role in regional connectivity and access to recreational and natural resources.

Connectivity Challenges

Utuado's mountainous terrain and extensive river valleys create transportation constraints throughout the municipality. Mobility is heavily dependent on a limited number of principal arterial roadways, particularly PR-10, PR-111, PR-123, and PR-140. Disruptions caused by landslides, flooding, or roadway failures along these corridors can significantly affect access to the urban center, rural communities, emergency services, and critical facilities. The dependence on winding mountain roads and river crossings can also increase travel times and reduce network redundancy during disaster events.

3.5.7 Lifeline: Hazardous Materials



The purpose of this lifeline is to prevent hazardous material releases, control spills, and protect communities located near industrial facilities, chemical plants, and hazardous materials transportation corridors.

FEMA indicates that disruption or failure of the Hazardous Materials Lifeline can result in severe consequences, including widespread contamination and the impairment of essential services. Accordingly, priority actions include identifying hazardous materials, activating specialized Hazardous Materials (HazMat) response teams, coordinating with federal and state agencies, and implementing rapid response protocols. Although hazardous materials may be present throughout the municipality, incidents involving hazardous materials are more likely to occur within industrial areas.

Map 8 shows that the Hazardous Materials Lifeline facilities are primarily located in and around Barrio Pueblo, with additional facilities distributed across other barrios of the municipality. The map also illustrates their location relative to the municipality's primary and secondary transportation routes, including access through major road corridors connecting the urban center and surrounding areas.

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3.5.8 Lifeline: Water Systems

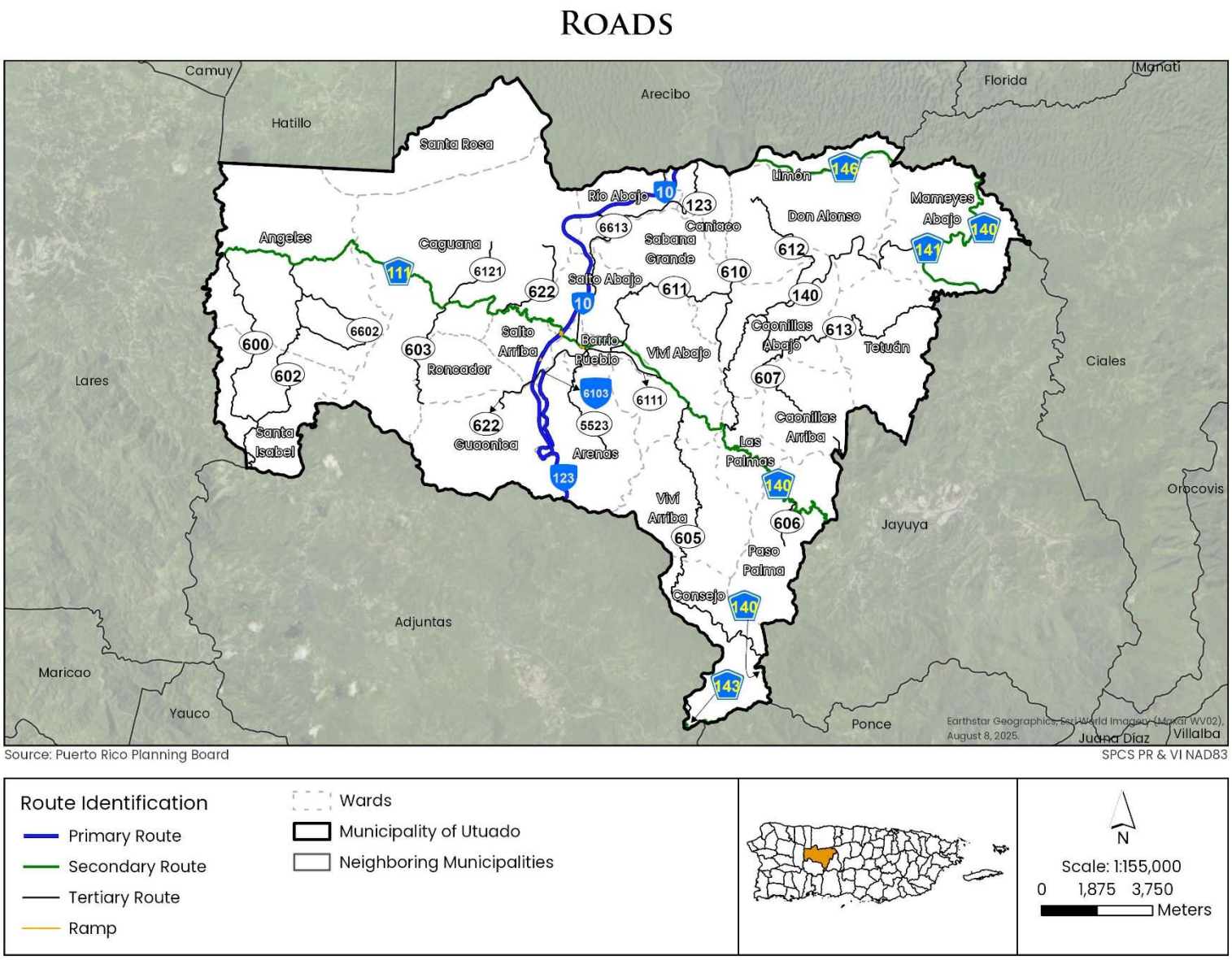


This lifeline highlights the critical role of water infrastructure in disaster response and recovery. Its primary objective is to ensure reliable access to and the timely restoration of drinking water and wastewater services, which are essential to public health, safety, and economic stability. The Water Systems Lifeline is structured around two core components: Potable Water Infrastructure, which includes water intake, treatment, storage, and distribution; and Wastewater Management, encompassing the collection, storage, treatment, and discharge of wastewater. By prioritizing the protection and functionality of water systems, FEMA seeks to maintain sanitation, support healthcare services, and minimize cascading impacts on food safety and overall community resilience.

Map 8 shows the Water Systems Lifeline facilities are widely dispersed across the municipality, with several located in and around Barrio Pueblo and additional facilities distributed throughout the northern, western, eastern, and southern barrios. The map also illustrates the relationship between water system facilities and the primary and secondary transportation network that provides access across the municipality.

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Map 9: Roads



3.6 Recent Development (E1-a)

Hazard mitigation planning must also account for future development conditions. To assess anticipated development trends within the municipality, historical patterns were evaluated using data on construction permits approved between 2020 and 2026. This period begins with the year of approval of the previous hazard mitigation plan. It should be noted that data for 2026 include permits approved through June 30, 2026.

Construction permit activity in Utuado fluctuated between 2020 and 2026. Annual approvals increased from 29 permits in 2020 to 34 in 2021, decreased to 30 in 2022, and then increased to 37 in 2023. Approvals reached a peak of 52 permits in 2024 and remained relatively high at 50 in 2025. The 18 permits reported for 2026 represent a partial year and should not be directly compared with the completed annual totals.

Across the full 2020–2026 dataset, Utuado recorded an average of approximately 35.7 approved construction permits per year, a median of 34 permits, and annual totals ranging from 18 to 52 permits. Excluding the partial 2026 data, the municipality averaged approximately 38.7 approved permits per year between 2020 and 2025. During that six-year period, approvals reached 50 or more in two years. Although permit activity increased during the latter part of the completed-year period, additional analysis would be required to determine whether this pattern was associated with post-disaster reconstruction, federal recovery funding, economic stimulus programs, or other factors.

Table 15 and Figure 12 present the number of construction permits approved between 2020 and 2026. Maps 10 and 11 illustrate the spatial distribution of these permits. To enhance legibility, the permits are depicted on two separate maps: one showing permits issued from 2020 to 2023, and another showing permits issued from 2024 to 2026.

Table 15: Approved Construction Permits, 2020-2026[9]

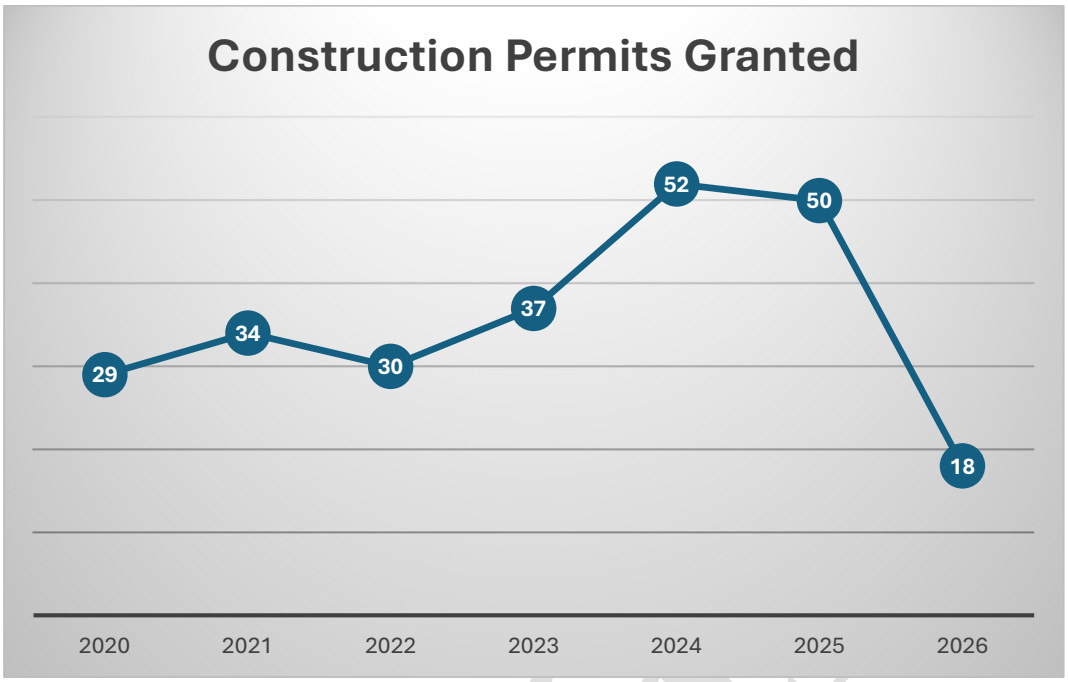
Approved Construction Permits 2020-2026	
Year	Permits Approved
2020	29
2021	34
2022	30
2023	37
2024	52
2025	50
2026	18

Source: Puerto Rico Planning Board

[9] 2025 total only accounts for permits up to June 30, 2026

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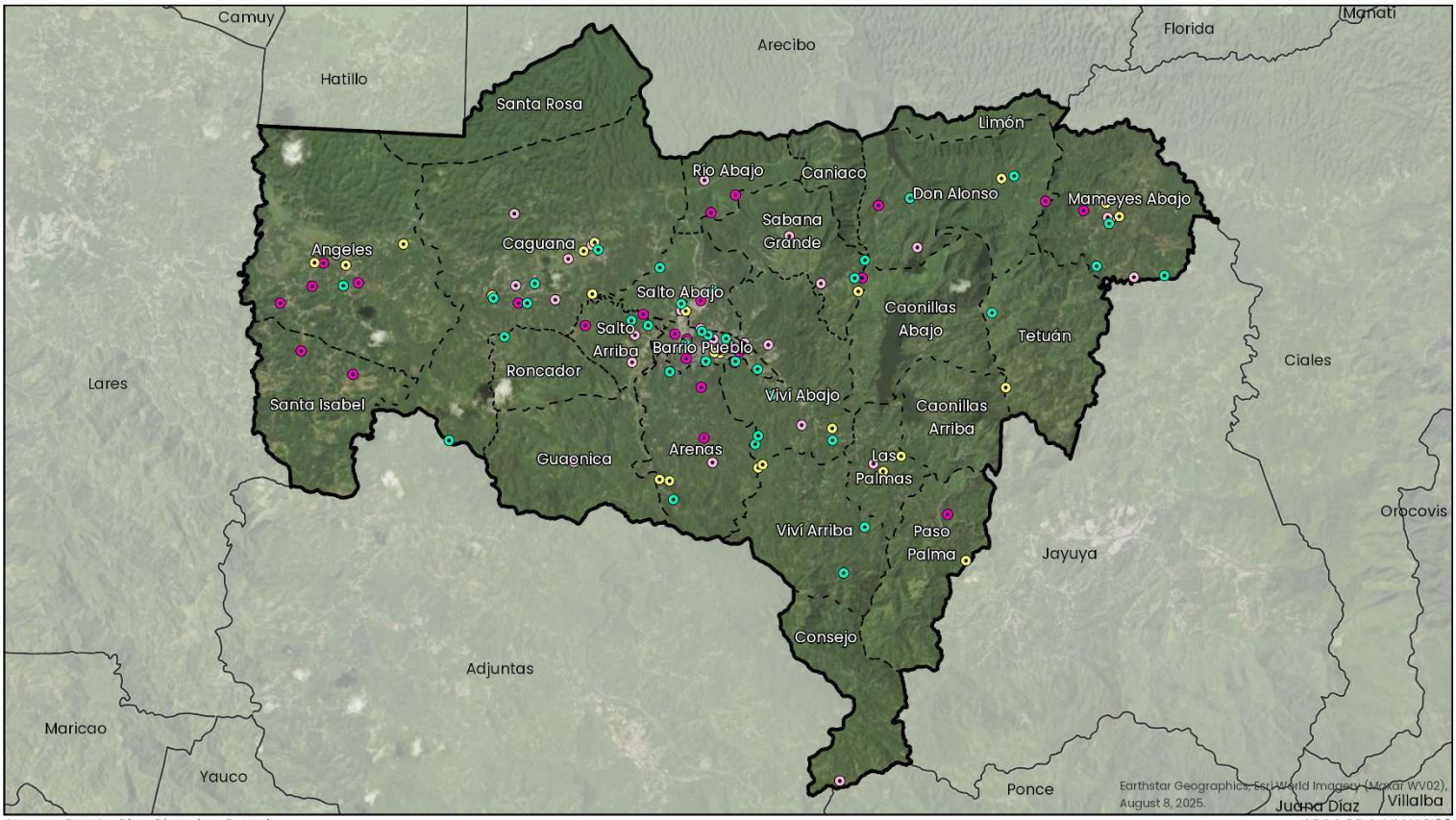
Figure 12: Approved Construction Permits 2020-2026



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Map 10: Recent Development 2020-2023

Recent Development 2020 - 2023



Source: Puerto Rico Planning Board

SPCS PR & VI NAD83

Construction Permits Granted

Year Created and Count

- 2020 (29)
- 2021 (34)
- 2022 (30)
- 2023 (37)
- Wards
- Municipality of Utuado
- Neighboring Municipalities



N

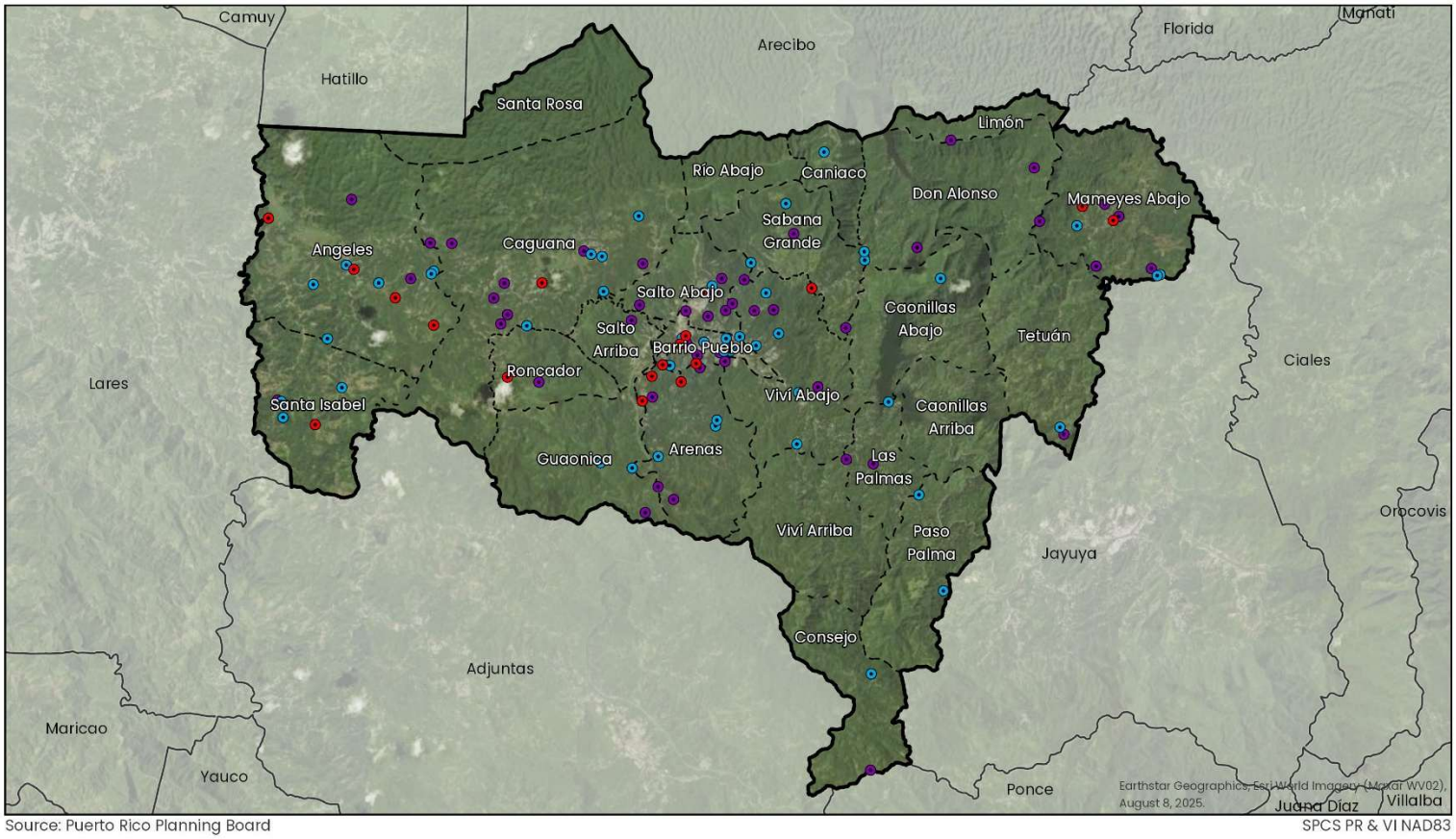
Scale: 1:155,000

0 1,875 3,750

Meters

Map 11: Recent Development 2023-2026

Recent Development 2024 - 2026



Source: Puerto Rico Planning Board

SPCS PR & VI NAD83

Construction Permits Granted

Year Created and Count

- 2024 (52)
- 2025 (50)
- 2026 (18)

- Wards
- Municipality of Utuado
- Neighboring Municipalities



N

Scale: 1:155,000

0 1,875 3,750

Meters

4. Hazards Profiles and Risks Analysis

4.1 Note on the Discussion of Hazards

The 2020 LHMP divided the discussion of the hazards evaluated in the plan into two separate and nonconsecutive sections. This arrangement made the analysis of each hazard cumbersome because the reader had to go back and forth between two different sections of the document. To improve readability and organization, the updated LHMP discusses both the profile of the hazard and the risk associated in one single section.

4.2 Regulatory Requirements

Federal regulation 44 C.F.R. § 201.6(c)(2) establishes the requirements related to hazard identification and risk assessment for LHMP. The LHMP must include the following:

- An assessment that provides the basis for identifying the proposed activities aimed at reducing losses associated with the identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses related to the identified hazards. The hazard assessment must include:
    - A description of the type, location, and extent of all natural hazards that may affect the jurisdiction. It must contain information on previous occurrences of hazard events and the probability of future hazards.
    - A description of the jurisdiction's vulnerability to the identified hazards. This description must include a comprehensive summary of each hazard and its impact on the community. This Plan must describe vulnerability in terms of:
        - The number of existing structures, infrastructure, and critical facilities located within identified hazard areas;
        - An estimate of the potential monetary losses to structures identified as vulnerable, along with a description of the methodology used to prepare the estimate; and, lastly,

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- A general description of land use and development patterns within the community so that mitigation options can be considered in future land-use decisions.
- A description of all structures insured under the National Flood Insurance Program (NFIP) that have experienced repetitive damage from different flood events. It must explicitly indicate whether the community participates in the NFIP and complies with its regulations. It must also include a table showing repetitive property losses along with a table of NFIP claims and losses.

4.3 Hazards that can Affect the Municipality

To select the Hazards to be addressed in this LHMP, the Municipality gathered information from the current 2026 Puerto Rico State Hazard Mitigation Plan, the 2020 Utuado LHMP and the current LHMP from the Municipalities that share a border with Utuado. The following table summarizes the hazard discussed in those HMPs. A check marks " ✓" in the table means that a hazard was discussed in the corresponding hazard mitigation plan, " X " means indicates that it was not.

Table 16: Historical Hazard Inventories

Hazard	2026 PRSHMP	2020 Utuado LHMP	Neighboring Municipalities
Earthquake/Liquefaction	✓	✓	✓
Landslides	✓	✓	✓
Flooding	✓	✓	✓
Extreme Winds Hazard	✓	✓	✓
Extreme Heat	✓	✓	✓
Drought	✓	✓	✓
Wildfire	✓	✓	✓
Tropical Cyclones	✓	✓	✓
Pandemic/Epidemic	✓	✗	✗
Epidemic Contagious Disease	✓	✗	✗
High Hazard Potential Dams	✓	✗	✓
Tsunami	✗	✗	✗
Coastal Erosion	✗	✗	✗
Sea Level Rise	✗	✗	✗
Storm Surge	✗	✗	✗

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After reviewing the hazards profiles in these documents, the Municipality of Utuado has decided that the following hazards shall be assessed and evaluated for the 2026 LHMP:

Table 17: Hazards to be included in the Utuado 2026 LHMP

Hazard	Included in Utuado 2026 LHMP?	Comments
Earthquake	✓	It is included given Puerto Rico's location among major fault lines and the 2020 Seismic activity.
Landslides	✓	It is included given the high propensity for landslides in Utuado territory.
Tsunami	×	The risk was not evaluated in this plan as the municipality has no direct risk exposure within its territory.
Flooding	✓	It is included given the presence of flood zones in the municipality.
Tropical Cyclone/Extreme Winds	✓	It is included given that the southeastern region of Puerto Rico has been the most recurrent point-of-entry for hurricanes that make landfall in Puerto Rico in recorded history. (National Oceanic and Atmospheric Administration, 2026).
Storm Surge	×	The risk was not evaluated in this plan as the municipality has no direct risk exposure within its territory.
Long Term Coastal Modification	×	The risk was not evaluated in this plan as the municipality has no direct risk exposure within its territory.
Extreme Winds	✓	Included as part of the discussion on tropical cyclones.

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Hazard	Included in Utuado 2026 LHMP?	Comments
Extreme Heat	✓	This hazard is included as the municipality continues to face recurrent events of extreme temperatures.
Drought	✓	This risk is included given the 2014-2016 droughts and recent periods of moderate drought.
Wildfire	✓	Various of Utuado's neighboring communities included this hazard.
Pandemic/Epidemic	✓	The municipality of Utuado included this in the previous LHMP. It will be considered by the LHMP update given the COVID -19 emergency declaration of 2020.
High Hazard Potential Dam	✓	It is included because potential inundation from upstream or nearby dam infrastructure could threaten residents, transportation corridors, public facilities, and utilities within Utuado.

For the rest of this document the hazards shall be considered in the following order:

Table 18: Order of Hazards to be Assessed

Classification	Hazard
Geological Hazards	Earthquake
	Landslides
Hydrological Hazards	Flooding
Meteorological Hazards	Extreme Winds Event
	Extreme Heat
	Drought
Environmental Hazards	Wildfire
Biological Hazards	Pandemic/Epidemic
Anthropogenic Hazards	High Hazard Potential Dam

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4.4 Chronology of Events

To prevent duplication of data and for easy reference in the discussion of each hazard profile the reader will find a chronology of events in the discussion of the hazard itself.

4.5 Risk Assessment Methodology

This section outlines the different methodologies used to assess the hazards. Because each hazard type has unique characteristics, data requirements, and levels of uncertainty, various approaches were applied to ensure accurate and comprehensive risk assessment.

4.5.1.1 HAZUS 6.1

HAZUS is a Geographic Information System (GIS)-based risk assessment tool developed by FEMA to estimate potential losses from natural hazards. It uses scientific modeling and spatial data to analyze the impacts of events such as earthquakes, floods, hurricanes, and tsunamis on buildings, infrastructure, populations, and the economy. Hazus provides detailed estimates of physical damage, economic losses, and social consequences, supporting hazard mitigation planning, emergency preparedness, and recovery strategies. By integrating hazard intensity, exposure, and vulnerability data, Hazus enables decisionmakers to prioritize mitigation actions and allocate resources effectively. The following hazards were evaluated using HAZUS 6.1 software:

- Earthquake
- Tropical Cyclone/Extreme Winds
- Flooding

4.5.1.2 Alternative GIS Modeling

There are some hazards that currently are not modeled by HAZUS, but they can be assessed by alternative GIS techniques. ESRI® ArcGIS PRO™ 3.6 was used to assess hazard vulnerability by utilizing digital risk data and the previously mentioned hazard information database. Using these data layers, vulnerability was quantified by estimating the number of critical facilities and buildings located in hazard-prone

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areas. Note that this method can overestimate risk exposure. In this LHMP the following hazards were assessed using this technique:

- Landslides[10]
- HHPD

4.5.1.3 Stochastic Risk Assessment

The stochastic risk assessment methodology was applied to evaluate hazards not addressed by existing hazard risk models or GIS-based analyses. This method is particularly suited for hazards lacking clear geographic boundaries, which are therefore excluded from GIS analysis. This approach can incorporate estimates of annual losses and impact data. However, the accuracy of the assessment is highly dependent on the availability and quality of the underlying datasets.

In the case of this LHMP, the hazards evaluated using this methodology are:

- Extreme Heat
- Drought
- Wildfire
- Pandemic/Epidemic

4.5.1.4 High Hazard Potential Dams

Please refer to Section 4.14.2.1 for details regarding the methodology used to assess high hazard potential dam risks.

4.6 Earthquake

4.6.1 Description (B1-a)

An earthquake is a sudden movement of the earth that occurs because of waves or vibrations spreading in all directions from the focus or point of origin of the earthquake (FEMA, 1997). The focus represents the place where the movement of rocks originates when they shift along faults. The epicenter, on the other hand, refers to the point on the earth's surface located directly above the focus (Puerto Rico Seismic Network,

[10] Correction Notice – The 2020 LHMP erroneously identified that landslides were model using HAZUS. This is incorrect as HAZUS does not model landslide hazards.

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2019). Earthquakes can occur because of changes in pressure experienced by the earth's crust, whether due to tectonic plate movement or rock rupture, a volcanic eruption, a landslide, or the collapse of caverns or cavities in underground land.

Most earthquakes are caused by the release of accumulated pressure resulting from the displacement of rocks along faults in the earth's outer crust. These faults are typically found along the edges of the earth's ten tectonic plates. The areas of greatest tectonic instability occur at the perimeters of plates that move slowly, as these places are subjected to the extreme force of plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes stress in the rock and the consequent accumulation of energy. When the accumulated stress exceeds the resistance strength of the rocks, a rupture occurs, releasing the stored energy and producing seismic waves, which generate an earthquake (NMEAD, 2021).

Earthquakes can affect hundreds of thousands of square miles and cause property damage amounting to tens of billions of dollars, loss of life and injuries to hundreds of thousands of inhabitants and disrupt the social and economic functioning of affected areas. Most property damage and earthquake-related deaths are caused by the collapse of structures due to ground movements (NMEAD, 2021). The level of damage experienced will depend on the amplitude and duration of the shaking, which is directly related to the size of the earthquake, the distance from the fault where it occurs, and the location and regional geology of the area where it is felt (NMEAD, 2021).

Other negative effects caused by the earthquake include landslides, the movement of soil and rock toward lower areas (mountainous regions and along slopes), and liquefaction, a process by which soil loses its rigidity and begins to behave like a fluid. In the case of liquefaction, anything that depends on the rigidity of the substrates for support can shift, tilt, break, or collapse.

Puerto Rico is located near the boundary between the North American and Caribbean tectonic plates, a subduction zone where one plate slowly moves downward beneath the other. These subduction zones are subject to substantial seismic activity and lateral displacement. Furthermore, the relative speed between the movement of these two plates is 2 centimeters (cm) per year (Puerto Rico Seismic Network, 2019).

According to the Puerto Rico Seismic Network, seismic activity is concentrated in eight zones:

- The Puerto Rico Trench to the North

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- The North and South Slope Faults of Puerto Rico
- The "Sombrero Zone", to the Northeast
- The Mona Passage and Mona Canyon to the West
- The Virgin Islands and Anegada depressions to the East
- The Muertos Trough to the South
- In the Southwest of Puerto Rico

To describe earthquake sizes, seismology has established three (3) terms: (1) earthquake intensity; (2) earthquake magnitude; and (3) acceleration. Intensity measures the shaking of structures and nature in a particular area. Intensity will vary according to the distance from the focus and the duration of the event. On the other hand, the magnitude of an earthquake refers to the measure of energy provided by seismometers, that is released during the event. Finally, ground acceleration is used to express the size of an earthquake (PRSN, 2019).

Some consequences of earthquakes include liquefaction, landslides, amplification, and tsunamis. For the purposes of this analysis, the main hazard to be addressed is liquefaction caused by earthquakes. This is because liquefaction is a hazard for which mitigation strategies can be established, as susceptible areas can be identified and marked for risk mitigation purposes. Liquefaction is the process by which certain soil behaves like a dense fluid, reducing its usual load-bearing capacity (PRSN, 2019). Liquefaction occurs mainly in places where there is medium to fine sandy soil, saturated with water, and of recent geological age. These deposits are mostly located on river margins and Quaternary (Q) age alluvial deposits. Another hazard to be considered is the amplification of seismic waves. Seismic wave amplification occurs in thick alluvial deposits where seismic waves slow down, amplifying their oscillation and causing the ground in these places to shake more strongly and for a longer time.

4.6.1.1 Affected Area (B1-B)

The following maps measure the spectral acceleration and spectral displacement in HAZUS run scenarios.

Spectral Acceleration

Spectral Acceleration is a measure used mainly in earthquake engineering to describe how strongly the ground motion from an earthquake would accelerate a structure with a specific natural period. This measure answers the question "If a building (or any structure) vibrates naturally at a certain period, how much acceleration would it

experience during an earthquake?" or , how hard the ground is pushing on the building at a specific vibration period? The higher the spectral acceleration, stronger the forces acting on the structure will be, which can cause structural failure if the building isn't designed for it (USGS, 2019).

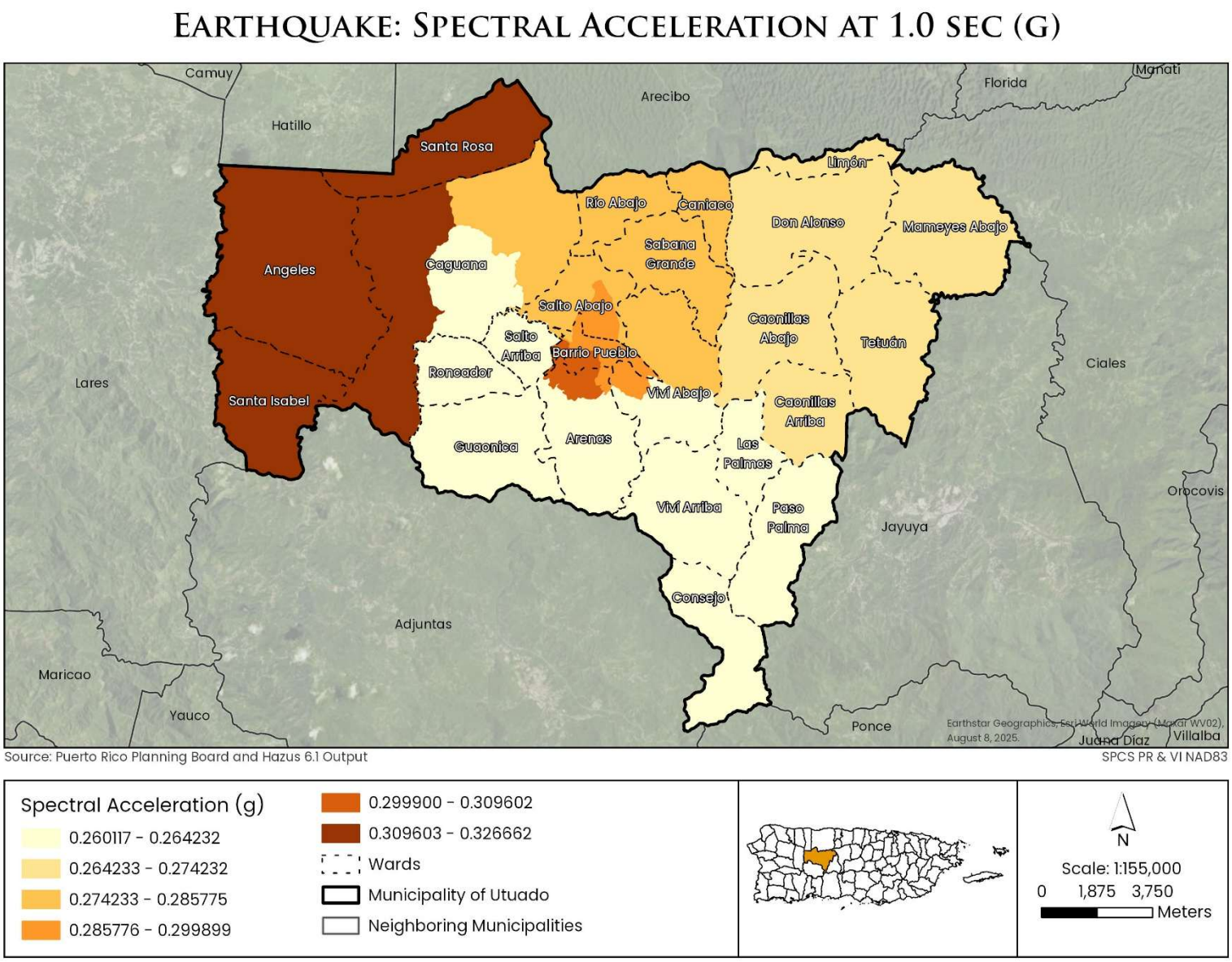
Spectral Displacement

Spectral Displacement measures how far a structure is expected to move (deform) during an earthquake, based on its natural vibration period and damping. In other words, it answers: "For a building with a given natural period, what is the maximum displacement it would experience during earthquake shaking?" (National Institute of Building Sciences, 2020).

Furthermore, maps 12 and 13 show the Hazus scenario for .3 seconds and 1.0 seconds. The difference relates to how an earthquake impacts different types of structures based on the natural vibration period of the building. The maps showing the 0.3-second scenario can affect buildings that are short, stiff structures like 1 or 2-story buildings. These buildings are rigid, so they vibrate quickly when the ground shakes. While the 1.0-second scenario that is more important for buildings are taller, more flexible structures, like mid- to high-rise buildings. These buildings are taller and less stiff and therefore sway more slowly (over a longer period) during an earthquake (FEMA, Hazus Earthquake Model User Guidance, 2024).

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Map 12: Earthquake: Spectral Acceleration at 1.0 sec (G)



As shown on Map 12, the highest spectral acceleration values are concentrated in the western portion of Utuado, particularly in the wards of Ángeles, Santa Isabel, and Santa Rosa, which are shown in the darkest shading. Moderate values extend through Salto Abajo, Río Abajo, portions of Caguana, and the urban center (Barrio Pueblo). Lower spectral acceleration values are mapped across most of the southern and eastern wards, including Caonillas Arriba, Caonillas Abajo, Tetuán, Mameyes Abajo, Viví Arriba, Consejo, and Paso Palma. Overall, the map shows a gradient of decreasing spectral acceleration from west to east and south within the municipality.

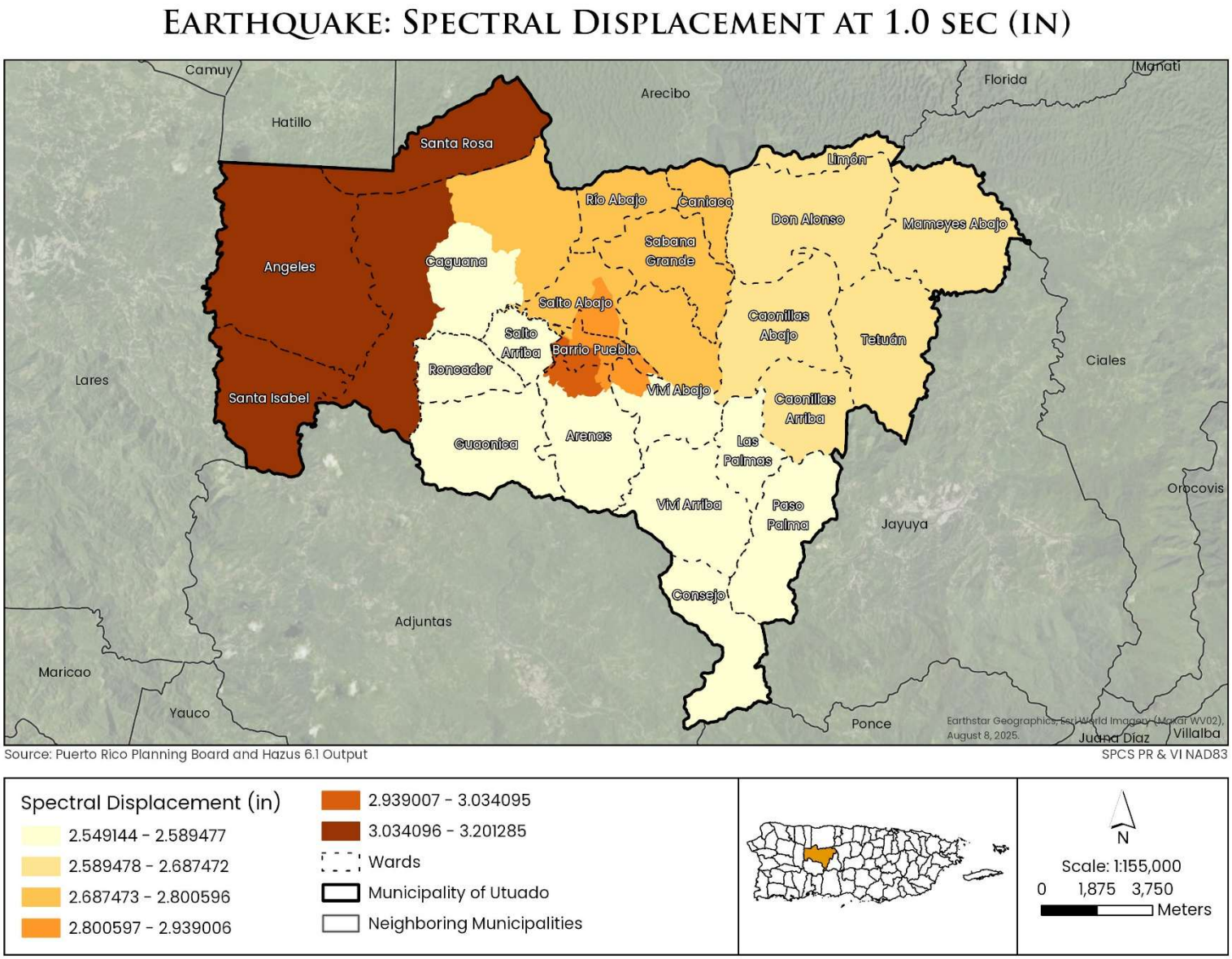
Map 13: Earthquake: Spectral Acceleration at 0.3 sec (G)



Map 13 illustrates that the highest spectral acceleration values are concentrated in the western wards of Ángeles, Santa Isabel, and Santa Rosa, represented by the darkest shading. Moderate values occur in Barrio Pueblo and portions of Salto Abajo, while intermediate values extend across much of the northern and eastern sectors, including Río Abajo, Don Alonso, Mameyes Abajo, Tetuán, and Caonillas Abajo. The lowest values are mapped throughout the southern wards, including Viví Arriba, Las Palmas, Paso Palma, Consejo, Arenas, and Guaonica. Overall, spectral acceleration values generally decrease from west to south within the municipality.

Maps 14 and 15 illustrate the spectral displacement expected during an earthquake, which represents the degree of movement or sway that buildings may experience. The spatial distribution of displacement closely mirrors the patterns observed in spectral acceleration, as higher acceleration levels generally correspond to greater structural sway.

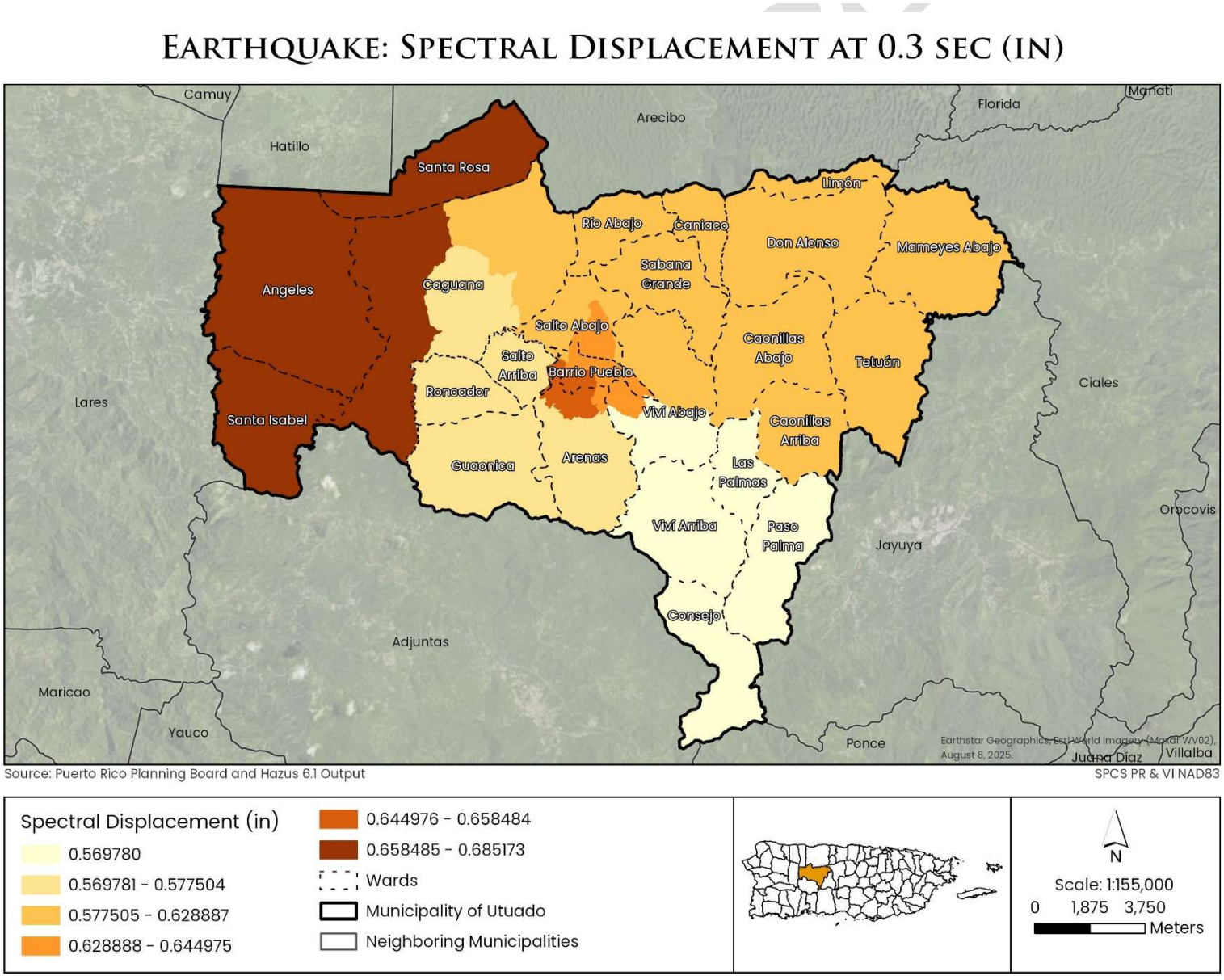
Map 14: Earthquake Spectral Displacement at 1.0 sec (IN)



Map 14 illustrates the highest spectral displacement values in the western wards of Ángeles, Santa Isabel, and Santa Rosa, which are represented by the darkest shading. Moderate values are mapped in Barrio Pueblo and portions of Salto Abajo, while

intermediate values extend across the northern and eastern wards, including Río Abajo, Don Alonso, Mameyes Abajo, Tetuán, and Caonillas Abajo. The lowest spectral displacement values are concentrated in the southern portion of the municipality, including Viví Arriba, Los Palmas, Paso Palma, Consejo, Arenas, and Guaonica. Overall, the map depicts decreasing spectral displacement values from west to south and east across Utuado.

Map 15: Earthquake: Spectral Displacement at 0.3 sec (IN)



Map 15 illustrates that the highest spectral displacement values are concentrated in the western wards of Ángeles, Santa Isabel, and Santa Rosa, represented by the

darkest shading. Moderate values occur in Barrio Pueblo and portions of Salto Abajo, while intermediate values extend across much of the northern and eastern sectors, including Río Abajo, Don Alonso, Mameyes Abajo, Tetuán, and Caonillas Abajo. The lowest spectral displacement values are mapped throughout the southern wards, including Viví Arriba, Las Palmas, Paso Palma, Consejo, Arenas, and Guaonica. Overall, the map depicts a pattern of decreasing spectral displacement from west to south across the municipality.

4.6.1.2 Risk Magnitude (B1-C)

The size of an earthquake, commonly associated with the Richter Scale, is widely recognized but often misunderstood. The concept of a logarithmic magnitude scale was first introduced by Charles Richter in the 1930s to measure earthquakes in Southern California using high-frequency recordings from nearby seismograph stations. This original scale, designated as ML where "L" stands for "local" eventually became known as the Richter magnitude scale.

As global seismic monitoring networks expanded, it became evident that the Richter method was accurate only within specific frequency and distance ranges. To accommodate a broader range of seismic signals recorded worldwide, additional magnitude scales were developed as extensions of Richter's original concept, including the body-wave magnitude (Mb) and the surface-wave magnitude (Ms). Each of these scales applies to a particular frequency range and type of seismic waves, and within their respective valid ranges, they provide magnitudes equivalent to the Richter scale (USGS, 2024).

Due to the limitations of the ML, Mb, and Ms scales, a more universally applicable moment magnitude scale (Mw) was developed. For large-magnitude earthquakes, Mw provides the most accurate and reliable estimate of earthquake size.

Moment is a physical quantity proportional to the amount of slip that occurs along a fault multiplied by the area of the fault surface that undergoes rupture. It reflects the total energy released by an earthquake. Moment can be derived from seismogram data and geodetic measurements and subsequently converted into a magnitude value using a standardized formula. The resulting measure, known as moment magnitude, provides a consistent and comparable estimate of earthquake size across the full range of magnitudes, a capability that earlier scales do not offer (USGS, 2024).

Table 19 below shows the Moment – Magnitude.

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Table 19: Moment - Magnitude Scale[11]

Range	Description
Mw < 3.0	Usually not felt by people.
Mw 3.0 – 4.9	Minor earthquakes, often felt but rarely cause damage.
Mw 5.0 – 5.9	Moderate, can cause slight damage to poorly built structures.
Mw 6.0 – 6.9	Strong can cause significant damage in populated areas.
Mw 7.0-7.9	Major, serious damage over large areas.
Mw ≥ 8.0	Great earthquakes, catastrophic damage over very large regions.

4.6.1.3 Past Events (B1-D)

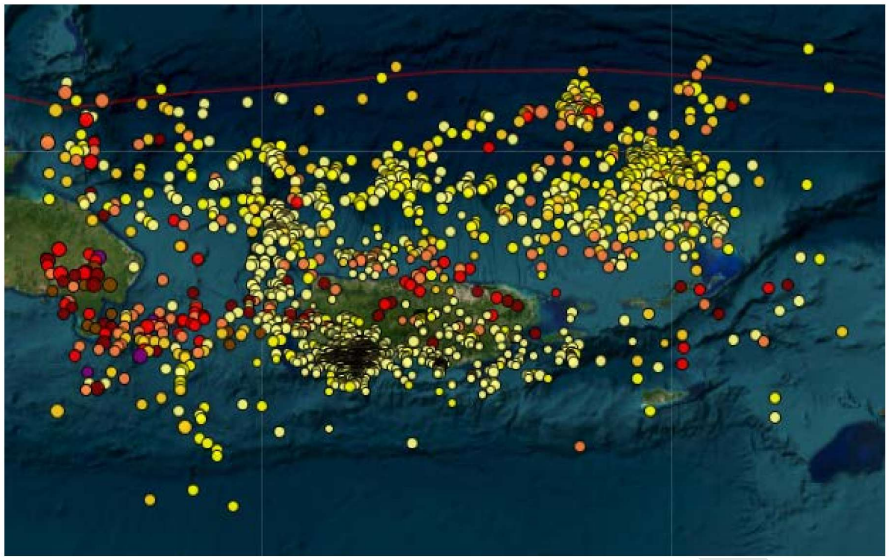
Earthquakes occur naturally daily, and their impacts increase significantly with greater magnitude. High-magnitude events can be particularly destructive, causing extensive property damage, loss of life, and severe disruption to affected regions. Puerto Rico is located near several active seismic zones including the Puerto Rico Trench, the Mona Canyon, the Anegada Trough, the Muertos Trough, and the southern fault system placing the island at heightened risk for seismic events. Seismicity in the southeastern region of Puerto Rico is primarily associated with faults in the Virgin Islands and Anegada depressions. In the southwestern region, activity is influenced by the Punta Montalva fault (Roig Silva, 2010), an area that has experienced a notable increase in seismic activity in recent years (Weilert & Laó-Dávila, 2023).

Figure 12 is a screengrab sourced from a report published by the Puerto Rico Seismic Network (in Spanish). This report illustrates the epicenters of earthquakes recorded in the Puerto Rico and U.S. Virgin Islands region in 2024 (PRSN, 2025).

[11] Source: USGS, 2025

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Figure 13: PRSN - 2024 Earthquakes Epicenter (PRSN, 2025)



Earthquake Chronology

Table 20 below shows the chronological list of the seismic activity in Puerto Rico for the period of 2012 to 2024 as reported by the PRSN (PRSN, n.d.).

Table 20: Puerto Rico Seismic Activity 2013-2024

Year	Description of seismic events
2024	The largest earthquake of 2024 occurred on May 14, 2024, at 8:30:11 p.m. (Puerto Rico local time). The magnitude 5.6 Ml earthquake was located 94.3 km north-northwest of Aguadilla (PR) at a depth of 7 km. This moderate earthquake was widely felt throughout Puerto Rico, with a maximum intensity of V (Modified Mercalli Intensity Scale, MMI) in Aguadilla (PR). During 2024, aftershocks from the South-Southwest Puerto Rico seismic sequence continued. This sequence began on December 28, 2019, with a magnitude 4.7 Ml earthquake. The main event of this sequence occurred on January 7, 2020, in the southern region of Puerto Rico, 12.7 km south of Guayanilla, with a magnitude of 6.4 Mw. This strong earthquake, at a depth of 7 km, had a maximum intensity of VIII in Guánica, Puerto Rico, and caused major damage across the island. From the start of the South-Southwest Puerto Rico seismic sequence in 2019 through April 2024, 27,497 earthquakes associated with this sequence have been processed (Figure 2). More than 1,688 felt earthquakes and over 492 significant events with magnitudes greater than 3.5 have been recorded. Of these, 42 earthquakes had magnitudes greater than 4.5.

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Year	Description of seismic events
2023	The largest earthquake of 2023 occurred on December 9, 2023, at 10:27:22 a.m. (Puerto Rico local time). The magnitude 5.7 Ml earthquake was located 192.28 km east-northeast of San Juan, PR, at a depth of 7 km. This moderate earthquake was widely felt throughout Puerto Rico and the Virgin Islands, with a maximum intensity of V (Modified Mercalli Intensity Scale, MMI) in St. Thomas (USVI). During 2023, aftershocks from South-Southwest Puerto Rico seismic sequence continued. This sequence began on December 28, 2019, with a magnitude 4.7 Ml earthquake. The main event of this sequence occurred on January 7, 2020, in the southern region of Puerto Rico, 12.7 km south of Guayanilla, with a magnitude of 6.4 Mww. This strong earthquake, at a depth of 7 km, had a maximum intensity of VIII in Guánica, Puerto Rico, and caused major damage across the island.
2022	The seismic sequence in the South-Southwest region of Puerto Rico, which began on December 28, 2019, continues. From its onset until the March 2022 report by the Puerto Rico Seismic Network, a total of 19,436 earthquakes associated with this sequence had been recorded. In that report, 1,502 events were documented for 2022, of which 30 were reported as felt. The regions with the highest seismic activity during March 2022 were in the southern area of Puerto Rico.
2021	The largest earthquake of 2021 occurred on January 24, 2021, at 7:21:41 p.m. (Puerto Rico local time). The magnitude 5.4 Ml earthquake was located 44.82 km southeast of Virgin Gorda, BVI, at a depth of 94 km. This moderate earthquake was widely felt throughout Puerto Rico and the Virgin Islands, with a maximum intensity of V (Modified Mercalli Intensity Scale, MMI) in Tortola, British Virgin Islands.
2020	The year 2020 was marked by significant seismic activity. An earthquake of magnitude 5.8 was recorded on January 6, 2020, followed by another of 6.5 on January 7, 2020, located 8 km from Indios, Puerto Rico. It is important to clarify that, starting from the 4.7 magnitude event recorded on December 28, 2019, up to October 22, 2020, approximately over 1,200 earthquakes of magnitude 2.0+ have been felt on the island. Tectonic activity in Puerto Rico is dominated by the convergence between the North American and Caribbean plates, with the island compressed between the two. To the north of Puerto Rico, the North American plate subducts beneath the Caribbean plate along the Puerto Rico Trench. To the south of the island, and south of the January 7 earthquake, the upper crust of the Caribbean plate subducts beneath Puerto Rico in the Muertos Trough. However, the January 6 earthquake and other recent events are occurring in the offshore deformation zone, connected by the Punta Montalva fault on land and the Guayanilla Canyon offshore.

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Year	Description of seismic events
	Between December 28, 2019, and January 23, 2020, southern Puerto Rico recorded 90 seismic events of magnitude 4.0 or greater, including the 6.5 magnitude earthquake on January 7, 2020, according to the USGS. These seismic movements led state authorities to request a disaster declaration from the President of the United States. This Disaster Declaration was issued on January 16, 2020, under number DR-4473. The Municipality of Utuado was not included among those designated to receive Individual Assistance funds from FEMA.
2019	During 2019, the Puerto Rico Seismic Network (PRSN) located a total of 6,510 earthquakes in the Puerto Rico and Virgin Islands region (our seismic responsibility area, between latitudes 17°N–20°N and longitudes 63.5°W–69°W). Compared to 2018 (3,974 earthquakes), the detected and located seismicity in 2019 increased. The year 2019 ended with 2,536 more earthquakes than the previous year. In 2019, the month with the highest activity was December with 1,291 earthquakes, while August had the lowest seismicity with 303 earthquakes. The region with the highest recorded seismicity during 2019 was the Mona Canyon with 1,288 seismic events, followed by the southern region of Puerto Rico with 885 earthquakes (Table 3). Earthquake depths ranged from 1 km to 191 km, and magnitudes varied from 0.34 Md to 6.0 Mw. Of the total earthquakes in 2019, 70 were reported as felt. On December 28, 2019, an active period of seismic activity began, with a 4.7 magnitude earthquake, followed several hours later by another 5.0 magnitude south of the island.
2018	During 2018, the Puerto Rico Seismic Network (PRSN) located a total of 3,974 earthquakes in the Puerto Rico and Virgin Islands region (our seismic responsibility area, between latitudes 17°N–20°N and longitudes 63.5°W–69°W). Compared to 2017 (3,129 earthquakes), the detected and located seismicity increased by 845 more earthquakes than the previous year. In 2018, the month with the highest activity was December with 549 earthquakes, while February had the lowest seismicity with 227 earthquakes. The region with the highest recorded seismicity during 2018 was the southern region of Puerto Rico with 412 seismic events, followed by the 19°N Fault Zone with 349 earthquakes. Earthquake depths ranged from 2 km to 185 km, and magnitudes varied from 0.63 Md to 4.67 Md. Of the total earthquakes in 2018, 29 were reported as felt within our area of responsibility.
2017	During 2017, the Puerto Rico Seismic Network (PRSN) located a total of 3,129 earthquakes in the Puerto Rico and Virgin Islands region (our seismic responsibility area, between latitudes 17°N–20°N and longitudes 63.5°W–69°W). Compared to 2016 (3,948 earthquakes), the detected and located seismicity decreased by 20%, which means 819 fewer earthquakes than the previous year. In 2017, the month with the highest activity was April with 518 earthquakes, while October had the lowest seismicity with 48 seismic events.

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Year	Description of seismic events
	The region with the highest recorded seismicity during 2017 was the Sombrero Seismic Zone with 856 seismic events, followed by the Virgin Islands Platform with 327 earthquakes. Earthquake depths ranged from 1 km to 180 km, and magnitudes varied from 0.85 Md to 4.8 Mb. Of the total earthquakes in 2017, 24 were reported as felt within our area of responsibility.
2016	During 2016, the Puerto Rico Seismic Network (PRSN) located a total of 3,947 earthquakes in the Puerto Rico and Virgin Islands region (our seismic responsibility area, between latitudes 17°N–20°N and longitudes 63.5°W–69°W). Compared to 2015 (3,235 earthquakes), the detected and located seismicity increased by 22.0%, or 712 more earthquakes than the previous year. In 2016, the month with the highest activity was September with 566 earthquakes, while March had the lowest seismicity with 169 earthquakes. The region with the highest recorded seismicity during 2016 was the Sombrero Seismic Zone with 973 seismic events, followed by the Virgin Islands Platform with 497 earthquakes. Earthquake depths ranged from 1 km to 177 km, and magnitudes varied from 0.76 Md to 4.6 Ml. Of the total earthquakes in 2016, 28 were reported as felt within our area of responsibility.
2015	During 2015, the Puerto Rico Seismic Network (PRSN) located a total of 3,235 earthquakes in the Puerto Rico and Virgin Islands region (our seismic responsibility area, between latitudes 17°N–20°N and longitudes 63.5°W–69°W). Compared to 2014 (3,420 earthquakes), the detected and located seismicity decreased by 5.4%, or 185 fewer earthquakes than the previous year. In 2015, the month with the highest activity was July with 473 earthquakes, while April had the lowest seismicity with 157 earthquakes. The region with the highest recorded seismicity during 2015 was the Sombrero Seismic Zone with 588 seismic events, followed by the 19°N Fault Zone with 477 earthquakes. Earthquake depths ranged from 1 km to 211 km, and magnitudes varied from 0.80 Md to 4.80 Md (duration magnitude). Of the total earthquakes in 2015, 23 were reported as felt within the area of responsibility.
2014	During 2014, the Puerto Rico Seismic Network (PRSN) located a total of 3,420 earthquakes in responsibility (AOR) known as the Puerto Rico and Virgin Islands Region (latitude 17.00˚ to 20.00˚N and longitude 63.50˚ to 69.00˚W). Compared to 2013 (2,293 earthquakes), the detected and located seismicity increased by 49%, which is 1,127 more earthquakes than the previous year. In this year, the month with the highest seismicity was January with 709 earthquakes, and the month with the lowest seismicity was November with 192 earthquakes. Of the total seismicity in 2014, 29 earthquakes (0.85%) were reported as felt, all located within our AOR. The magnitudes (Md) of the seismic events calculated for this year by PRSN ranged from 1.0 to 6.4, although for felt events they ranged from 2.53 Md to 6.4 Mwp. During 2014, depths varied between 1 km and 182 km, while for felt earthquakes they ranged from 6 km to 134 km.

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Year	Description of seismic events
	Earthquakes with depths of 0 to 25 km were the most frequent with 1,385 events, while those between 175 km and 200 km were the least frequent this year. The region with the highest recorded seismicity during 2014 was the 19°N Fault Zone with 905 seismic events, followed by the Sombrero Seismic Zone with 483 earthquakes.
2013	During 2013, the Puerto Rico Seismic Network (PRSN) located a total of 2,293 earthquakes in the Puerto Rico and Virgin Islands region (latitude 17.00˚ to 20.00˚N and longitude 63.50˚ to 69.00˚W). Compared to 2012 (2,852 earthquakes), the detected and located seismicity decreased by 20%, which is 559 fewer earthquakes than the previous year. In this year, the month with the highest seismicity was September with 272 earthquakes, and the month with the lowest seismicity was February with 114 earthquakes. Of the total seismicity in 2013, 44 earthquakes (1.92%) were reported as felt, all located within the Puerto Rico and Virgin Islands region. The magnitudes of the seismic events calculated for this year by PRSN ranged from 1.0 to 5.12, although for felt events they ranged from 2.36 to 5.12. During 2013, depths varied between 1 km and 182 km, while for earthquakes they ranged from 4 km to 112 km. The region with the highest recorded seismicity during 2013 was the Sombrero Seismic Zone with 504 seismic events, followed by the Virgin Islands Platform with 246 earthquakes. Through its educational program, PRSN reached 14,099 people in Puerto Rico and the U.S. and British Virgin Islands during 2013.

2020 Seismic Sequence

In early January 2020, Puerto Rico experienced a significant seismic sequence that began with a series of foreshocks and culminated in a powerful earthquake on January 7. The main shock registered a magnitude of 6.4 Mw, striking near the island's southern coast, particularly affecting the municipalities of Guayanilla, Ponce, and Yauco. This event was preceded by a 5.8 Mw earthquake on January 6, which caused widespread concern and structural damage (USGS, n.d.). The seismic activity was linked to the complex interaction between the Caribbean and North American tectonic plates, an area known for its subduction zones and fault systems. The shaking was felt across the island, leading to power outages, school closures, and the collapse of several buildings, including homes and public structures.

The aftermath of the earthquake revealed extensive damage to infrastructure and homes, displacing thousands of residents and prompting a federal emergency declaration. The southern region faced prolonged aftershocks, some exceeding magnitude 5.0, which continued for weeks, heightening anxiety among the population.

The event underscored Puerto Rico's vulnerability to seismic hazards and the importance of preparedness and resilient construction practices. This seismic event received a Presidential Disaster Declaration under the Stafford Act - DR-4473-PR (FEMA, n.d.). Although the Municipality of Utuado was not included in the Disaster Declaration, the municipality is aware that due to Puerto Rico' s position along an active tectonic boundaries seismic events can cause millions of dollars in damage, disrupting daily life.

According to the Puerto Rico Seismic Network (PRSN), from the onset of the South–Southwest Puerto Rico seismic sequence in 2019 through April 2024, a total of 27,497 earthquakes associated with this sequence were recorded and processed. Of these events, more than 1,688 were reported as felt, and over 492 registered magnitudes greater than 3.5. Additionally, 42 earthquakes reached magnitudes exceeding 4.5.

4.6.1.4 Future Event Probabilities (B1-E)

Contrary to atmospheric events, currently there is no scientific way to predict earthquakes. However, current technical state of knowledge allows for scientific forecasts. Between 1670 and today, Puerto Rico has experienced four significant, destructive earthquakes in the years 1670, 1787, 1867, and 1918. This historical record suggests a recurrence cycle ranging from 51 to 117 years, with an average of 83 years for destructive earthquakes. However, it is important to note that each of these events occurred along different faults; therefore, calculating a precise recurrence rate cannot rely solely on these events.

For more comprehensive studies, geologic maps of specific zones are analyzed, focusing on active faults and other structural features. These are correlated with historical earthquake intensity distributions, seismic attenuation models, and statistical data. The result is a map of seismically active zones, identifying regions where varying degrees of strong earthquakes may occur. Identifying these high-risk zones is essential for land-use planning and emergency preparedness.

In the case of Puerto Rico, PRSN quotes a probabilistic seismic hazard study conducted in 1987 by Dr. William McCann that estimated a 33–50% probability of a strong earthquake (Intensity VII or higher on the Modified Mercalli Scale) occurring in different parts of the island within a 50-year period (PRSN, 2025).

Further research by the U.S. Geological Survey in 2003 revealed that an area west-southwest of Puerto Rico is the most likely location for strong earthquakes on the

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island. This probabilistic analysis does not account for secondary effects such as tsunamis, liquefaction, and seismic wave amplification, which primarily impact low-lying coastal zones and highland areas prone to landslides.

Though the Municipality of Utuado has not been directly impacted by earthquakes in the recent past, this type of information is relevant to identify actionable mitigation strategies and proactively address them.

4.6.2 Risk Analysis (B2-a, B2-b)

4.6.2.1 Estimated Losses

Municipal Exposure

The Federal Emergency Management Agency's Hazus Earthquake Analysis provides estimates of Annualized Earthquake Losses—representing the long-term average economic impact of earthquakes on the general building stock within a specific geographic area for any given year—as well as an annualized estimate of population loss.

The Annualized Earthquake Loss is calculated using the Riemann Sums Method. This approach averages the annual losses associated with multiple return periods, then multiplies each return period's averaged loss by its differential probability to generate a single loss value for each Census tract. (FEMA, National Risk Index Data - Technical Documentation, 2025).

Table 21 shows the Exposure to Earthquake Hazards. Here we must clarify that although it might be difficult to precise the value of a human life, following FEMA guidance population loss is converted into a monetary value using a "population equivalence" approach based on the Value of Statistical Life (VSL). Under this method, each fatality—or every ten injuries—is assigned an economic loss of $13.7 million, which reflects FEMA's inflation-adjusted VSL estimate. All historical loss values are further adjusted to December 2024 dollars to account for inflation.

The HAZUS 6.1 analysis shows that the total exposure of the municipality to an earthquake event is $331,476,112,000.00. This includes $3,346,912,000.00 exposure of building value and $328,129,200,000.00 of population exposure.

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Table 21: Exposure to Earthquake Hazard

Exposure - Impacted Area (sq mi)	Exposure - Building Value	Exposure - Population	Exposure - Population Equivalence	Exposure - Total
116.230772	$3,346,912,000.00	28,287	$328,129,200,000.00	$331,476,112,000.00

Source FEMA's NRI

Annual Expected Loss

The Federal Emergency Management Agency's Hazus Earthquake Analysis provides estimates of Annualized Earthquake Losses—representing the long-term average economic impact of earthquakes on the general building stock within a specific geographic area for any given year—as well as an annualized estimate of population loss.

The Annualized Earthquake Loss is calculated using the Riemann Sums Method. This approach averages the annual losses associated with multiple return periods, then multiplies each return period's averaged loss by its differential probability to generate a single loss value for each Census tract (FEMA, National Risk Index Data - Technical Documentation, 2025).

The expected annual loss for the jurisdiction represents the average yearly economic impact, expressed in dollars, anticipated from natural hazard events. Table 22 presents the expected annual earthquake-related losses for both buildings and population for the whole municipality.

Table 22: Expected Annual Loss to Earthquake

Expected Annual Loss - Building Value	Expected Annual Loss - Population	Expected Annual Loss - Population Equivalence	Expected Annual Loss -Total
$2,558,257.20	0.1788	$2,073,785.08	$4,632,042.28

Source FEMA's NRI

The results indicate an average annual building-related loss of approximately $2.5 million due to earthquake events. In addition, the estimated annual population loss is 0.1788 population equivalents, which FEMA converts to an annualized economic loss of approximately $2 million using its population equivalence methodology. Combined, these values result in a total expected annual earthquake loss of approximately $4.6

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million. These estimates represent the long-term average annual impact of earthquake events and provide an indication of the municipality's relative earthquake risk and potential future economic losses.

4.6.2.2 Lifelines and Critical Infrastructure

Earthquakes can impact a community's lifeline in the following matter:

- Safety and Security – An earthquake can lead to the structural collapse of critical facilities such as police and fire stations, increased demand for search and rescue operations and population displacement requiring emergency sheltering. Potential challenges could happen maintaining public order and security.

- Food, Hydration, and Shelter – A seismic event can damage to water treatment plants and distribution systems, leading to contamination or loss of potable water. There could also be disruption of food supply chains due to damaged transportation routes and storage facilities. There can be increased need for temporary shelters because of widespread structural damage. Finally, loss of refrigeration capacity can lead to loss of perishable goods.

- Health and Medicine - Hospitals and clinics may suffer structural damage or lose operational capacity. Surge in injuries requiring emergency medical care may overburden existing medical facilities. Disruption of pharmaceutical supply chains and medical logistics can also happen. Elevated risk of disease outbreaks in shelters due to compromised sanitation is also a possibility.

- Energy - Damage to power plants, substations, and transmission lines, will create widespread outages. Gas line ruptures can create fire and explosion hazards. There can also be interruptions in fuel supply for generators and emergency vehicles.

- Communications - Damage to cell towers, fiber-optic cables, and communication hubs, resulting in connectivity loss. Overloaded networks due to emergency call volume. Impaired coordination for emergency response operations.

- Transportation - Collapse or severe damage to roads, bridges, and tunnels can restrict mobility. Airports and seaports may become inoperable due to runway

or dock damage. Rail systems (Tren Urbano) can be disrupted by track deformation or landslides.

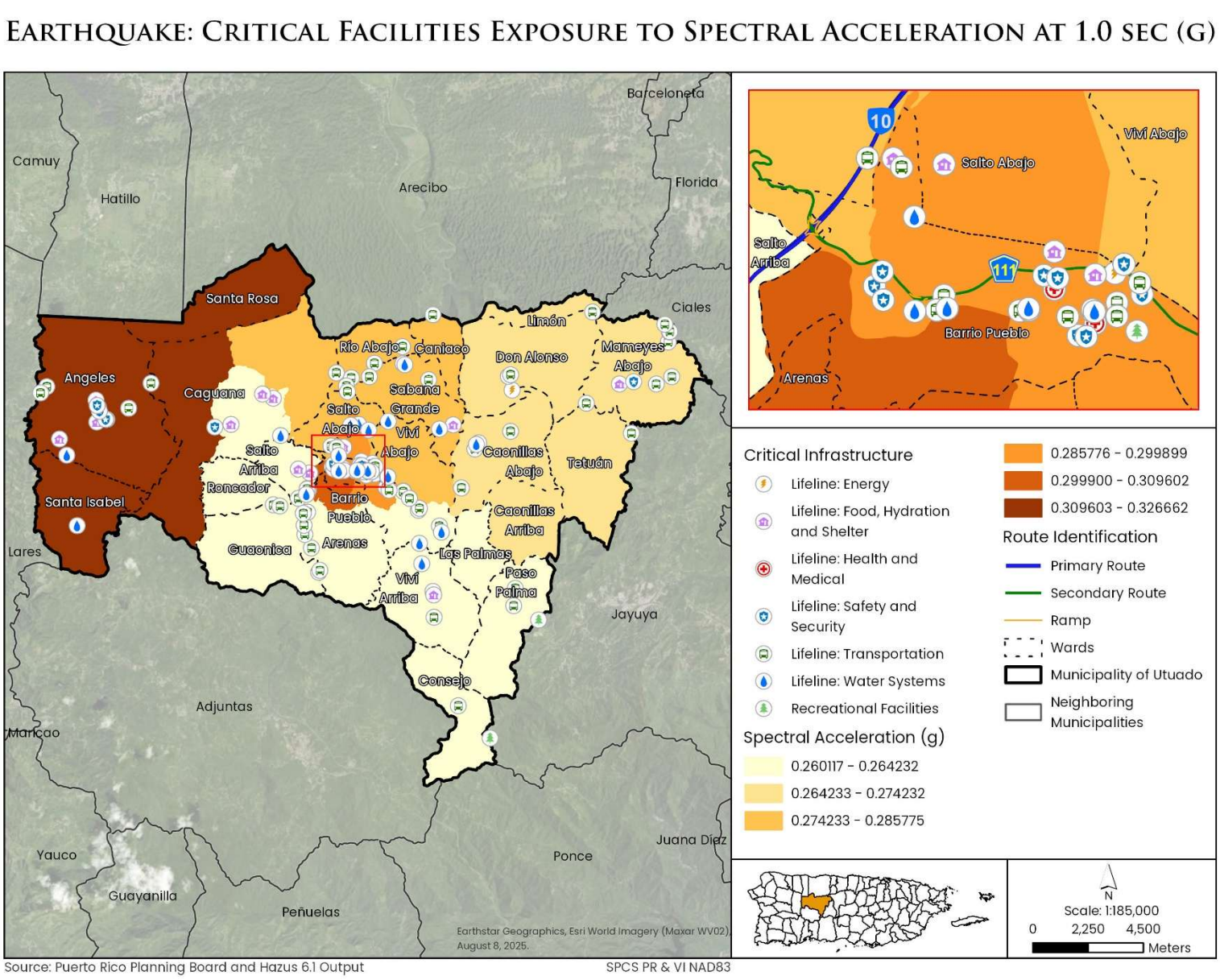
- Hazardous Materials – An earthquake may lead to spills from industrial facilities, chemical plants, or storage tanks. This can lead to Increased risk of environmental contamination in air, soil, and water. Fires or explosions from damaged hazardous material sites can also happen.

- Water Systems - Breakage of water mains and sewer lines can cause flooding and contamination. There can also be reduced firefighting capability due to lack of water pressure as well as long-term disruption of sanitation services.

Maps 16 and 17 show the identified critical infrastructure location in respect to the spectral acceleration areas shown in section 4.6.1.1.

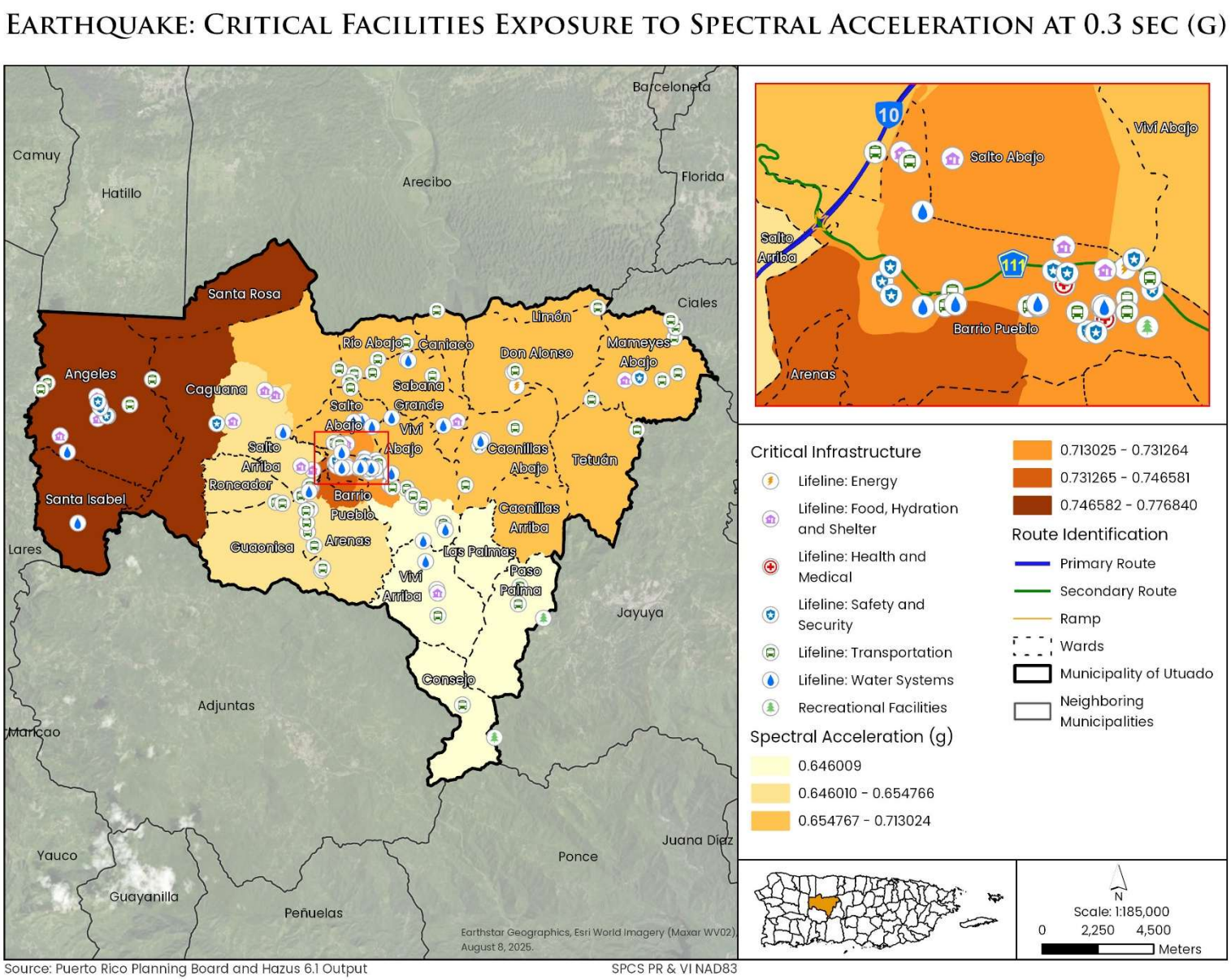
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Map 16: Earthquake: Critical Facilities Exposure to Spectral Acceleration at 1.0 sec (G)



Map 16 illustrates that the greatest concentration is in and around Barrio Pueblo, where multiple transportation, water, safety and security, health and medical, food and shelter, and energy facilities are clustered. Areas of higher spectral acceleration are mapped in the western wards of Ángeles, Santa Isabel, and Santa Rosa, while lower values are found across much of the southern and eastern portions of the municipality. Additional critical facilities are dispersed along the primary transportation corridors extending from the urban center to the western, northern, eastern, and southern wards.

Map 17: Earthquake: Critical Facilities Exposure to Spectral Acceleration at 0.3 sec (G)



Map 17 illustrates that the highest concentration is clustered around Barrio Pueblo and the surrounding wards of Salto Abajo, Salto Arriba, and Viví Abajo. Additional facilities are dispersed across the northern, eastern, western, and southern portions of the municipality. The highest spectral acceleration values are mapped in Ángeles, Santa Isabel, and Santa Rosa, while lower values occur across much of the southern wards. Critical facilities are present within all mapped spectral acceleration zones, with many located within the central area of the municipality.

4.6.2.3 Social Vulnerabilities

Social vulnerability to earthquakes in Puerto Rico is shaped by high levels of poverty, aging infrastructure, and limited access to essential resources, all of which disproportionately affect the ability of communities to withstand and recover from seismic events. Many residents face compounding disadvantages—such as disability, low educational attainment, and limited vehicle access—that reduce their capacity to evacuate, access information, or secure aid after a damaging earthquake. Research on disaster governance also shows that systemic governmental neglect and energy insecurity intensify the impacts of disasters, leaving communities with fewer resilience mechanisms in the aftermath of earthquakes.

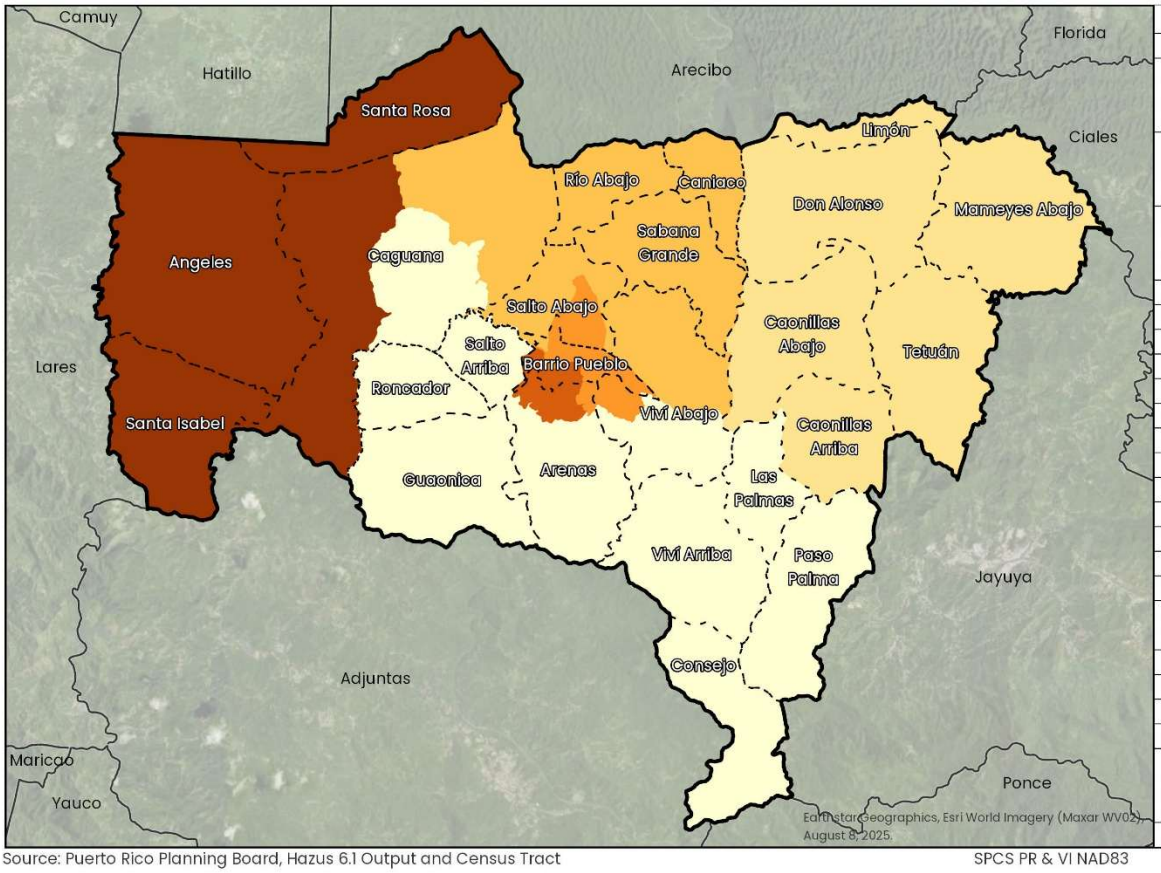
Puerto Rico's disaster research literature identifies long-standing structural inequities that heighten vulnerability, including political and economic marginalization that limit long-term recovery and exacerbate risk accumulation across hazard types. Federal assessments further find that many census tracts exhibit high social vulnerability scores (US Census Bureau, 2024), (US Census Bureau, 2025), meaning that an earthquake's impacts are likely to intersect with broader socio-economic fragility. Overall, these combined factors demonstrate that earthquakes in Puerto Rico pose not only a physical hazard but also a deep social challenge tied to historical, economic, and infrastructural conditions that shape uneven disaster outcomes. For more details about Social Vulnerabilities see section 3.4.

Maps 18 and 19 show the municipality's exposure to an earthquake by ward for a spectral acceleration event of 1.0 sec. (g) and 0.3 sec (g) periods, respectively. The maps indicate that population vulnerability varies among wards according to the level of spectral acceleration and the number of residents within each risk category.

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Map 18: Earthquake: Population Exposed to Spectral Acceleration at 1.0 sec (G)

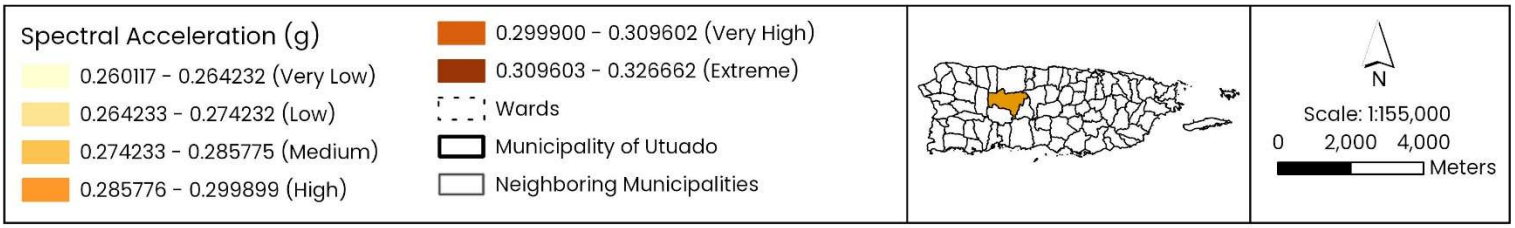
Earthquake: Population Exposure to Spectral Acceleration at 1.0 sec (G)



Wards	Risk Category	Population
Angeles	Extreme	1,760
Arenas	High	330
	Very High	1,195
	Very Low	1,058
Barrio Pueblo	High	2,191
	Very High	699
	Medium	14
Caguana	Very Low	830
	Extreme	1,061
	Medium	1,222
Caníaco	Medium	412
Caonillas Abajo	Low	585
Caonillas Arriba	Low	361
Consejo	Very Low	748
Don Alonso	Low	793
Guaonica	Very Low	1,379
Las Palmas	Very Low	390
Limón	Low	138
Mameyes Abajo	Low	683
Paso Palma	Very Low	861
Roncador	Very Low	591
Río Abajo	Medium	557
Sabana Grande	Medium	939
Salto Abajo	High	2,153
	Medium	480
Salto Arriba	Very Low	394
Santa Isabel	Extreme	791
Santa Rosa	Extreme	744
Tetuán	Low	597
Viví Abajo	High	1,118
	Very Low	393
	Medium	754
Viví Arriba	Very Low	918

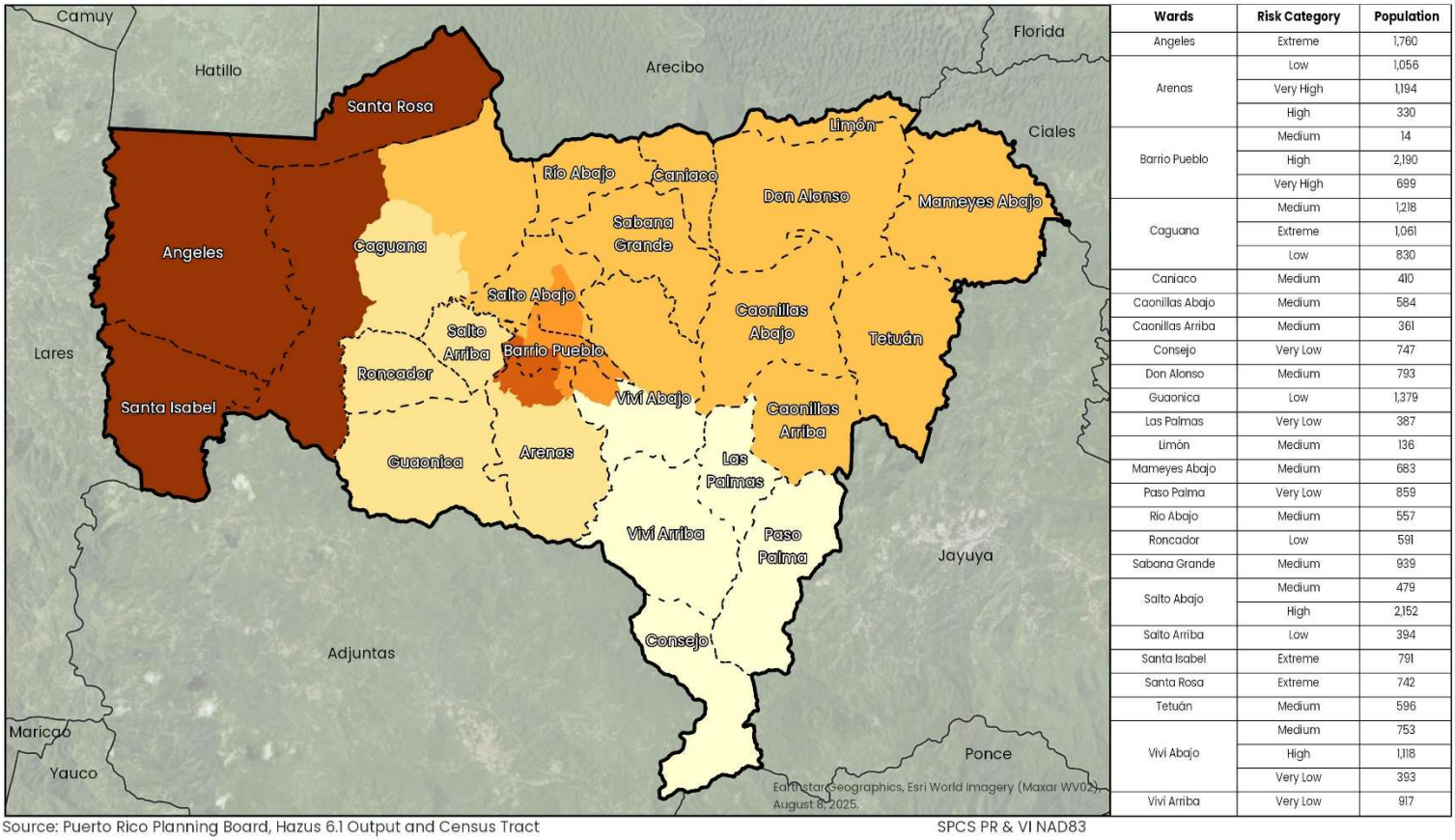
Source: Puerto Rico Planning Board, Hazus 6.1 Output and Census Tract

SPCS PR & VI NAD83



Map 18 illustrates that the highest spectral acceleration exposure categories (Extreme) are concentrated in the western wards of Ángeles, Santa Isabel, and Santa Rosa. High and Very High exposure categories are located around Barrio Pueblo and portions of Salto Abajo, while medium exposure extends across several central and northern wards, including Río Abajo, Caníaco, Sabana Grande, and Viví Abajo. The eastern and southern wards, including Caonillas Arriba, Caonillas Abajo, Tetuán, Don Alonso, Viví Arriba, Consejo, and Paso Palma, are primarily mapped within the Low and Very Low exposure categories. Overall, the map shows a pattern of decreasing exposure from west to east and south across the municipality.

Map 19: Earthquake: Population Exposure to Spectral Acceleration at 0.3 sec (G)



Wards	Risk Category	Population
Angeles	Extreme	1,760
Arenas	Low	1,056
	Very High	1,194
	High	330
Barrio Pueblo	Medium	14
	High	2,190
	Very High	699
Caguana	Medium	1,218
	Extreme	1,061
	Low	830
Caníaco	Medium	410
Caonillas Abajo	Medium	584
Caonillas Arriba	Medium	361
Consejo	Very Low	747
Don Alonso	Medium	793
Guaonica	Low	1,379
Las Palmas	Very Low	387
Limón	Medium	136
Mameyes Abajo	Medium	683
Paso Palma	Very Low	859
Río Abajo	Medium	557
Roncador	Low	591
Sabana Grande	Medium	939
Salto Abajo	Medium	479
	High	2,152
Salto Arriba	Low	394
Santa Isabel	Extreme	791
Santa Rosa	Extreme	742
Tetuán	Medium	596
Viví Abajo	Medium	753
	High	1,118
	Very Low	393
Viví Arriba	Very Low	917

Map 19 illustrates that the highest population exposure category (Extreme) is concentrated in the western wards of Ángeles, Santa Isabel, and Santa Rosa. Very High and High exposure categories are mapped around Barrio Pueblo and Salto Abajo, while medium exposure extends across much of the central and eastern portions of the municipality, including Río Abajo, Caníaco, Sabana Grande, Don Alonso, Caonillas Arriba, Caonillas Abajo, Tetuán, and Mameyes Abajo. The lowest exposure categories (Low and Very Low) are primarily located in the southern wards, including Viví Arriba, Consejo, Paso Palma, Los Palmas, and portions of Arenas and Guaonica. Overall, the map indicates decreasing exposure from west to south across Utuado.

4.6.2.4 Natural and Cultural Resources

Earthquakes can produce a wide range of impacts on natural and cultural resources:

- Landslides and Soil Instability: Earthquakes can trigger landslides, rockfalls, and soil liquefaction, altering landscapes and damaging habitats.
- Water Quality and Hydrology: Ground shaking may disrupt river courses, damage aquifers, and cause sedimentation in water bodies, reducing water quality and affecting aquatic ecosystems.
- Vegetation and Wildlife: Habitat destruction and fragmentation can occur due to ground deformation and secondary hazards such as flooding or fires.
- Coastal and Marine Environments: Submarine earthquakes can lead to tsunamis, causing erosion, coral reef damage, and loss of coastal ecosystems.

While the following damage can happen to Cultural Resources:

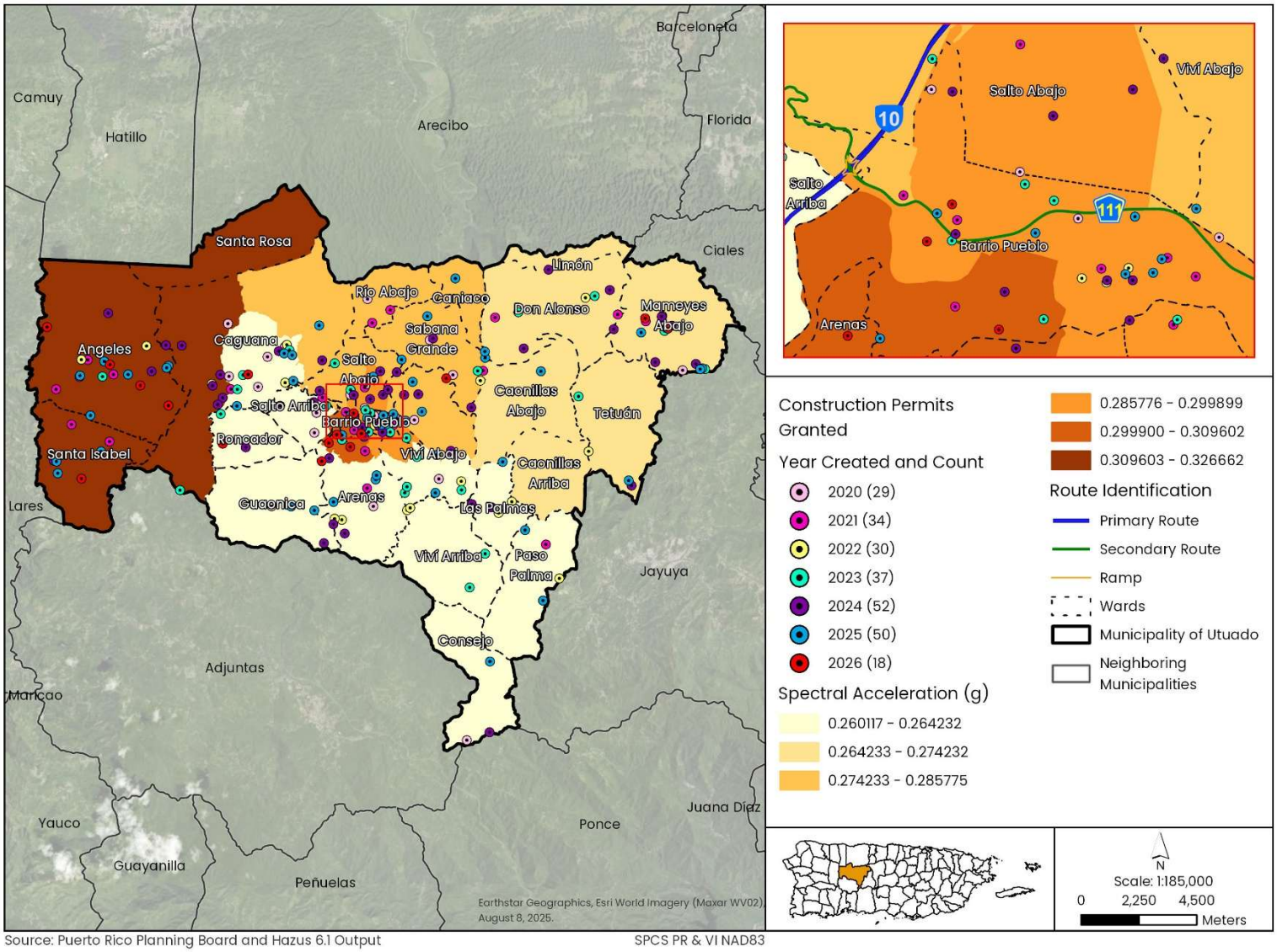
- Historic Buildings and Monuments: Structural damage or collapse of heritage buildings, archaeological sites, and monuments due to seismic forces.
- Museums and Archives: Loss or deterioration of artifacts, documents, and collections caused by building failure or inadequate seismic protection.
- Community Identity and Tourism: Damage to culturally significant sites can impact local identity and reduce tourism revenue, affecting economic stability.

4.6.2.5 Future Conditions (E1-a)

As discussed in Section 3.6, the elevated number of construction permits issued by the Municipality reflects a sustained level of economic activity. To further support this analysis, Maps 20 and 21 highlight the areas with the highest spectral acceleration values at 0.3 and 1.0 seconds alongside the distribution of authorized construction permits. Taken together, these findings indicate that future exposure to earthquake hazards is unlikely to diminish in the near term, as development continues to expand within zones of elevated seismic vulnerability.

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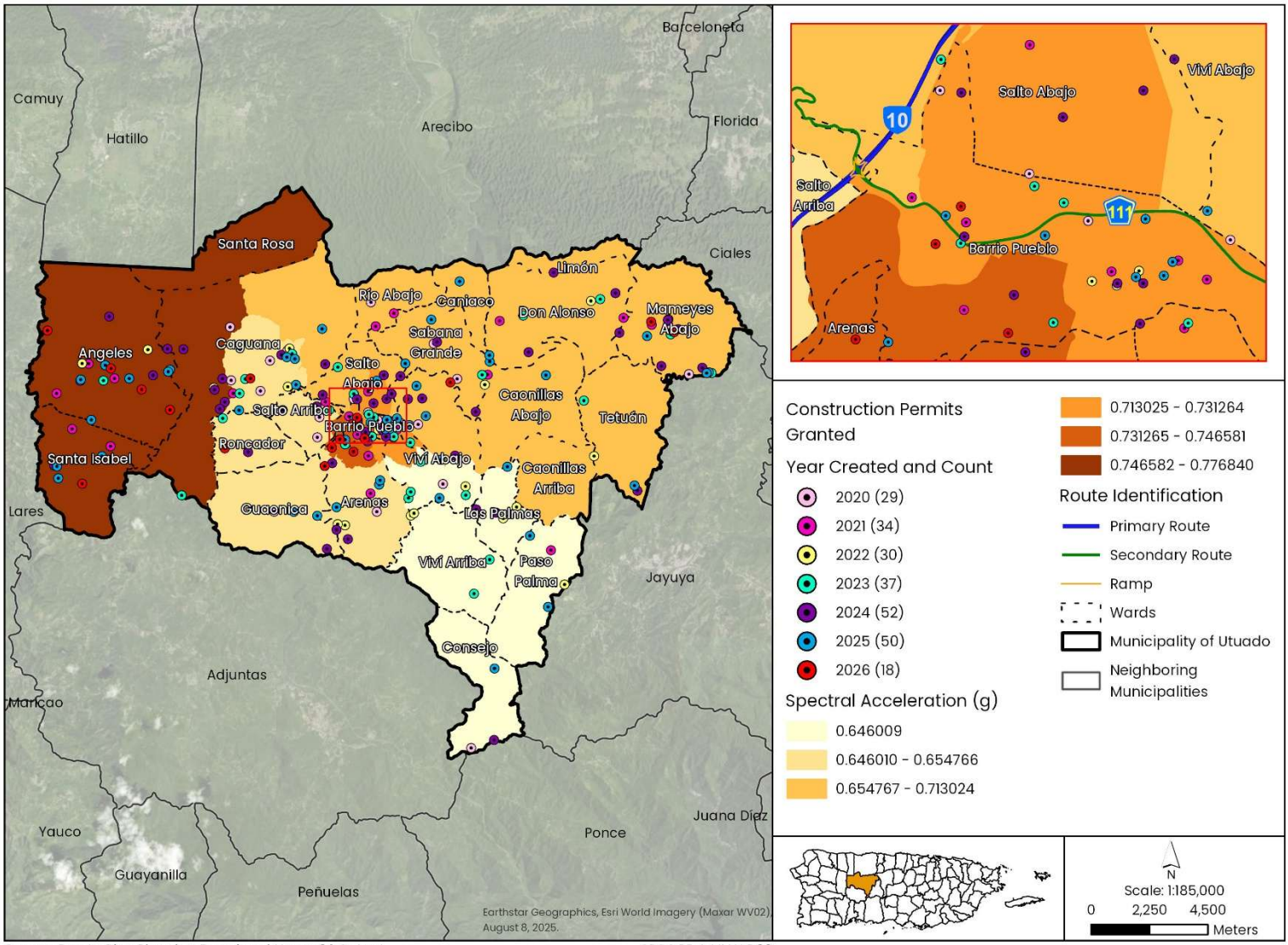
Map 20: Earthquake: Recent Development Exposure to Spectral Acceleration at 1.0 sec (G)



Map 20 illustrates that recent development permits are distributed throughout Utuado, with the highest concentration clustered around Barrio Pueblo and the surrounding wards of Salto Abajo, Salto Arriba, Viví Abajo, and Arenas. Additional development permits are dispersed across the western wards of Ángeles and Santa Isabel, as well as throughout the northern, eastern, and southern portions of the municipality. The highest spectral acceleration values are mapped in Ángeles, Santa Isabel, and Santa Rosa, while lower values occur across much of the southern and eastern wards. Recent development is present within all mapped spectral acceleration zones, including the areas with the highest acceleration values in the

western part of the municipality.

Map 21: Earthquake: Recent Development Exposure to Spectral Acceleration at 0.3 sec (G)



Map 21 illustrates that recent development permits are distributed throughout Utuado, with the greatest concentration located in and around Barrio Pueblo and the adjacent wards of Salto Abajo, Salto Arriba, Viví Abajo, and Arenas. Additional permits are dispersed across the western wards of Ángeles and Santa Isabel, as well as throughout the northern, eastern, and southern portions of the municipality. The highest spectral acceleration values are mapped in Ángeles, Santa Isabel, and Santa Rosa, while lower values are mapped across the southern wards. Recent development

locations occur within all mapped spectral acceleration zones across the municipality.

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4.7 Landslides

4.7.1 Description (B1-a)

Landslides are classified as a natural process caused by the downward movement of a mass of earth triggered by the instability of a given terrain. Landslides or slope failures occur when conditions converge so that the force of gravity exerts its influence on the materials of the Earth's crust beyond the natural inertia of those materials. The term "landslide" includes a wide variety of ground movements, such as rockfalls, slope failures, and debris flows. These ground movements endanger life and property and can also interrupt traffic on roadways and drag along trees, houses, bridges, and cars, among others (FEMA, 1997).

The passage of meteorological phenomena that cause prolonged and intense rainfall, such as tropical waves, troughs, and tropical cyclones, are major causes that can trigger landslide events. Likewise, population growth and informal construction increase the municipality's susceptibility to the effects of landslides. Potable water supply and waste management systems (sanitary pipes, septic tanks, and storm sewers), both in authorized and informal constructions, aggravate the conditions that cause landslides. The probability of landslides occurring increases if these systems leak or are poorly located or constructed (USGS, n.d.).

Among the many factors that cause landslide formation are soil type, slope or inclination of the terrain, water saturation of the soil, erosion, the presence of depressions or cavities, human activities, and the occurrence of earthquakes. As stated in the Building Performance Assessment Report (BPAR), prepared after Hurricane Georges, "landslides will become a major problem in the future as more houses are built and more development occurs in areas susceptible to these risks" (FEMA, 1997).

Many of the landslides that occur in Puerto Rico fall into a special category of landslides known as "debris flows." The flow occurs in mountainous areas with significant slopes during intense rainfall. Rain saturates the soil and causes the flat subsurface to lose solidity and detach, usually where this subsurface meets the bedrock. There are many types of landslides; however, those associated with water saturation of the ground are as follows (PREMB, 2021):

- Slow landslide: Slow and sustained movement of earth or rock descending down the slope. Recognized by its content of tree trunks, pieces of twisted

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fences or retaining walls, and leaning posts or fences.

- Debris flow: A mass of rapid movement in which loose soils, rocks, organic matter combine with infiltrated air and water to form a viscous flow sliding down the hillside.

- Debris avalanche: A variety of very fast or extremely fast debris flow.

- Mudflow: A mass of rapid flow containing wet material of at least 50 percent sand, silt, and clay particles.

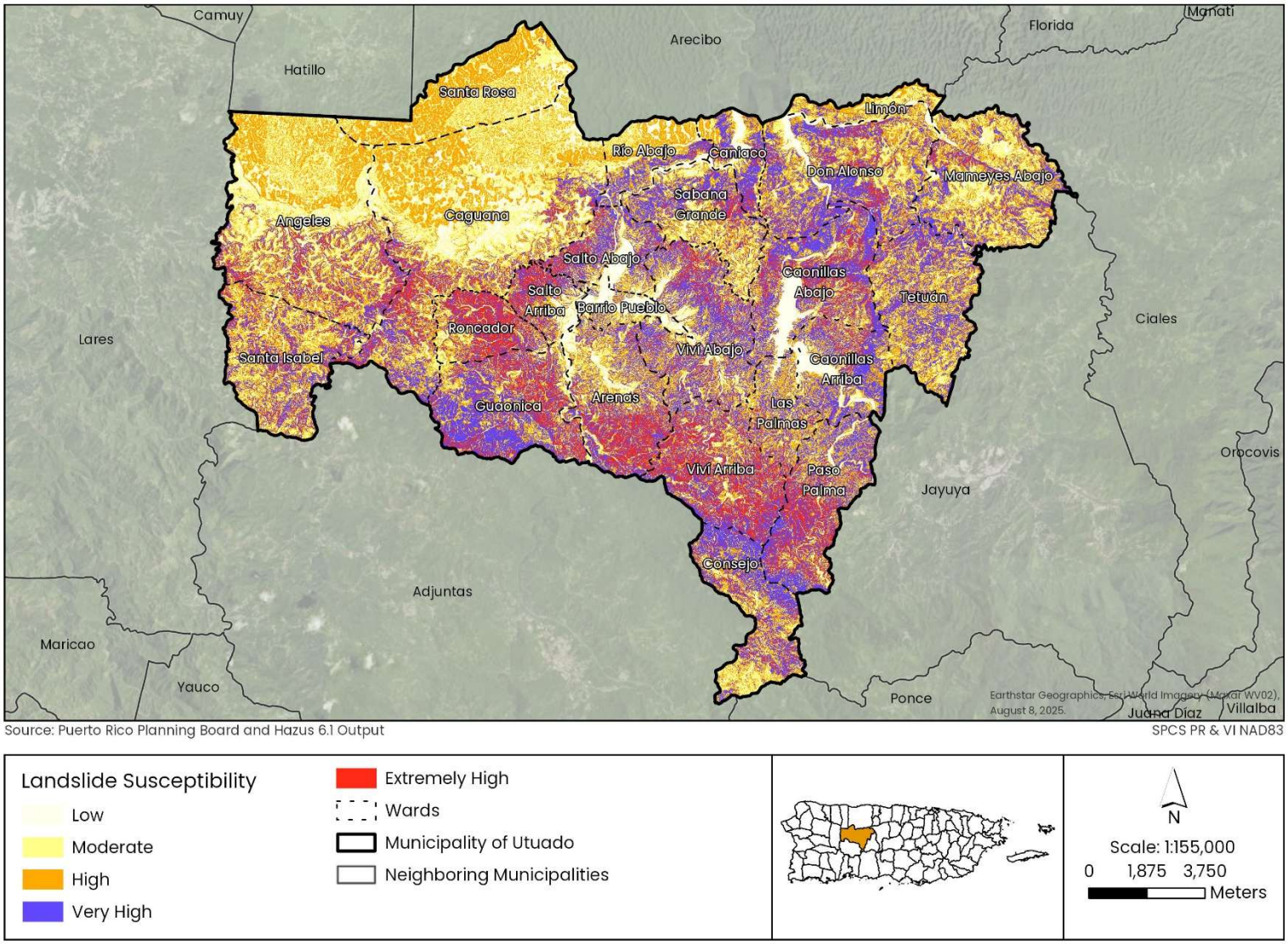
4.7.1.1 Affected Area (B1-B)

As with all municipalities within Puerto Rico's mountainous region, Utuado has experienced a high volume of landslides in recent years. Map 22 shows the areas considered moderately and highly susceptible to landslides in Utuado. The following map identifies the areas with the highest susceptibility to landslide events.

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Map 22: Landslide Susceptibility

Landslide Susceptibility



Source: Puerto Rico Planning Board and Hazus 6.1 Output

SPCS PR & VI NAD83

The landslide susceptibility map illustrates that high, very high, and extremely high landslide susceptibility is distributed throughout much of the central and southern portions of Utuado, particularly in Roncador, Guaonica, Arenas, Viví Arriba, Consejo, Paso Palma, Salto Arriba, Salto Abajo, and areas surrounding Barrio Pueblo. Lower susceptibility is concentrated in portions of the northern wards, including Santa Rosa, Caguana, Limón, Don Alonso, and Mameyes Abajo. Overall, landslide susceptibility is widespread across the municipality, with the most extensive areas of very high and extremely high susceptibility occurring in the central and southern wards.

4.7.1.2 Risk Magnitude (B1-C)

Landslides commonly occur in steep mountainous areas during periods of intense rainfall. Rain saturates the soil and causes natural drainage to lose its structural capacity and fail. Some areas tend to be more prone to landslides than others. Sites with greater slope are among the most susceptible to landslides. Vegetation contributes to how soil remains compacted, helping resist surface erosion. Slopes without vegetation tend to be more prone to erosion than vegetated slopes. The shape and condition of a slope can affect stability. Factors that influence slope stability include height, inclination, vegetation, and geology. In general, an increase in height and slope correlates with reduced terrain stability. Below are factors that influence the occurrence of landslides:

- The base of inclined terrain
- Near the base of small hollows where drainage is nearby
- The base of a slope that has fill material
- The base or crest of a very steep slope
- Areas with previous landslides
- Hillsides that have been developed and where septic systems have been used
- Steep slopes in clayey soils
- Hills or slopes with an inclination greater than 12 degrees and an elevation over 300 meters

Hazard categories come from the index used by the USGS. These categories are based on slope and soil characteristics as defined by the federal agency. Table 23 provides a description of the event according to the categories: low, moderate, high, and very high.

Table 23: Landslide Risk Categories

Category	Description
Low	Areas with minimal slopes and stable soil; landslides are unlikely except under extreme conditions.
Moderate	Areas with some susceptibility; landslides may occur during prolonged or intense rainfall.
High	Areas with significant susceptibility; landslides are likely during heavy rain or seismic activity.
Very High	Areas extremely prone to landslides; frequent events during storms or earthquakes.

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Category	Description
Extremely High	Areas with the greatest susceptibility to landslides where terrain, geology, and slope conditions are highly unstable. Landslides are very likely to occur during intense rainfall events or seismic activity, and recurrent slope failures may be expected.

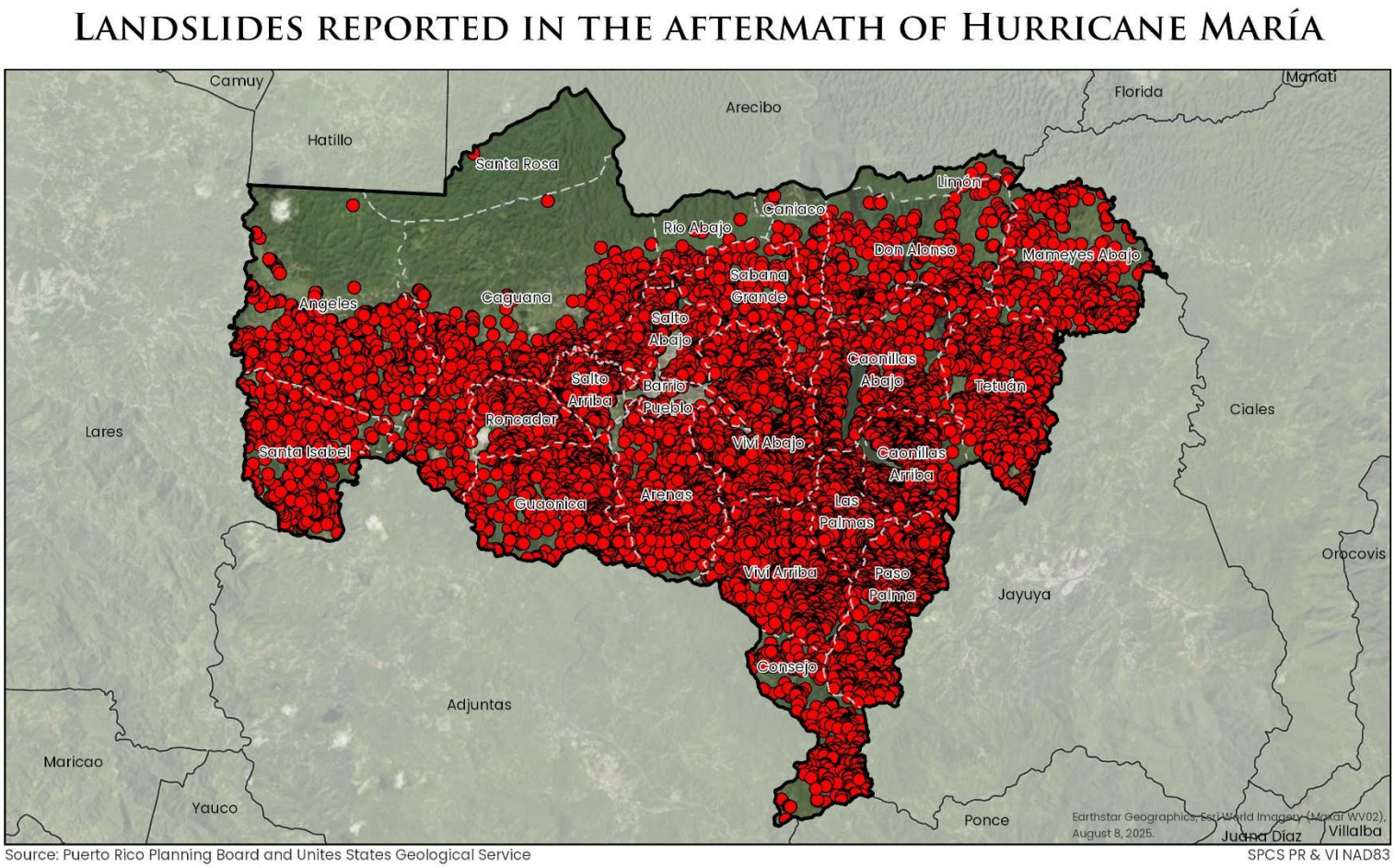
The municipality considers landslide prevention and mitigation within earthquake preparedness and response planning due to the potential for earthquake-induced slope failures.

4.7.1.3 Past Events (B1-d)

As stated above, landslides are frequently associated with heavy rainfall events. Map 23 illustrates the landslides reported following Hurricane María in 2017, which are distributed throughout Utuado. The map illustrates a dense distribution of reported landslides across most of Utuado following Hurricane María. Landslide points are concentrated throughout the central, southern, eastern, and western wards, including Ángeles, Santa Isabel, Roncador, Guaonica, Arenas, Barrio Pueblo, Viví Arriba, Paso Palma, Caonillas Arriba, Caonillas Abajo, Tetuán, Don Alonso, and Mameyes Abajo. Comparatively fewer landslide points are mapped in the northern wards of Santa Rosa, Caguana, and portions of Limón. Overall, reported landslides are widespread across nearly the entire municipality.

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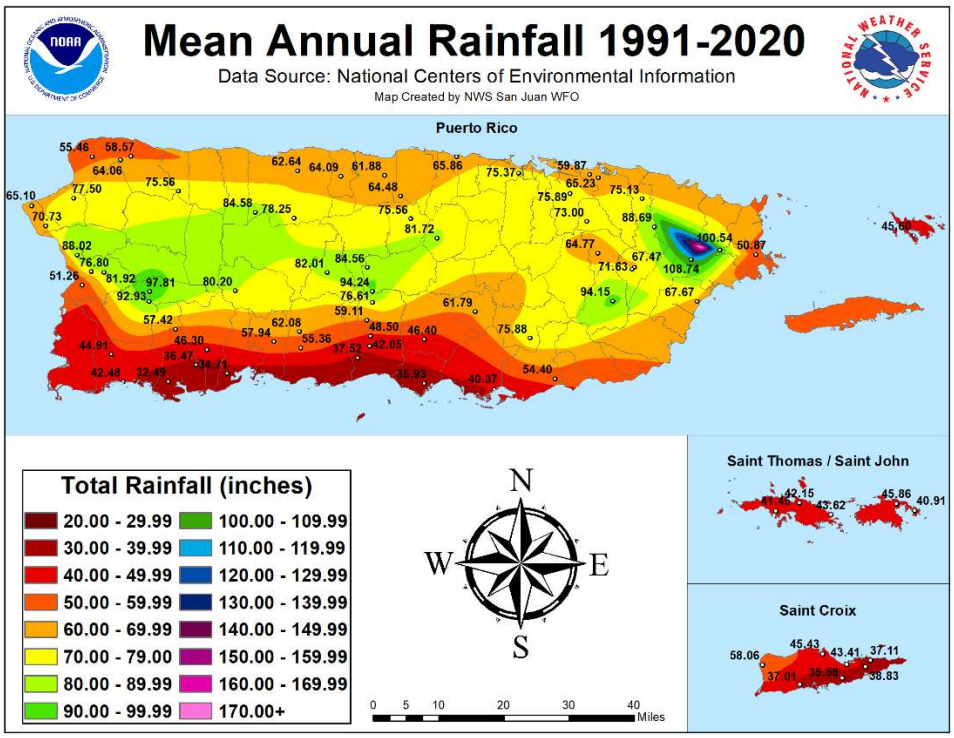
Map 23: Landslides Reported in the Aftermath of Hurricane María



4.7.1.4 Future Event Probabilities (B1-e)

Though landslides can be caused by earthquakes or anthropogenic factors, most of the landslides in Puerto Rico are caused by rain events. As shown before landslides can happen by any type of rain event. Figure 13 shows the Mean Annual Rainfall for Puerto Rico and the US Virgin Islands from 1991 to 2020. Utuado is located within one of the wettest regions of Puerto Rico, with mean annual rainfall generally ranging from approximately 80 to 100 inches per year across much of the municipality. The highest rainfall amounts occur in the central and western portions of Utuado, where mapped values exceed 90 inches annually, while northern and eastern areas are generally mapped between 80 and 90 inches per year. The map indicates a gradient of increasing rainfall from the north and east toward the central and western portions of the municipality.

Figure 14: Mean Annual Rainfall 1991-2020 (PR & USVI)[12]



[12] Obtained from https://www.weather.gov/sju/climo_pr_usvi_normals

4.7.2 Risk Analysis (B2-a, B2-b)

4.7.2.1 Estimated Losses

In the Municipality of Utuado as in much of Puerto Rico, landslides typically occur during or after major storms with torrential rainfall. The occurrence of rainfall-induced landslides is closely associated with severe storms or sequential rain events that saturate vulnerable steep soils.

Currently, there are no standardized models to estimate structural and content losses caused by landslides and other mass movements. For this reason, susceptibility indices from the USGS were empirically applied using the best available data to assess potential losses from mass movements in Utuado. These indices are categorized into four risk levels: low, moderate, high, and very high. Due to limited data, it is not possible to estimate monetary losses for building damage currently.

4.7.2.2 Lifelines and Critical Infrastructure

Landslides can affect FEMA Lifelines in the following ways:

- Safety and Security - Landslides can entrap and kill individuals through rapid debris movement, complicate rescue efforts, and lead to loss of life and security threats due to isolated or destroyed emergency services (Center for Disaster Resilient Communities, n.d.).
- Food, Hydration, and Shelter - Destruction of homes and agricultural land leads to displacement and food insecurity; disruption of local water and sanitation increases contamination risks, particularly in temporary shelter settings (IFRC, 2023).
- Health and Medicine - Direct injuries (e.g., trauma, suffocation) occur during landslides; longer-term impacts include outbreaks of waterborne and vector-borne diseases, and psychological trauma among survivors (Center for Disaster Resilient Communities, n.d.).
- Energy - Landslides can damage power lines, substations, and fuel infrastructure, causing wide-ranging electrical outages hindering both public and emergency responses.
- Communications - Cable disruptions, toppled poles, and blocked access to telecom facilities can impair alert systems, responder coordination, and public information networks.

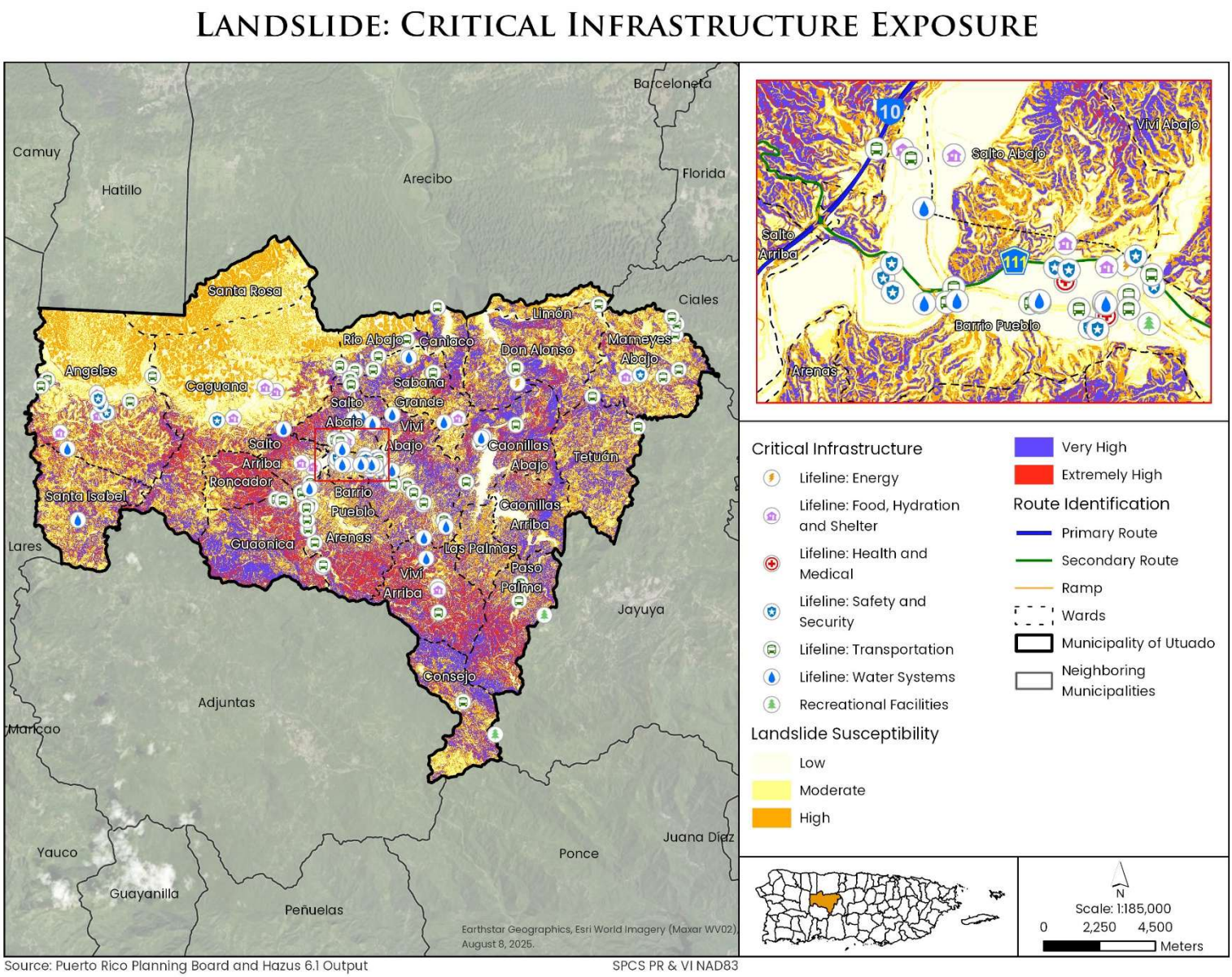
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- Transportation - Roads, railways, bridges, and tunnels can become impassable or destroyed due to landslide deposits, severely restricting mobility for both the public and emergency services.
- Hazardous Materials - Landslides may rupture containment units, pipelines, tanks, or industrial facilities, release chemicals or pollutants and create HAZMAT emergencies (FEMA, 2024).
- Water Systems - Damage to water intake, treatment, distribution, sewage collection, and treatment facilities can result in contamination, reduced water pressure, and service interruption (IFRC, 2023).

Map 24 shows the identified critical infrastructure that could be affected by Landslides. The map illustrates critical infrastructure facilities distributed throughout Utuado, with the highest concentration located in and around Barrio Pueblo. Areas mapped with very high and extremely high landslide susceptibility are concentrated across the central and southern wards, including Roncador, Guanica, Arenas, Viví Arriba, Consejo, Paso Palma, and portions of Caonillas Arriba and Caonillas Abajo. Critical infrastructure facilities are present within areas of low, moderate, high, very high, and extremely high landslide susceptibility throughout the municipality.

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Map 24: Landslide: Critical Infrastructure Exposure



Source: Puerto Rico Planning Board and Hazus 6.1 Output SPCS PR & VI NAD83

4.7.2.3 Social Vulnerabilities

Social vulnerability to landslides in Puerto Rico is the product of topography, poverty, aging populations, fragile infrastructure, and geographic isolation, all of which shape the severity of impacts after major storms or seismic events. Academic and federal analyses consistently show that landslides disproportionately burden communities that already struggle with access to transportation, healthcare, income stability, and emergency response. Addressing these vulnerabilities requires hazard mitigation strategies that integrate geospatial risk analysis, social vulnerability indicators,

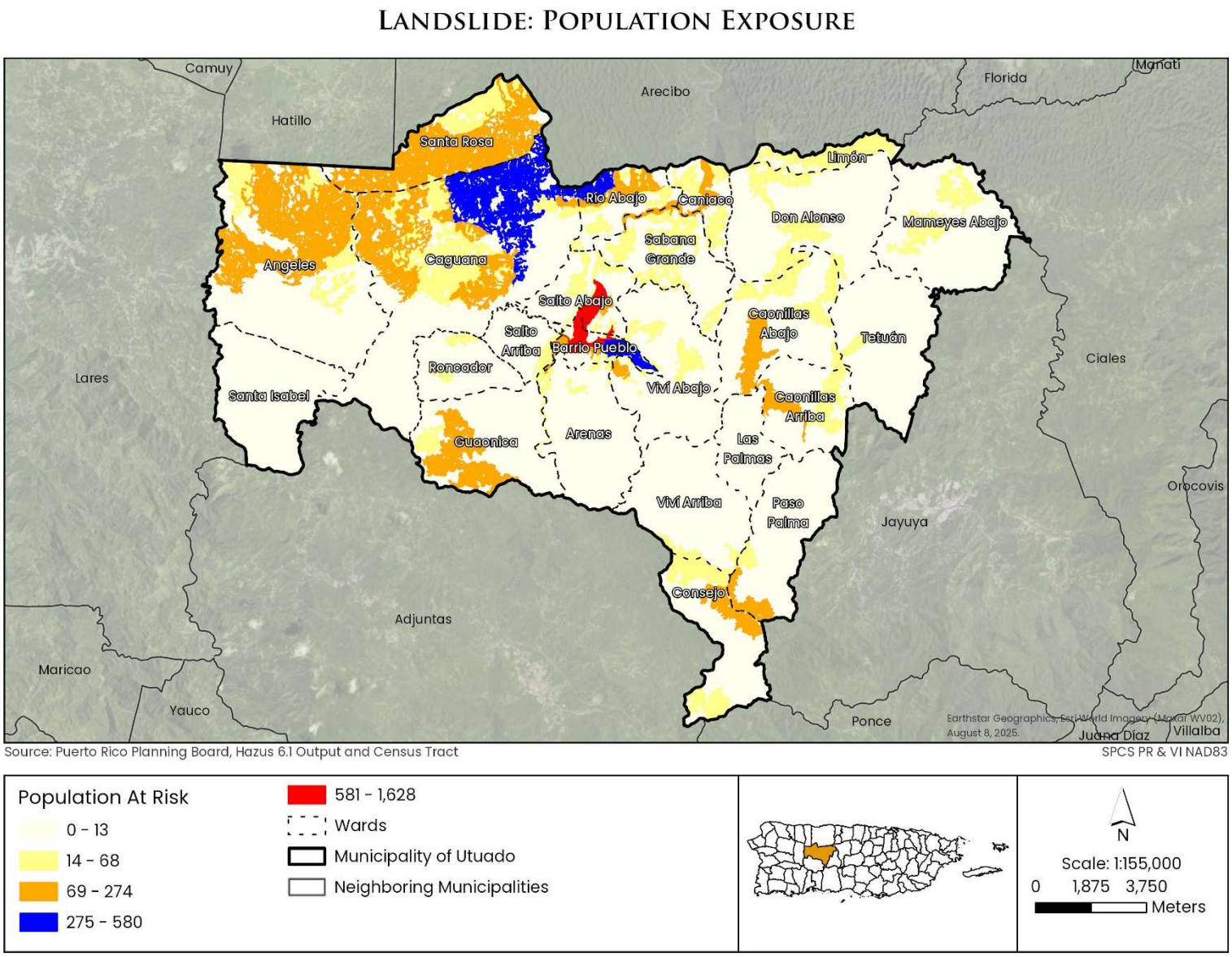
community-based planning, and infrastructure reinforcement tailored to rural and mountainous municipalities (West, Rodríguez Cruz, & Hughes, 2023).

Focus groups on the municipality of Utuado highlighted that landslides cut off access to medical facilities, emergency response, and even water and food, sometimes for months. This creates immediate life-threatening conditions for people with health conditions, mobility limitations, or emergency medical needs (West, Rodríguez Cruz, & Hughes, 2023).

Map 25 illustrates that the landslide population exposure is concentrated in Barrio Pueblo, where the highest exposure category is mapped. Additional areas of elevated population exposure occur in the northern wards of Caguana and Santa Rosa, as well as portions of Ángeles, Guaonica, Caonillas Arriba, Caonillas Abajo, and Consejo. Most of the municipality is mapped within the lower exposure categories, with exposed populations occurring in scattered clusters across multiple wards rather than continuously throughout the municipality.

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Map 25: Landslide: Population Exposure



4.7.2.4 Natural and Cultural Resources

Landslides represent one of the most destructive natural hazards, with consequences that extend beyond immediate physical damage (Eliot, Cloyd, & Philbin, 1994). Their effects on natural resources are profound and often irreversible. When a landslide occurs, vast areas of vegetation are uprooted or buried, leading to the loss of critical habitats and a decline in biodiversity. The displacement of soil not only strips away fertile layers essential for agriculture but also introduces large volumes of sediment into rivers and reservoirs. This sedimentation degrades water quality, disrupts aquatic

ecosystems, and can compromise drinking water supplies. Furthermore, landslides frequently alter hydrological systems by blocking river channels, creating temporary dams that increase flood risk and modify groundwater recharge patterns.

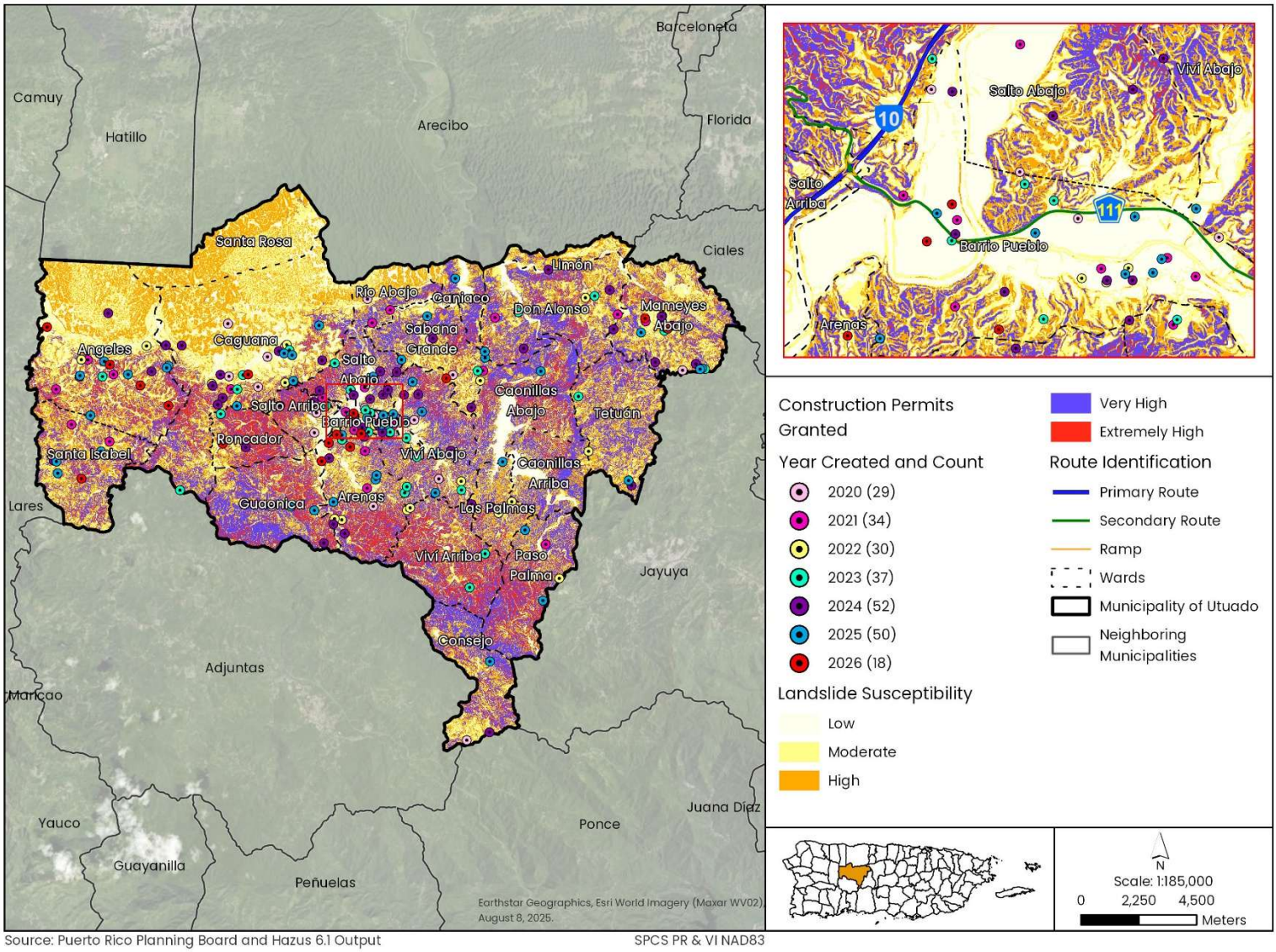
The cultural dimension of landslide impacts is equally significant. Archaeological sites, historic monuments, and culturally significant landscapes are highly vulnerable to burial or destruction during such events. These losses are irreplaceable, erasing tangible links to the past and diminishing cultural heritage. In many regions, landslides have damaged centuries-old structures, including churches, colonial buildings, and sacred sites, resulting in costly restoration efforts or permanent loss. Beyond physical damage, the alteration of cultural landscapes such as terraced fields or ceremonial grounds undermines community identity and traditions deeply tied to the land. Economically, these impacts ripple through local economies dependent on cultural tourism, reducing visitor numbers and income for communities that rely on heritage-based activities.

4.7.2.5 Future Conditions (E1-a)

Map 26 shows that recent development permits are distributed throughout Utuado, with the greatest concentration located around Barrio Pueblo, Salto Abajo, Salto Arriba, and Viví Abajo. Additional recent development is dispersed across the western wards of Ángeles and Santa Isabel, as well as throughout the eastern and southern portions of the municipality. Many permit locations coincide with areas mapped as very high and extremely high landslide susceptibility, particularly in the central and southern wards, while others are located within areas of lower susceptibility.

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Map 26: Landslide: Recent Development Exposure



Source: Puerto Rico Planning Board and Hazus 6.1 Output SPCS PR & VI NAD83

4.8 FLOODING

4.8.1 DESCRIPTION (B1-A)

Floods, generally caused by excessive rainfall (FEMA, 1997), are classified into two main categories: general floods and flash floods.

- General floods are long-duration events that can last several days and include riverine, coastal, and urban floods. Coastal floods are associated with storm

surges, waves, and heavy rains generated by hurricanes and tropical storms, while urban floods result from the alteration of natural drainage due to urban development. Riverine floods occur when rivers overflow due to excessive water runoff though rainfall or structural failures, causing water to spill into surrounding land. Flash floods often stem from stationary storms, hurricanes, or dam failures, affecting both mountainous areas and urbanized zones.

- Flash floods happen when prolonged rainfall falls over a watershed (water basin). The latter result from intense precipitation over a short period in specific areas. The magnitude of flash floods events depends on factors such as basin topography and physiography, weather patterns, soil saturation, and surface impermeability. Flash floods mainly originate from slow-moving storms over specific areas or from intense rainfall associated with hurricanes and tropical storms (NMEAD, 2021). However, they can also occur after the collapse of dams or levees within minutes or hours, due to extreme rainfall or the sudden release of water from retention basins or other stormwater control facilities. Although more frequent in mountain streams, these events can occur in urban areas where impermeable surfaces limit infiltration.

The periodic flooding of land adjacent to rivers, streams, and coasts, known as floodplains, is a predictable natural phenomenon based on recurrence intervals. These intervals represent the average time, in years, between events of equal or greater magnitude. The longer the recurrence interval, the greater the magnitude of the event, which implies a significant increase in risk and the extent of the affected area. Floodplains flood periodically according to recurrence intervals, defined as the average time between events of equal magnitude. For example, a 100-year flood has a 1% annual probability, while a 500-year flood corresponds to 0.2%. These frequencies are calculated through statistical analysis of historical flow records and extreme events.

Table 24 shows the different flood zone classifications for Puerto Rico adopted by the PRPB (PRPB, 2021).

Table 24: Puerto Rico Flood Zones

Flood Zone	Description
Zone A	Special Flood Hazard Area with a recurring period of one hundred (100) years determined by using approximate methodologies with no base flood elevation or Floodway determined.

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Zone AE	Special Flood Hazard Areas with a recurring period of one hundred (100) years determined by detailed methodologies with base flood elevations indicated. According to the scope of the study, may include the Floodway determination.
Zone AO/AH	Shallow Special Flood Hazard Areas with a recurring period of one hundred (100) years with a base flood depth fluctuating between 0.30 meters (one (1) foot) and 0.91 meters (three (3) feet). The average flood depths are obtained from detailed hydraulic analysis.
Zone A99	Areas prone to flooding from a flooding event with a one percent (1%) annual chance of occurring. These special areas are within a flood protection or control system where enough progress has been made in its construction, even though it has not been completed, but specific statutory progress has been reached to complete it. This zone does not detail base flood elevations or flooding depths, so it is recommended to use, if required, the previous flood elevation for Zone 99. Mandatory flood insurance purchase requirements apply.
Zone D	Flooding area that is not determined but is possible.
Zone VE	Coastal high flood hazard area with a recurring period of one hundred (100) years with velocity and energy (storm surge) and a determined base flood elevation.
Zone X Shaded	Flooding area with 0.2% chance of occurring each year or the one hundred (100) year flood with a water depth of less than 0.3 meters, with drainage areas of less than 2.6 square kilometers or areas protected by levees against the one hundred (100) year flood.
Zone X (unshaded)	Area determined to be outside the five hundred (500) year storm flood.

4.8.1.1 AFFECTED AREA (B1-B)

Flood Hazard Insurance Map

Map 27 illustrates the 1% annual chance flood hazard zones concentrated along the municipality's major river and stream corridors. The largest mapped flood hazard areas occur in and around Barrio Pueblo, extending north through Salto Abajo and Río Abajo, and east through Caonillas Abajo, Caonillas Arriba, and Paso Palma. Additional 1% annual chance flood hazard areas are mapped in portions of Limón, Don Alonso, Arenas, and Ángeles. A small area of 0.2% annual chance flood hazard is mapped near Barrio Pueblo. Overall, the mapped flood hazard zones follow the municipality's primary waterways and tributaries.

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Figures 15 and 16 show various FIRMette that shows specific areas of flooding in the Municipality.

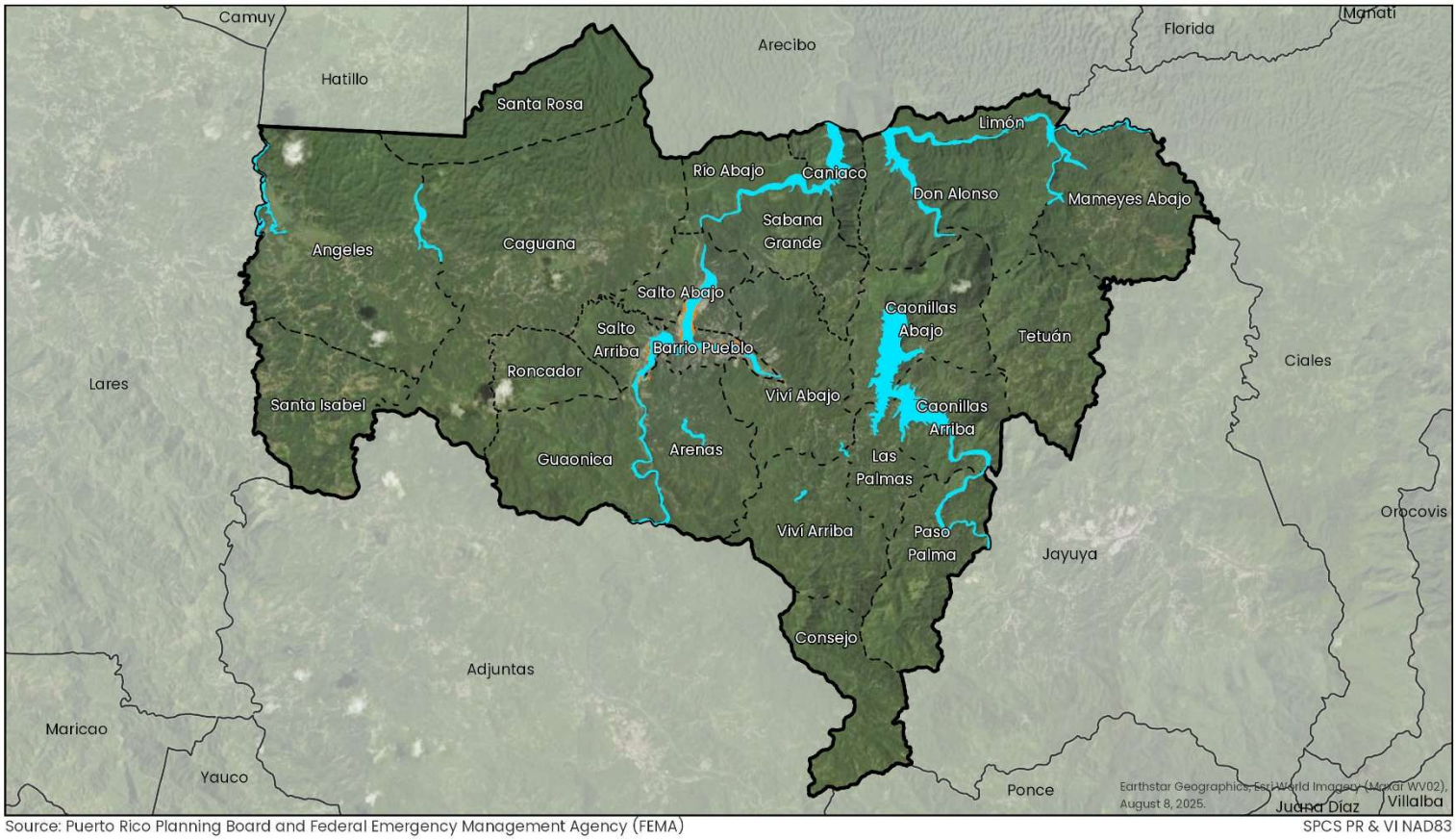
- Figure 15 shows the 1% annual chance flood hazard areas (Zone A/AE) concentrated along the river corridor that passes through Barrio Pueblo and extends north toward Salto Abajo and south toward Arenas. Additional mapped flood hazard areas are located west of the urban center and along river segments in the northern portion of the mapped area. A narrow regulatory floodway is shown within portions of the main floodplain corridor. The mapped flood hazard zones follow the river channels and adjacent low-lying floodplain areas. Specific development affected by these flood zones are Areas that are affected by this flood zone are Cabrera, Barraida Nueva, San Martín and the Jesús María Lago Subdivision.

- Figure 16 illustrates a 1% annual chance flood hazard area (Zone AE) extending along the river corridor that passes through Barrio Pueblo. The mapped floodplain follows the river channel from west to east across the urban center and includes adjacent developed areas. A regulatory floodway is mapped within portions of the floodplain, and multiple base flood elevation cross-sections are shown along the corridor. Overall, the flood hazard area is concentrated along the main river and its immediate floodplain through the central portion of Utuado. Specific areas affected by floods couased by the Viví River in the Utuado Town Center include; Calle Robles, Calle Cedro, Calle Las Palmas, Calle Flamboyán, Road PR-111R (Ave. Dr. Adrián Cueto Rodríguez), Road PR-611 (Ave. Fernando Luis García Ledesma, including the bridge over the Viví River. Calle Sgto Israel Malaret Juarbe, among others.

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Map 27: Flood Hazard Zones

Flood Hazard Zones



Source: Puerto Rico Planning Board and Federal Emergency Management Agency (FEMA)

SPCS PR & VI NAD83

FEMA Flood Hazard

- 1% Annual Chance Flood Hazard
- 0.2% Annual Chance Flood Hazard

- Wards
- Municipality of Utuado
- Neighboring Municipalities



N

Scale: 1:155,000

0 1,875 3,750 Meters

Figure 15: National Flood Hazard Layer FIRMette

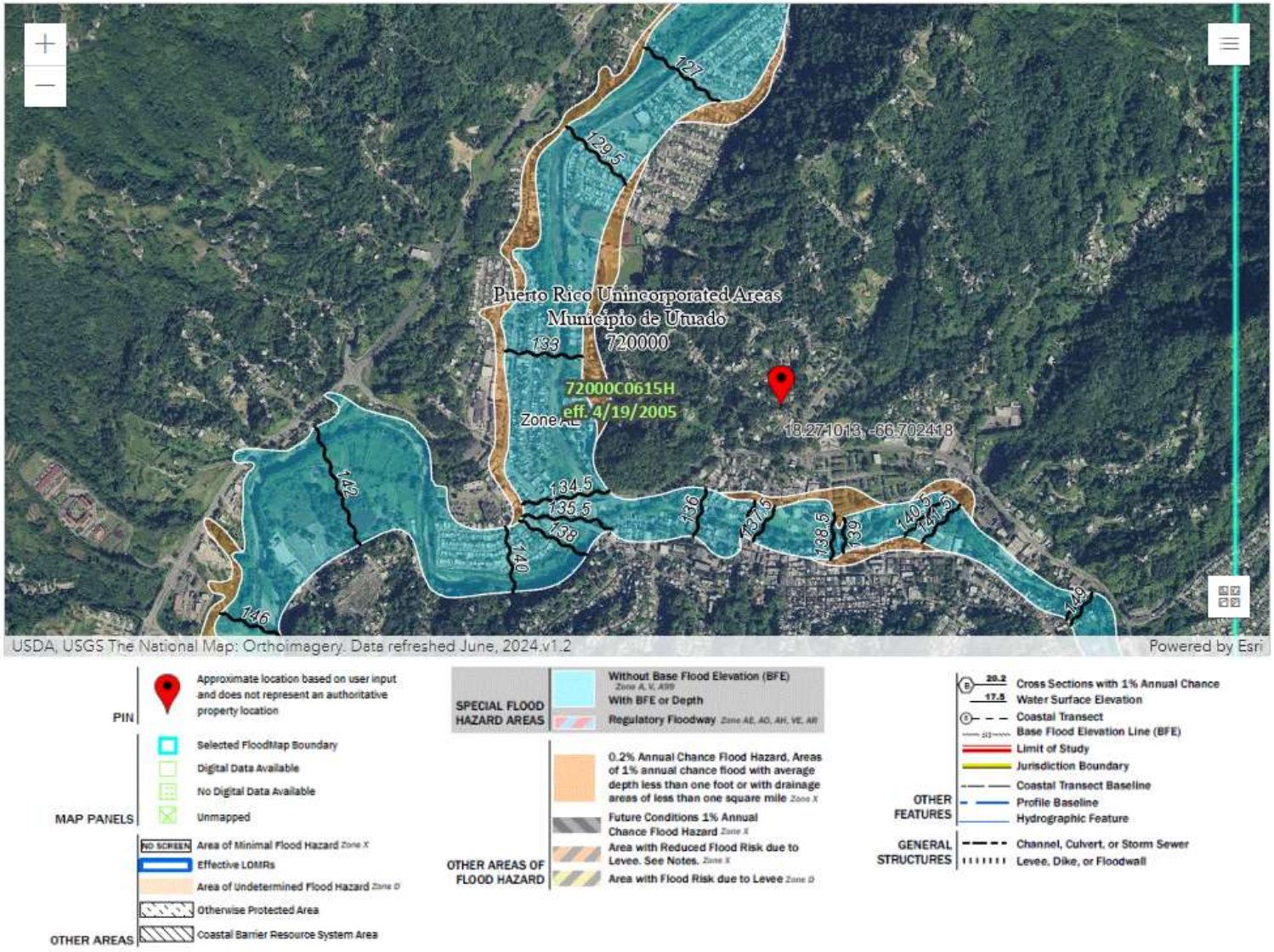
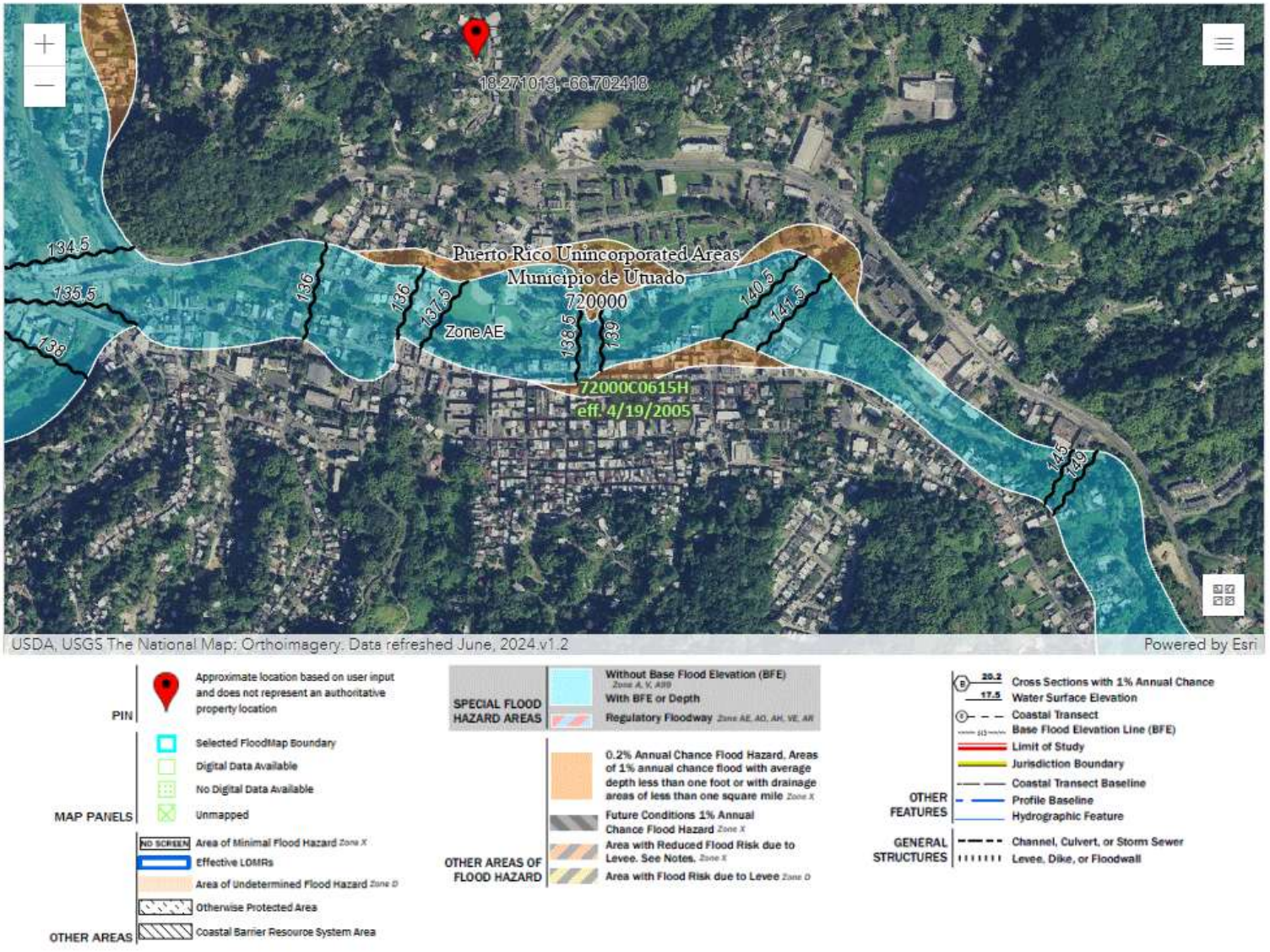


Figure 16: National Flood Hazard Layer FIRMette (Casco Urbano)



Advisory Base Flood Elevation (ABFE)

Likewise, FEMA uses another type of map for the purpose of developing regulations and construction permits known as the Advisory Base Flood Elevation Maps (ABFE). ABFEs are developed after the occurrence of a high-impact atmospheric event, and several factors related to the latest engineering analysis are taken into consideration to determine whether an analysis is necessary. Some of the factors considered in the analysis include the age of the analysis, the territory covered by the analysis, and the engineering models/data used in the analysis. ABFEs have been produced for states such as Mississippi (Hurricane Katrina), New York, and New Jersey (Hurricane Sandy).

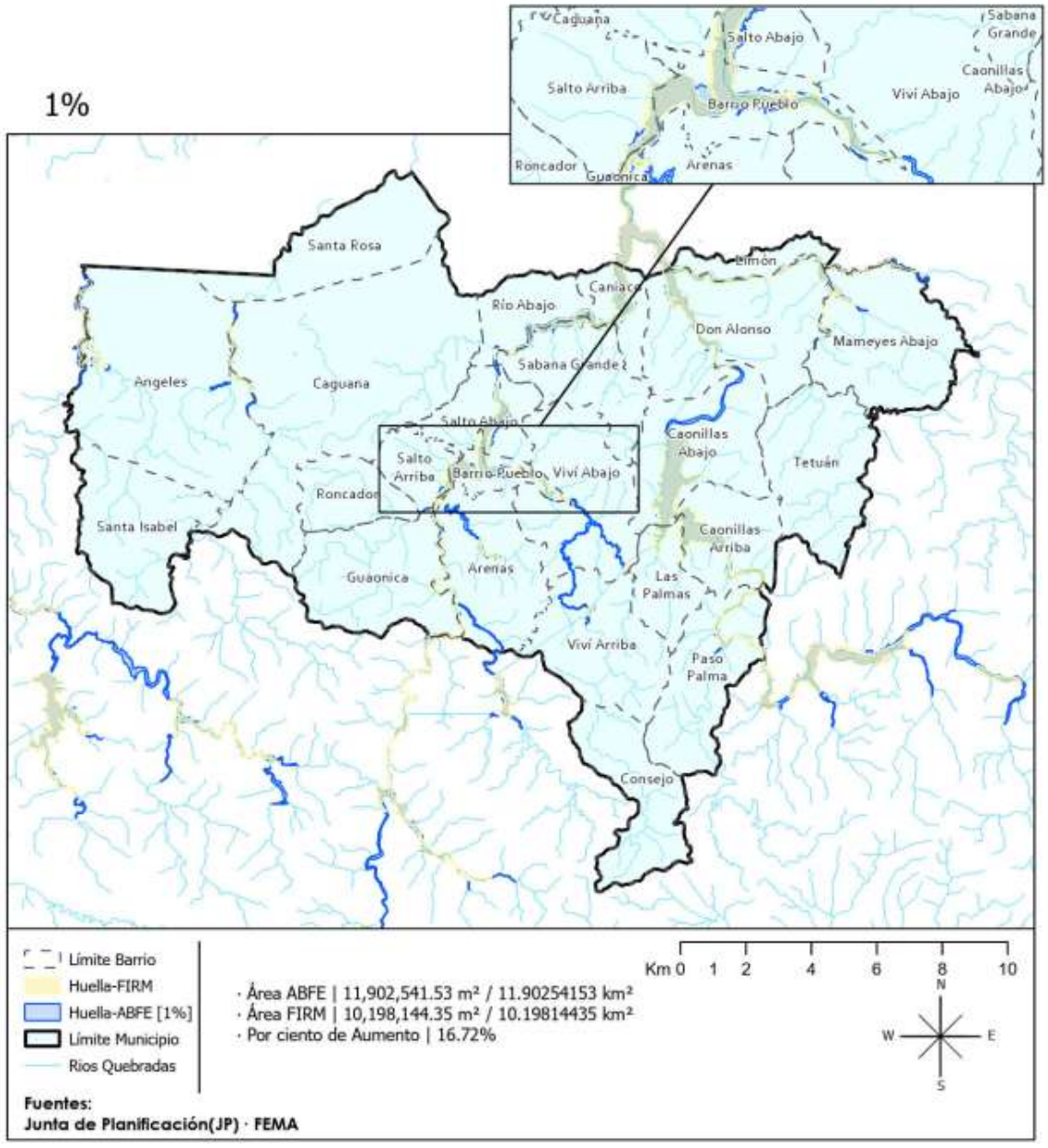
Following Hurricane María's passage through Puerto Rico in 2017, and due to the availability of better data, FEMA developed ABFEs for Puerto Rico. It should be noted that the Puerto Rico Planning Board adopted the ABFEs on an emergency basis in March 2018. At present, Puerto Rico has two (2) types of flood maps: the FIRMs (2009), which are used solely for flood insurance rates, and the ABFEs (2018), which are used to regulate construction on the Island.

For comparison purposes, this subsection includes the difference in the extent of land affected by flooding based on the FIRMs prior to Hurricane María in September 2017 and the ABFEs developed by FEMA for Puerto Rico. After Hurricane María in 2017, the areas designated as flood-prone throughout the Island increased by 20%. Thus, this reflected an increase of 41%.

The next Figure (in Spanish) compares the FEMA Flood Insurance Rate Map (FIRM) floodplain with the Advisory Base Flood Elevation (ABFE) floodplain in the Municipality of Utuado. According to the map, the ABFE floodplain covers approximately 11.90 km², while the FIRM floodplain covers approximately 10.20 km², representing an increase of 16.72 percent. The mapped floodplain areas are concentrated along the municipality's river corridors, with the inset highlighting flood-prone areas near Barrio Pueblo and adjacent sectors. The map indicates that approximately 1 percent of the municipal area is located within the ABFE floodplain.

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Figure 17: ABFE vs FIRM 1% (100 years)



As instructed by PRPB the hazard analysis was made using the ABFE maps.

HAZUS Modeling

Flooding source identification and hazard loss estimation were performed using Federal Emergency Management Agency's (FEMA) Hazus platform, a nationally standardized tool for multi-hazard risk assessment. The Hazus flood module was used to delineate streams in areas where no engineering studies have been developed and used to estimate potential monetary losses associated with structural damage.

Input data included depth grids produced by a Base Level Engineering (BLE) study in 2018 post hurricanes Irma and Maria. This BLE study did not review all potential riverine flooding sources so additional modeling was developed with Hazus hydrology and hydraulics to review other potential losses associated with streams with drainage areas of one square mile or more.

Topographic data used by Hazus for depth calculations and damage estimation was sourced from the USGS 3D Elevation Program (3DEP) seamless 1/3 arc-second Digital Elevation Model (DEM), at an approximate resolution of 10 feet. This dataset provides current coverage of Puerto Rico and its surrounding islands.

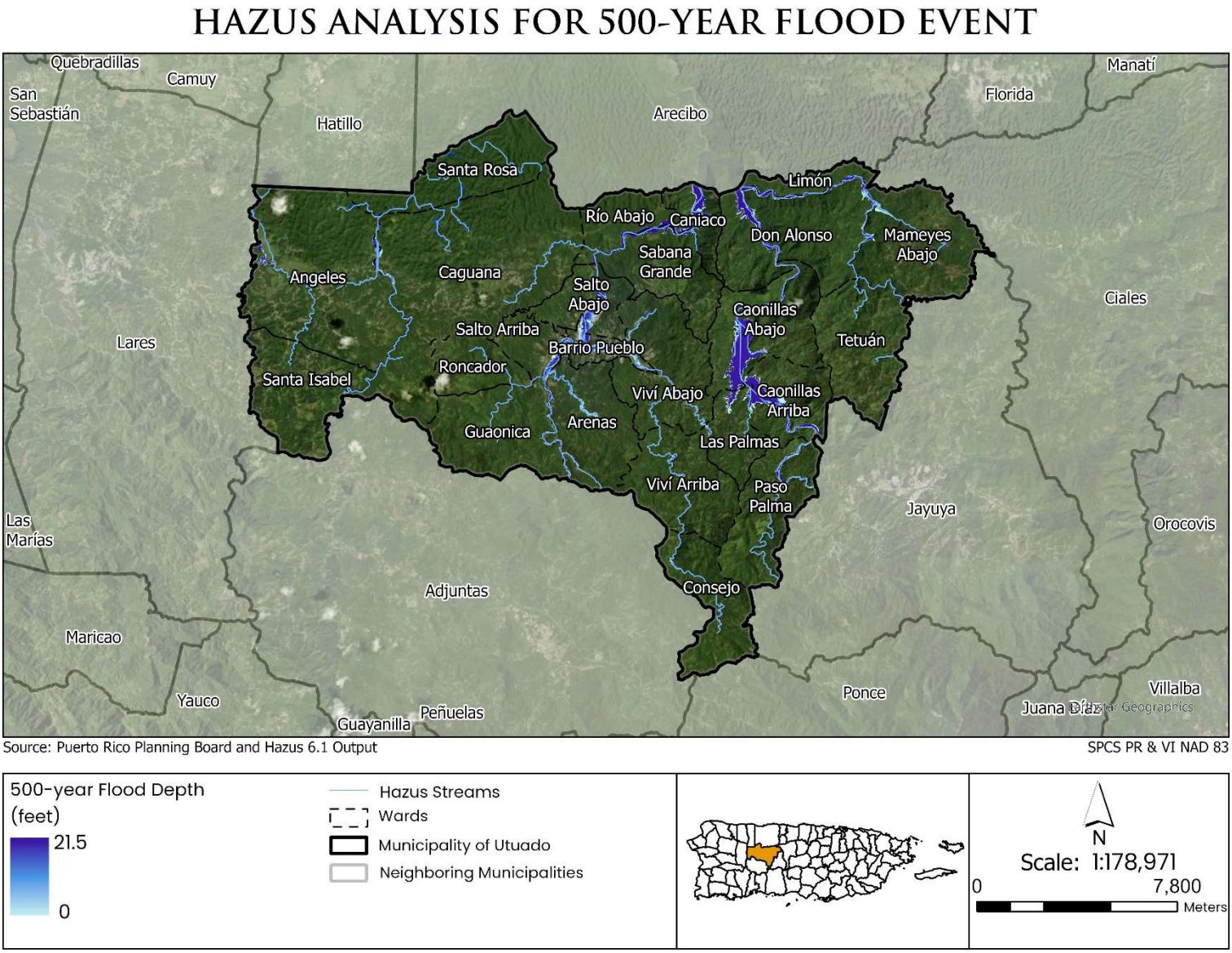
The 3DEP seamless DEM for Puerto Rico is derived from two lidar collection efforts: a 2016–2017 USGS lidar survey and a 2018 USGS post-Hurricane Maria lidar survey. The 2018 collection, conducted following the significant coastal geomorphic changes caused by Hurricane Maria, represents the most current available terrain data for the island and forms the primary basis of the 3DEP elevation layer used in this analysis.

The areas documented in the maps included within the LHMP may have streamlines represented but with no depth grids associated with them. Due to the inconsistency of available regression equations and other data necessary for computation of flood risk and losses with Hazus's hydrology and hydraulics models, some streams that were delineated were unable to be completed during modeling runs. These stream areas may need to be reviewed for future flood studies and potential flood risk identification but, due to the lack of data, they were unable to be included in the Hazus studies.

The following map shows the result of the Hazus Run. The most up to date Hazus Run shows that flooding may extend beyond what was determined in the 2018 ABFE.

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Map 28: Hazus Analysis for 500-Year Flood Event



The HAZUS 500-year flood event analysis shows flood depths concentrated along major stream and river corridors throughout Utuado. The greatest flood depths are mapped in portions of Limón, Caníaco, Caonillas Abajo, and Caonillas Arriba, with additional flood-prone areas extending through Barrio Pueblo, Salto Abajo, Viví Abajo, and Paso Palma. Smaller flood-depth areas are also mapped along stream corridors in Río Abajo and other northern wards. Overall, the mapped flood depths follow the municipality's primary waterways and tributaries.

4.8.1.2 Risk Magnitude (B1-C)

Flood events can represent one of the most severe atmospheric threats, as there is no other event worldwide that causes greater loss of life (FEMA, 1997). This is due to the high frequency of such events and the population's lack of awareness regarding the magnitude of the damage they can cause, whether physical harm or property damage. It should be noted that most disaster declarations in the U.S. are related to flood events. Most flood-related incidents involve people being swept away, along with their vehicles, by water currents (FEMA, 1997). Each year, the devastation caused by floods results in billions of dollars in asset losses. Regions with the highest population density are areas at high risk of flash floods, as the construction of buildings, roads, and parking lots create impermeable surfaces, reducing the land's ability to absorb water (NSWL, n.d.).

Floods are the most common natural disaster, occurring when water overflows and submerges land that is typically dry. They are often triggered by heavy rainfall, rapid snowmelt, or storm surges from tropical cyclones or tsunamis in coastal regions.

Floods can cause extensive destruction, including loss of life and severe damage to homes, property, and critical public health infrastructure. Between 1998 and 2017, floods impacted more than 2 billion people worldwide. Those living in floodplains, in poorly constructed buildings, or without access to warning systems and hazard awareness are the most vulnerable (WHO, 2025).

Three common types of floods include:

- Flash floods: Result from sudden, intense rainfall that rapidly raises water levels, overwhelming rivers, streams, channels, or roads.
- River floods: Occur when prolonged rainfall or snowmelt causes rivers to exceed their capacity.
- Coastal floods: Caused by storm surges linked to tropical cyclones or tsunamis.

Regarding the impact on life, property, and operations, floods cause loss of life and property damage, including residences, buildings, infrastructure, agriculture, and sanitation and drainage systems. After a flooding event, the aftermath can increase the occurrence of various diseases, such as leptospirosis, and lead to rises in contaminated water (Malilay, 2000).

According to a Congressional Budget Office (CBO) report "Over the past 10 years, damage from flooding in the United States has averaged $46 billion per year (in 2023

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dollars)" (CBO, 2024). This estimate includes costs such as:

- "The replacement of residential and commercial property
- Repairs for or rebuilding of public infrastructure
- Emergency response measures
- Costs associated with the ongoing loss of the use of property (for example, the provision of temporary housing)
- Losses in the commercial sector due to business interruptions
- Damage to crops, livestock, and timber (CBO, 2024)

Although the impact of adaptation projects can vary significantly, Corps estimates suggest that about two-thirds of its projects, excluding the top and bottom sixth in benefit-cost ratios are expected to reduce flood damage by $2 to $6 for every dollar spent over a 50-year lifespan (CBO, 2024).

4.8.1.3 Past Events (B1-D)

For the most part flooding events in Puerto Rico are related to tropical systems (tropical waves, tropical depressions, tropical storms and hurricanes). As such flooding hazards occur mostly within the hurricane season that runs from June 1 to November 30.

However, flooding events can occur outside this window as shown in the case of the April- May 2024 Floods, the February 2022 floods and the Three Kings' Flooding of 1992.

The next table shows the major flooding events in the period of 2010–2025.

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Table 25: Major flooding events in Puerto Rico 2010-2025

Event	Date	Disaster Declaration Number	Utuado Included?	Description
Tropical Storm Ernesto	8/14/2025 – 8/16/2025	DR-4850- PR	Public Assistance – No Individual Assistance - No	The storm's slow movement and moisture-rich environment contributed to prolonged precipitation, particularly in central and eastern municipalities. Parts of Central Puerto Rico recorded 12–14 inches of rainfall in localized areas. Flash flooding occurred in urban and rural areas, rendering primary and secondary roads impassable. Floodwaters caused structural failures in bridges and washed-out critical road segments, isolating several communities. Stormwater drainage systems in metropolitan areas, leading to localized urban flooding. Emergency Response and Disruptions Evacuations were conducted in flood-prone areas to mitigate loss of life.
Puerto Rico Severe Storms, Flooding,	4/29/2024 – 5/10/2024	DR-4808-PR	Public Assistance – No	In April 2024, Puerto Rico was struck by a series of severe storms that delivered prolonged heavy rainfall—some areas

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
Landslides, and Mudslides			Individual Assistance - No	received more than 10 inches—leading to widespread flooding and landslides. Central and western municipalities saw rivers overflow, Urban areas, especially in the southwest faced flash flood warnings as heavy afternoon downpours overwhelmed drainage systems. Floodwater turned streets into torrents, trapping residents on rooftops and prompting emergency evacuations in over 20 municipalities.
Hurricane Fiona	9/17/2022-9/21/2022	DR-4671-PR	Public Assistance – Yes Individual Assistance - Yes	Hurricane Fiona struck Puerto Rico in September 2022, unleashing torrential rains—up to 31.22 inches of rainfall over 72 hours in Ponce, nearly matching the accumulation from Hurricane Maria. This deluge led to catastrophic flooding, with 7 to 20 inches common across most of the island and localized spots exceeding 30 inches.
Puerto Rico Severe Storm, Flooding and Landslide	2/4/2022 – 2/6/2022	DR-4649-PR	Public Assistance - No Individual Assistance - No	In February 2022, Puerto Rico experienced a severe storm that brought prolonged heavy rainfall, causing widespread flooding across the island. Rainfall totals ranged from 3 to 10 inches in many areas, with localized peaks reaching up to 16 inches. The intense precipitation

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				overwhelmed drainage systems, leading to urban flooding. Rivers swelled beyond their banks, inundating roads and isolating communities, while landslides compounded the damage in mountainous regions. Emergency responders issued flash flood warnings and conducted evacuations as homes and businesses were submerged.
Puerto Rico Severe Storm and Flooding	9/13/2020	DR-4571-PR	Public Assistance - No Individual Assistance - No	Puerto Rico was battered by a severe storm and flooding on September 13, 2020, resulting in widespread flood damage and infrastructure disruption. Torrential rains overwhelmed drainage systems and caused rivers to overtop. Roads and bridges were submerged or damaged, isolating communities and impeding emergency response efforts. Floodwaters inundated homes and public facilities, prompting evacuation orders and flash flood warnings across several municipalities.
Tropical Storm Isaías	7/29/2020 - 7/30/2020	DR-4560-PR	Public Assistance - No Individual Assistance - No	Although the center of Tropical Storm Isaías did not make landfall on the island, the system left a large amount of rain in its path, causing flooding throughout Puerto Rico. Rainfall accumulation of up

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				to 10 inches was recorded around the island.
Hurricane María	9/20/2017	DR-4339-PR	Public Assistance – Yes Individual Assistance - Yes	Widespread flooding severely affected the whole Island. For example, in San Juan, water levels reached up to 6 feet in some areas and numerous structures losing their roofs. Survivors reported that floodwater rose 6 feet in just 30 minutes, and some areas experienced depths of up to 15 feet (4.6 m).
Hurricane Irma	9/5/2017	DR-4336-PR	Public Assistance – Yes Individual Assistance - No	On September 5, 2017, Hurricane Irma impacted Puerto Rico; an Emergency Declaration was issued for the Island. On September 6, 2017, a Major Disaster Declaration was issued following Hurricane Irma's passage. Two people died due to torrential rains before the hurricane. Wave heights in Puerto Rico reached 9 meters.
Tropical Storm María[13]	9/8/2011 – 9/14/2011	DR-4040-PR	Public Assistance - No Individual Assistance - No	Tropical Storm (later Hurricane) Maria formed in early September 2011 and passed near Puerto Rico, bringing significant heavy rainfall and tropical storm conditions to the island. The storm

[13] Tropical Storm María was a tropical system that pass to the northeast of Puerto Rico in 2011 and that caused flooding in the Island. Not to be confused with the 2017 Hurricane María. The name "María" was retired from the official Atlantic hurricane season list of names after 2017.

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				caused widespread flooding that inundated numerous roadways and homes; floodwaters near Patillas destroyed several homes and bridges, and approximately 150 houses in Yabucoa were flooded and damaged.
Hurricane Irene	8/22/2011	DR-4017-PR	Public Assistance - Yes Individual Assistance - No	Total rainfall reached 22 inches over three days, with the eastern region being the most affected—the same area that had already received over 6 inches earlier in August during the close passage of Tropical Storm Emily. The Río Grande de Manatí in Manatí recorded its third-highest level in history, surpassed only during Hurricane Hortense (1996) and Hurricane Georges (1998). The Puerto Nuevo River near Hato Rey reached its fourth-highest level on record. Flooding was severe enough to cause infrastructure stress and dangerous conditions across multiple municipalities. Tragically, there was one direct fatality attributed to Irene, due to drowning.
Puerto Rico Severe Storms, Flooding.	5/20/2021 – 6/8/2021	DR-4004-PR	Public Assistance - Yes	In May 2021, Puerto Rico experienced a series of intense rainfall events that caused flash flooding, river overflows, mudslides, and landslides, particularly in

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
Mudslides and Landslides			Individual Assistance - No	mountainous and interior regions. Although May is normally one of the wettest months of the year, several storm systems produced short-duration but high-intensity rainfall, overwhelming local drainage systems and destabilizing steep terrain.
Sub-Tropical Storm Otto	10/3/2010 – 10/8/2010	DR-1946-PR	Public Assistance - Yes Individual Assistance - No	An extensive rain band covered Puerto Rico while Otto moved as a distant tropical cyclone north of the Island (NOAA). This resulted in heavy and continuous rainfall that caused serious flooding (Eco Exploratorio).
Puerto Rico Severe Storms and Flooding	5/26/2010 – 5/31/2010	DR-1919-PR	Public Assistance - Yes Individual Assistance - No	In May 2010, Puerto Rico was hit by a series of severe storms that produced torrential rainfall and widespread flooding across the island. Rainfall exceeded 12 inches in some areas, overwhelming drainage systems and causing rivers to overflow their banks. Low-lying communities and urban centers experienced significant inundation, with roads submerged and bridges damaged, isolating several municipalities. Flash floods swept through residential areas, forcing evacuations and leaving homes and

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				businesses underwater. Landslides triggered by saturated soil compounded the crisis, blocking access routes and delaying emergency response efforts. The event resulted in extensive infrastructure damage and highlighted the island's vulnerability to prolonged heavy rain events during the wet season.

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In summary, in the 2010-2025 period there have been a total of 13 major disaster declarations caused by flooding or events that had flooding related damage. Of those the municipality of Utuado was eligible for either public assistance or individual assistance in seven instances.

4.8.1.4 Special Considerations: Karst Formation

The karst formation in Puerto Rico is a limestone region that covers about 27.5% of the island's surface and includes northern, southern, and scattered limestone areas, with karst features present throughout. The most pronounced karst topography occurs in the northern limestone, known as the "karst belt," which spans approximately 142,544 hectares, or 65% of that region. Tropical solution processes have shaped this belt into a landscape of mogotes, cone hills, sinkholes, blind valleys, caves, rugged canyon walls, and disappearing streams, formed by the dissolution of Oligocene and Miocene limestone under tropical conditions (Lugo, et al., 2021) (PRPB, 2014). This terrain supports the island's largest freshwater aquifers, mature forests, wetlands, estuaries, and extensive cave systems, all vital to hydrology and biodiversity. Its rugged topography and shallow soils have limited agriculture and dense settlement, leaving much of the area relatively undisturbed. However, the karst region remains vulnerable to human activities such as vegetation clearing, wetland drainage, paving, groundwater extraction, and pollution, which threaten its stability and ecological functions (Lugo, et al., 2021) (PRPB, 2014).

The karst belt is in northern Puerto Rico, of which part is in Utuado. Karst is a unique limestone landscape shaped by tropical solution processes, featuring mogotes, sinkholes, caves, and underground aquifers. It provides the island's largest freshwater reserves, supports mature forests, wetlands, and diverse ecosystems, and plays a critical role in maintaining water quality and biodiversity (Lugo, et al., 2021) (PRPB, 2014).

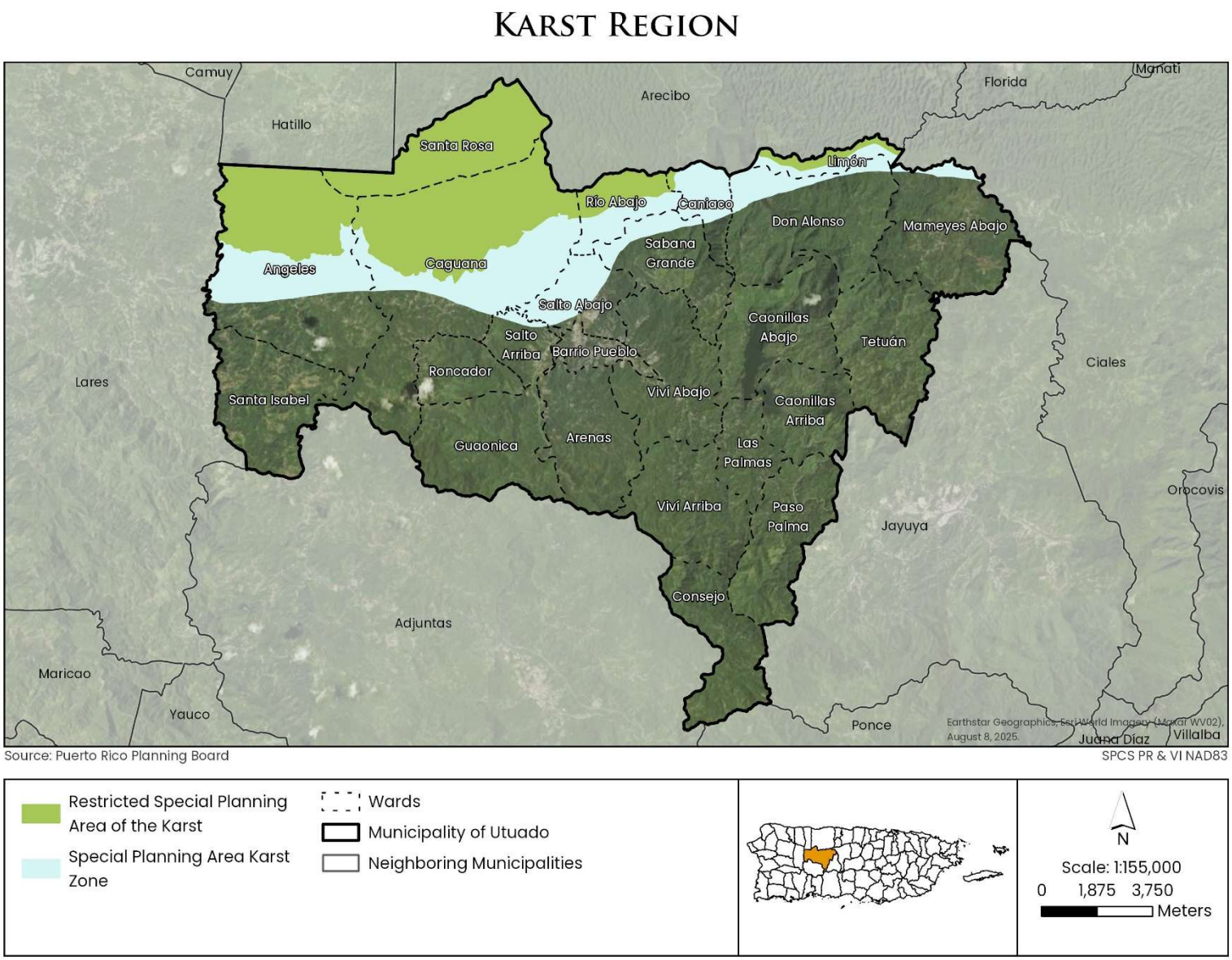
Economically, the region reduces flood risks, sustains agriculture in surrounding areas, and offers recreational and tourism opportunities. Its rugged terrain has limited urban development, preserving ecological integrity, but it remains vulnerable to deforestation, groundwater extraction, and pollution (Lugo, et al., 2021) (PRPB, 2014). According to Lugo, et al. protecting this region is essential for water security.

For Utuado, the Restricted Special Planning Area of the Karst is concentrated in the northern portion, covering most of Santa Rosa and extending into Ángeles and Caguana. The Special Planning Area Karst Zone extends east-west across the

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municipality and includes portions of Ángeles, Caguana, Río Abajo, Caníaco, and Limón. The remaining central, southern, and eastern wards are located outside the mapped karst planning areas.

Map 29: Karst Formation



4.8.1.5 Special Consideration: Floods by Stormwater Management Deficiencies

Urban drainage systems—natural or constructed—carry surface water to receive

bodies of water. When storm drains, channels, or swales become obstructed or insufficient due to heavy rainfall or urbanization, they can overflow and flood surrounding areas. Floodwaters may spread beyond FEMA's mapped floodplains, even entering zones typically considered low or moderate risk (Zones B, C, or X) (FEMA, Reducing Damage from Localized Flooding, 2025).

Puerto Rico's stormwater runoff is conditioned by the island's climate, topography and land cover. Annual rainfall varies from less than 1,000 millimeters (mm) to over 4,000 mm (40 to 157 inches). Its largely mountainous watersheds are characterized by relatively steep slopes. Stream valleys are usually well-incised and narrow, and major storms tend to be intense but brief; hence, flooding is rapid with peak discharges several orders of magnitude above base discharge. All of Puerto Rico's watersheds have experienced significant alterations It is estimated that more than 11% of the island is composed of developed surfaces, reaching up to 40% in regions such as the San Juan Metropolitan Area. These changes have significantly modified stormwater drainage patterns and downstream floodwater levels (FEMA, 2024).

Paved surfaces severely limit the infiltration of rainwater. This not only increases the volume of runoff that moves initially as sheet flow over land, but also its velocity. Storm drains can easily become overwhelmed by the resulting augmented flows. In addition, stormwater flowing over paved surfaces reaches streams and rivers much faster, overwhelming the capacity of these water bodies to receive and manage a greater volume of water within their existing channel configurations, which could lead to more frequent and higher flood levels along adjoining lands. Moreover, contaminants from both point and non-point sources of pollution are more likely to reach surface water bodies when transported by runoff over paved surfaces instead of being partially or totally degraded by vegetated soils. Higher flows also have a greater capacity to remove and transport soil and other loose materials from streambanks and riverbeds, facilitating erosion and scouring (FEMA, 2024).

Paradoxically, river flow tends to be lower between rain events after urbanization. Paved surfaces act as a barrier that isolates the soil, preventing the infiltration of rainwater that otherwise would have gradually discharged from the ground and into streams days later, a process that is critical for maintaining base flows for riparian fish and wildlife species, but also to sustain public water supply. In response, various hard infrastructure measures (flood control pump stations, curved side gutters, concrete trapezoidal channels, etc.) have been widely adopted across the island to address stormwater runoff-related flooding with minimal consideration to ecological, social, cultural, or aesthetic impacts. These practices often involve significant operation and

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maintenance costs and, in many instances, could even promote erosion, scouring and water quality impairments farther downstream and in other receiving water bodies.

A possible alternative would be to take advantage of the ecological services that green areas and other sustainable practices offer to manage runoff flows and improve water quality is more vital than ever before to safeguard the wellbeing of communities, especially against the increasing water-related impacts associated with climate change in Puerto Rico (FEMA, 2024).

4.8.1.6 Future Event Probabilities (B1-e)

A sustained historical increase in the frequency of extreme rainfall events has been identified in recent decades as stated above the Island of Puerto Rico has had 13 flood – related flood major disaster declaration in the last fifteen years. This means that the average frequency of a flooding event is approximately every 14 months.

Any mitigation action adopted to reduce the effects of flooding in the Municipality of Utuado must consider, for example, that 100-year return events or those with a 1% annual probability could become 50-year return events or have a 2% annual probability in the future. This means that flood events of a certain magnitude and impact on the municipality may increase, particularly in high-risk areas. Though there are many floods control t projects in Utuado, the probability of future events is considered high."

4.8.2 Risk Analysis (B2-a, B2-b)

4.8.2.1 Estimated Losses

Map 30 shows estimated building losses associated with a 500-year flood event (0.2% annual chance flood) concentrated along major stream and river corridors throughout Utuado. Areas with mapped building losses are located in portions of Ángeles, Río Abajo, Caníaco, Limón, Don Alonso, Mameyes Abajo, Barrio Pueblo, Viví Abajo, Arenas, Las Palmas, Caonillas Arriba, Caonillas Abajo, Paso Palma, and Viví Arriba. The highest potential loss area is identified along a river corridor in the northern portion of the municipality. Overall, the mapped building losses follow the municipality's major waterways and flood-prone areas.

Map 31 shows the estimated building losses associated with a 100-year flood event (1% annual chance flood) concentrated along major river and stream corridors

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throughout Utuado. Areas with mapped losses occur in portions of Ángeles, Río Abajo, Caníaco, Limón, Don Alonso, Mameyes Abajo, Barrio Pueblo, Viví Abajo, Arenas, Las Palmas, Caonillas Arriba, Caonillas Abajo, Paso Palma, and Viví Arriba. The highest potential loss area is located near Barrio Pueblo along the main river corridor. Overall, the mapped building losses follow the municipality's primary waterways and adjacent flood-prone areas.

As a reminder, this map does not measure extent of flooding, but rather the estimated economic losses resulting from flooding.

The following table shows the municipality's exposure to flood according to the NRI.

Table 26: Flood Exposure

Exposure - Impacted Area (sq mi)	Exposure - Building Value	Exposure - Population	Exposure - Population Equivalence	Exposure - Total
0.428863	$350,403,489.29	2,281	$26,462,830,891.56	$26,813,419,475.76

Source FEMA's NRI

Table 27 presents the expected annual flood-related losses for both buildings and population.

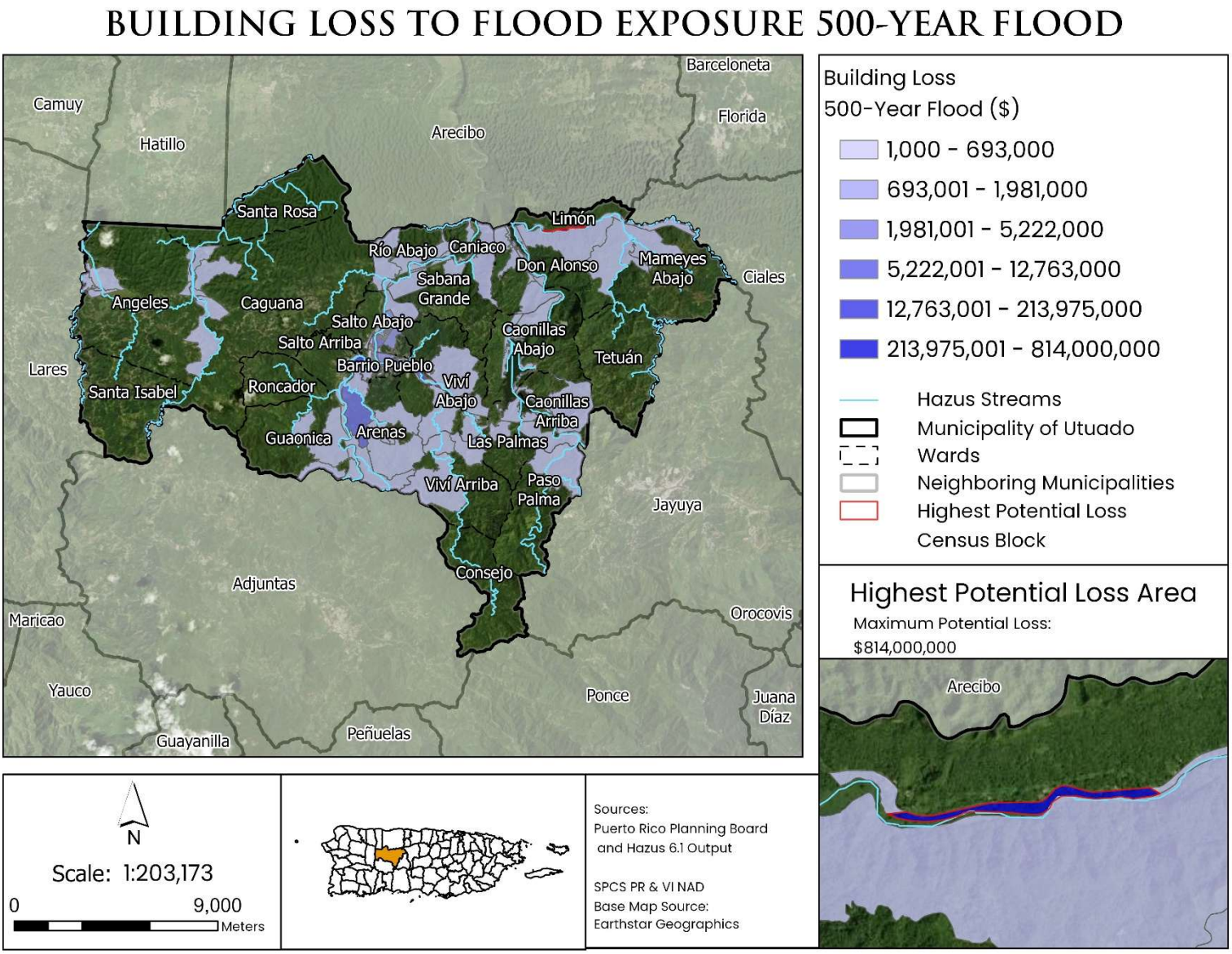
Table 27: Expected Annual Loss to Flood

Expected Annual Loss - Building Value	Expected Annual Loss - Population	Expected Annual Loss - Population Equivalence	Expected Annual Loss -Total
$1,660,725.95	0.0081	$93,983.09	$1,755,447.30

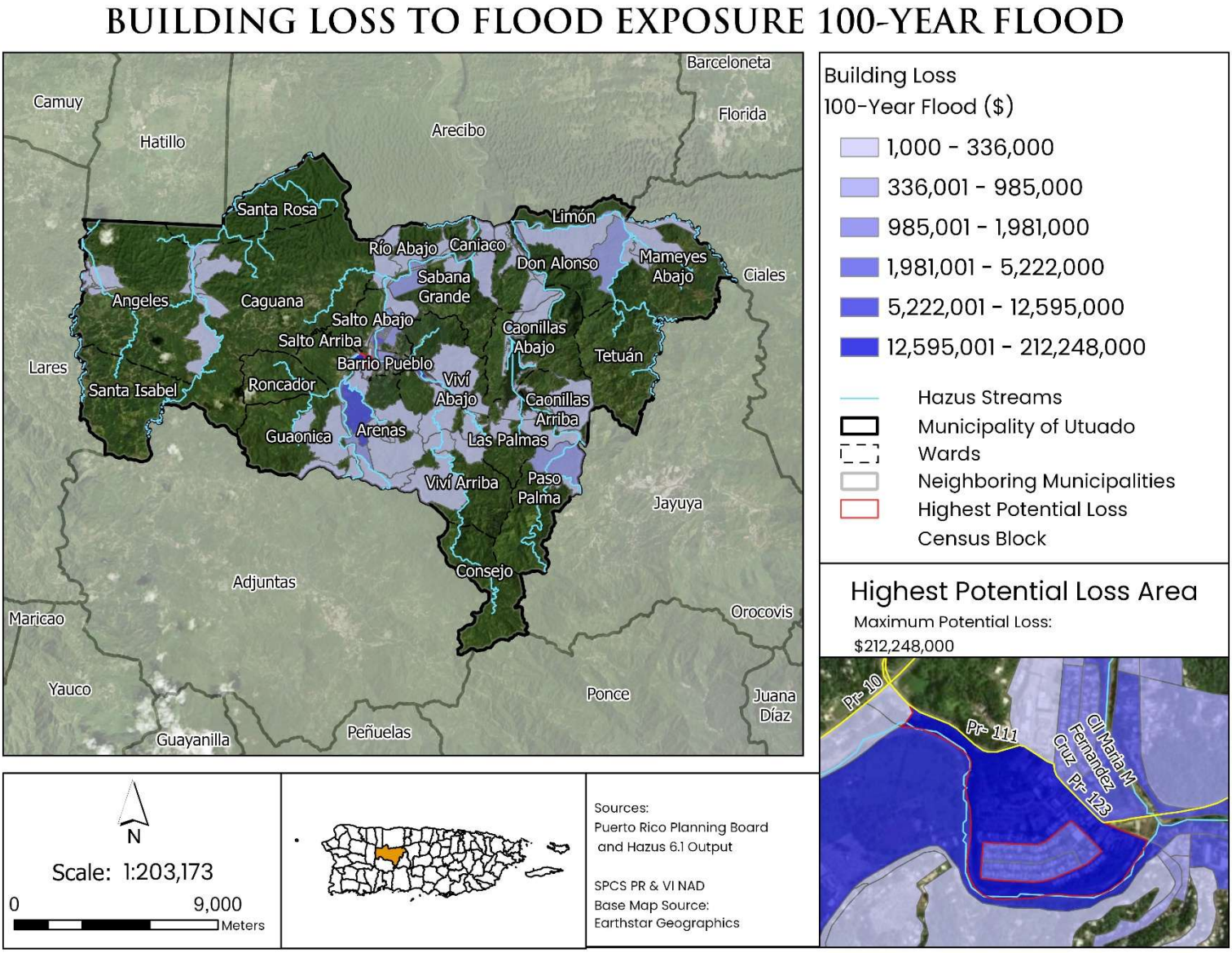
Source FEMA's NRI

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Map 30: Building Loss to Flood Exposure 500–Year Flood



Map 31: Building Loss to Flood Exposure 100–Year Flood



After running the Hazus model, the following losses were determined for flooding in Utuado:

- A total of 16,116 structures would experience losses (see Table 28).
- An estimated total of $349,143,000.00 in losses is projected for a 100-year event (1%) and $356,022,000 for a 500-year event (0.2%) (see Table 29).
- Specifically, for nonresidential structures, total losses are estimated at $235,103,000.00 for 100-year events (1%) and $240,354,000.00 for 500-year events (0.2%) (see Table 30).

- For residential uses, losses are estimated at $114,040,000.00 for 100-year events (1%) and $115,668,000.00 for 500-year events (0.2%) (see Table 31).

Table 28: Total Structures at Risk

Structures	
Non-Residential	40
Residential	16,076
Total	16,116

Table 29: Aggregated Dollar Losses for 1% (100-year) and 0.2% (500-year) events

Occupancy Type	Losses in Dollars. 1% Event	Losses in Dollars. 0.2% Event
Non-Residential	$235,103,000	$240,354,000
Residential	$114,040,000	$115,668,000
Total	$349,143,000	$356,022,000

Table 30: Detailed Loss for Non-Residential Buildings

Occupancy	Losses in Dollars, 1% Event	Losses in Dollars, 0.2% Event
Commercial	$8,937,000	$9,724,000
Education	$18,152,000	$19,222,000
Government	$207,631,000	$211,025,000
Religious	$0	$0
Agriculture	$0	$0
Industrial	$383,000	$383,000
Total	$235,103,000	$240,354,000

Table 31: Detailed Loss for Residential Buildings

Residential, Detailed Losses	Losses in Dollars, 1% Event	Losses in Dollars, 0.2% Event
Structure	$46,881,000	$46,943,000
Contents	$25,633,000	$25,653,000
Relocation	$27,258,000	$28,205,000
Rental Income	$14,268,000	$14,867,000
Total	$114,040,000	$115,668,000

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4.8.2.2 Lifelines and critical infrastructure

Flooding is among the most disruptive natural hazards, affecting all eight FEMA Community Lifelines. These lifelines represent essential services that support public health, safety, and economic stability. Below is an analysis of some of the impacts that flooding can have on lifelines:

- Safety and Security - Flooding can damage emergency services infrastructure such as police stations, fire departments, and emergency operations centers. Blocked evacuation routes and submerged roads hinder rescue efforts, while prolonged outages increase vulnerability to crime and civil unrest.

- Food, Water, Shelter - Floodwaters often contaminate drinking water supplies and damage water treatment facilities. Food distribution networks are disrupted when warehouses and grocery stores are flooded. Residential destruction leads to mass displacement, creating urgent demand for temporary shelters.

- Health and Medical - Hospitals and clinics may become inaccessible or lose power during floods. Waterborne diseases and mold-related illnesses increase significantly. Medical supply chains are disrupted, delaying emergency care and routine treatments.

- Energy (Power and Fuel) - Flooding can submerge electrical substations and transformers, causing widespread outages. Fuel distribution networks are interrupted due to impassable roads, and prolonged power loss affects critical facilities such as hospitals and water treatment plants.

- Communications - Flood damage to cell towers, fiber-optic cables, and emergency communication systems reduces the ability to coordinate rescue and recovery operations. This disruption can delay critical information sharing during emergencies.

- Transportation - Roads, bridges, and rail lines are often washed out or blocked by floodwater. Airports and seaports may close, delaying evacuation and the delivery of emergency supplies. Transportation disruptions amplify the overall impact of the disaster.

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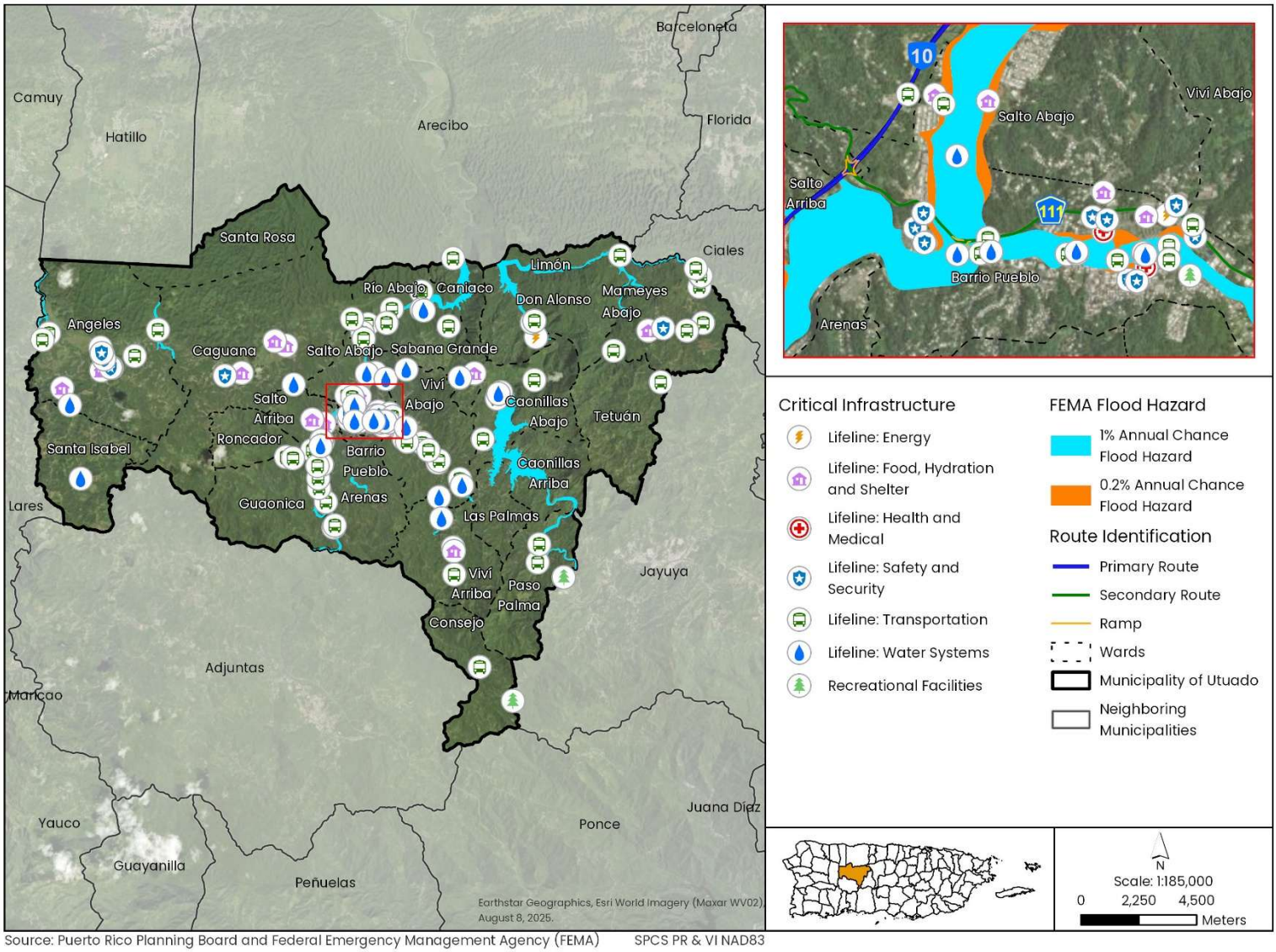
- Hazardous Materials Floodwaters can spread chemicals from industrial sites, sewage systems, and fuel tanks, increasing the risk of environmental contamination. Cleanup efforts become costly and time-consuming, posing long-term health hazards.

- Water Systems - Floodwaters often contaminate drinking water supplies and damage water treatment facilities. Excessive inflow from floodwaters overwhelms sewer systems, causing untreated sewage to backflow into streets and homes. Flooding exceeds the design capacity of storm drains and retention basins, resulting in urban flooding and infrastructure damage. Sediment and debris clog drainage systems, reducing effectiveness and increasing flood risk during subsequent storms.

The flood critical infrastructure exposure map, Map 32, illustrates the highest concentration located in and around Barrio Pueblo and extending into Salto Abajo, Viví Abajo, and adjacent areas. The mapped 1% annual chance flood hazard follows the major river corridor through the urban center and portions of Caonillas Arriba, Caonillas Abajo, and Paso Palma. Multiple transportation, water systems, safety and security, health and medical, food and shelter, and energy facilities are located within or adjacent to the mapped flood hazard areas, particularly in the vicinity of Barrio Pueblo.

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Map 32: Flood: Critical Infrastructure Exposure



Source: Puerto Rico Planning Board and Federal Emergency Management Agency (FEMA) SPCS PR & VI NAD83

4.8.2.3 Social Vulnerabilities

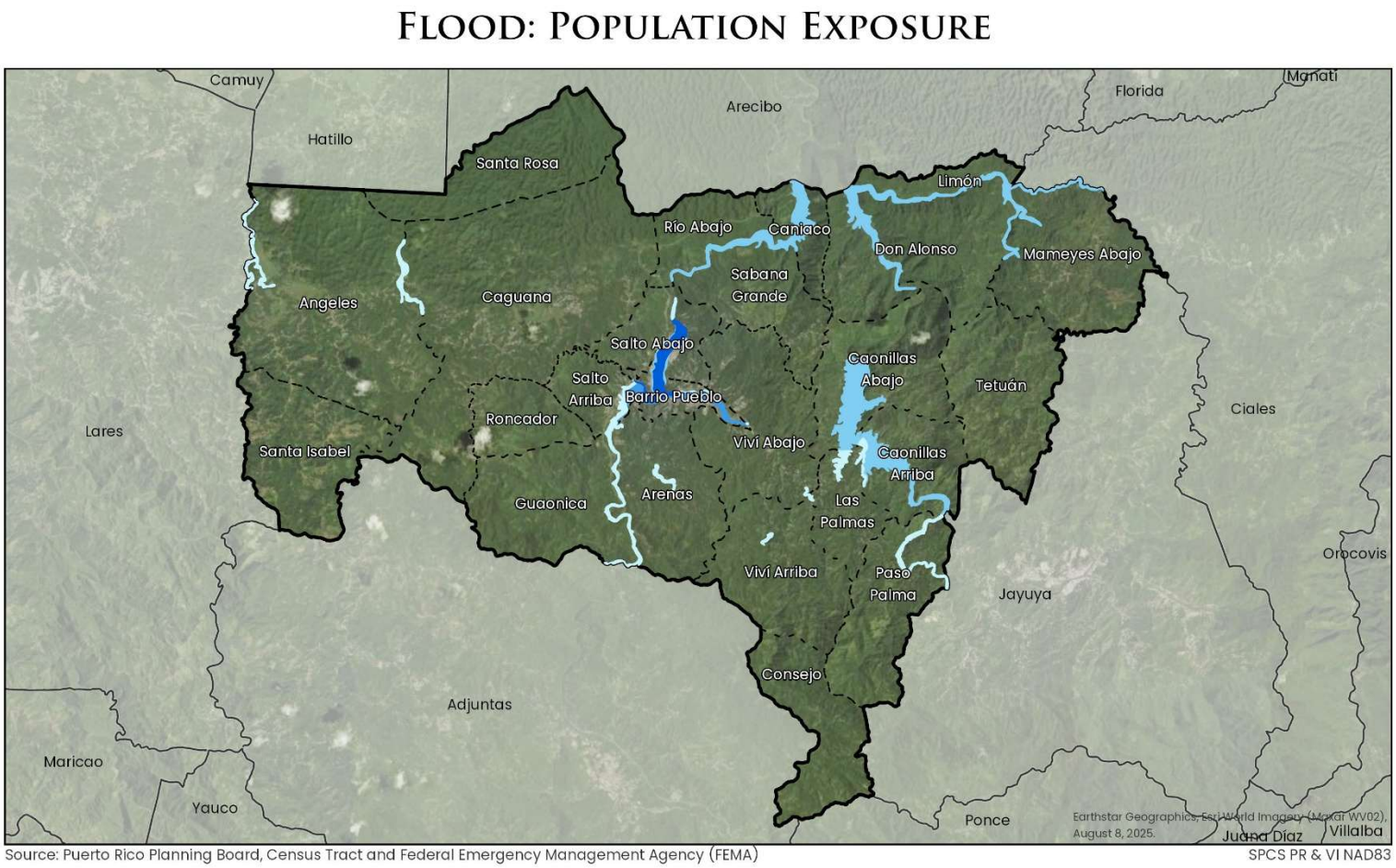
Map 33 shows populations exposed to flood hazards concentrated along the municipality's major river and stream corridors. The highest population exposure category (643–2,958 people) is mapped in Barrio Pueblo, while moderate exposure categories occur in portions of Salto Abajo, Caonillas Arriba, and Caonillas Abajo. Lower exposure categories are mapped along waterways in Ángeles, Río Abajo, Caníaco, Limón, Don Alonso, Mameyes Abajo, Arenas, Las Palmas, and Paso Palma. Overall, population exposure is concentrated along the main river corridors and

around the urban center of Utuado.

Research in flood-prone Puerto Rican communities shows that access to economic, material, and social resources strongly influences adaptive capacity, with low-income residents facing significant barriers to elevating homes, purchasing insurance, or relocating away from high-risk zones. These same communities frequently experience "false security" due to structural flood-control measures that reduce perceived risk but do not eliminate underlying exposure, which can worsen long-term vulnerability when residents underestimate future flood potential. Flood impacts also disproportionately affect individuals with limited mobility—including older adults, disabled residents, and those with chronic medical conditions—who may be unable to evacuate rapidly or access emergency shelters during rising waters. The Census Bureau's Community Resilience Estimates indicate that vehicle access, caregiver support, health insurance gaps, and disability prevalence are among the most widespread vulnerability components in the commonwealth, factors that directly shape whether individuals can flee or recover from flooding (US Census Bureau, 2024), (López Marrero, 2010) .

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Map 33: Flood: Population Exposure



4.8.2.4 Natural and Cultural Resources

In most flood events, water resources are exposed to high levels of contaminants associated with rising water, sewage accumulation, and other hazardous or toxic substances left behind by flooding (Malilay, 2000). This situation fosters the spread of diseases in municipal water bodies and can negatively impact local flora and fauna, including humans. For example, prolonged stagnant water after a flood can promote diseases such as dengue and leptospirosis. Following Hurricane María, stagnant water contributed to leptospirosis outbreaks and increased mosquito breeding, highlighting

the potential public health consequences associated with post-flood environmental conditions. Leptospirosis is a bacterial disease that affects both humans and animals and can spread through urine from infected animals. These contaminated residues often remain in stagnant water after flooding events.

Floods also lead to the accumulation of debris, including structural remnants, soil, sediments, organic waste, and personal belongings. If not properly managed, this debris can contaminate land and water when burned, abandoned, buried, or dumped into water bodies.

4.8.2.5 Special Consideration: Repetitive Losses and Severe Repetitive Losses

In Utuado there are properties insured under the National Flood Insurance Program (NFIP). Section 6.5 provides further details on how the municipality can use the NFIP as a mechanism for mitigation planning.

The Municipality has included properties that have experienced repetitive losses and/or severe repetitive losses located in identified flood hazard areas. These properties currently lack descriptions of the type of structures (residential, commercial, institutional, among others). Including this information helps to understand the vulnerability of properties affected by flooding within the jurisdiction and increases the likelihood of qualifying for flood control or prevention grants through programs such as Flood Mitigation Assistance (FMA), Hazard Mitigation Grant Program (HMGP), Housing and Urban Development (HUD), CDBG-DR, and others.

As of December 2025, the information regarding NFIP coverage for the Municipality of Utuado is as follows:

Table 32: NFIP Policies in Force and coverage

Amount of NFIP Policies	Total Disbursement for both RL and SRL Loses
27	$121,386

Source: Puerto Rico Planning Board

This information includes properties covered by the NFIP that have experienced repetitive losses (RL) and/or severe repetitive losses (SRL) located in identified flood hazard areas.

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Table 33: NFIP Repetitive Losses

Structures with Repetitive Losses (RL)	Insured Structures (RL)	Total Repetitive Losses (RL)
3	0	7

Source: Puerto Rico Planning Board

Table 34: NFIP Severe Repetitive Losses

Structures with Severe Repetitive Loses (SRL)	Insured Structures (SRL)	Total Repetitive Losses (SRL)
0	0	0

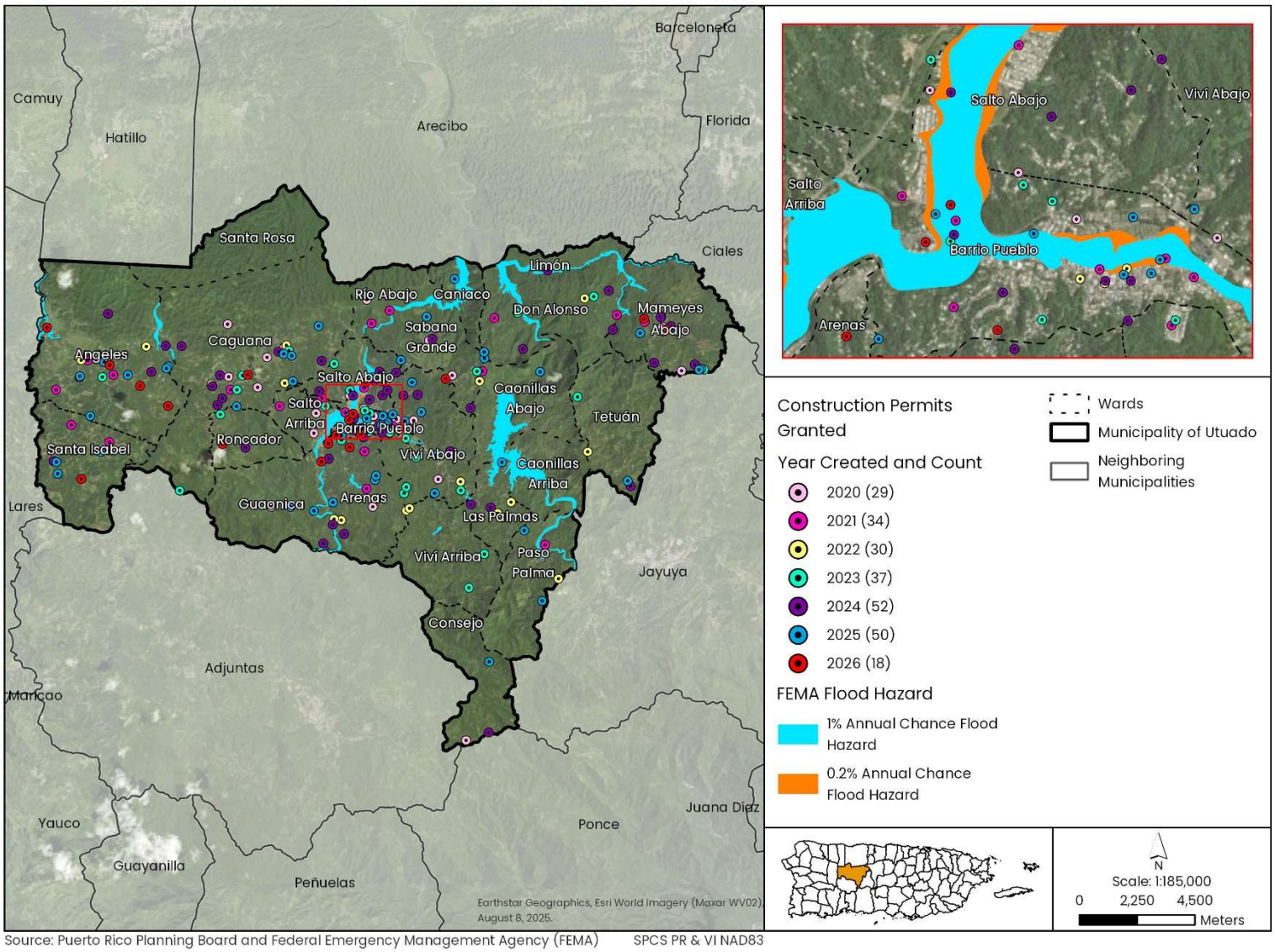
Source: Puerto Rico Planning Board

4.8.2.6 Future Conditions (E1-a)

The following map shows the locations of recent development permits issued between 2020 and 2026 distributed throughout the municipality of Utuado in relation to the mapped 1-percent and 0.2-percent annual chance flood hazard areas. Development permits are concentrated in and around Barrio Pueblo, Salto Abajo, and Viví Abajo, with additional permit locations dispersed throughout Ángeles, Caguana, Don Alonso, Mameyes Abajo, Arenas, Caonillas Arriba, Caonillas Abajo, Las Palmas, Paso Palma, and Consejo. Several permit locations are mapped within or adjacent to the identified flood hazard areas, particularly near Barrio Pueblo and along the municipality's major river corridors.

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Map 34: Flood: Recent Development Exposure



Source: Puerto Rico Planning Board and Federal Emergency Management Agency (FEMA) SPCS PR & VI NAD83

4.9 Tropical Cyclones and other Extreme Weather Events

4.9.1 Description (B1-a)

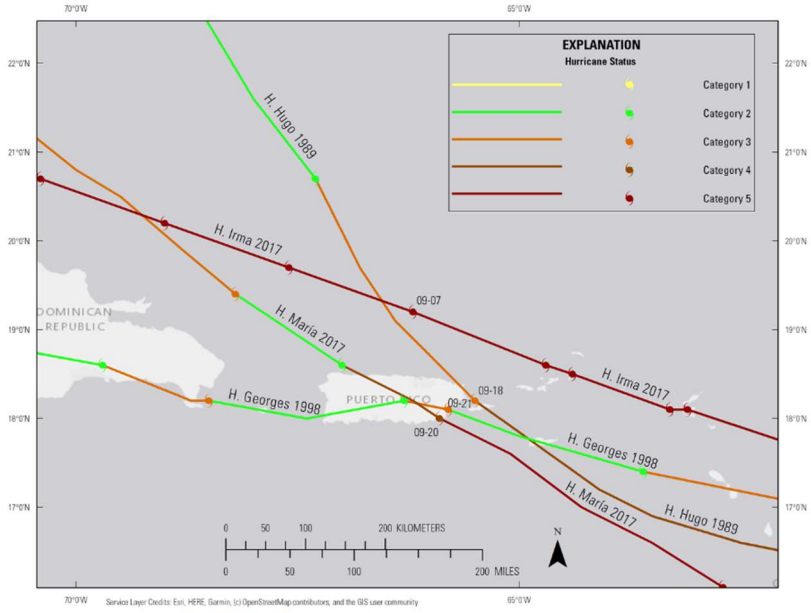
Winds are air currents generated in the atmosphere due to variations in pressure. Although these currents are constantly present, when their intensity increases, they can become a high-level hazard. For the purposes of this Plan, we will focus on events

capable of producing severe winds, specifically tropical cyclones and their extreme force (Castro Rivera & López Marrero, Cartilla de los Ciclones, 2018).

This sub-chapter has been named tropical cyclones to include phenomena such as tropical storms and tropical depressions; however, hurricanes are particularly hazardous due to their destructive potential, their ability to impact large areas, their spontaneous formation, and their unpredictable movement. Hurricanes are often accompanied by high tides, storm surges, and heavy rainfall, which can trigger landslides and flooding from river overflow. Since these accompanying hazards are addressed in separate sections, this section will focus exclusively on the effects of wind on the municipality.

Figure 18 shows the path of hurricanes category 2–5 that have affected Puerto Rico since 1993.[14]

Figure 18: Hurricane Tracks 1989-2017 (only Cat 2-5) [15]



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Figure 1. *Hurricane tracks for Hugo (1898), Georges (1998), Irma (2017) and Maria (2017). Data provided by NOAA. Base image is intellectual property of Esri and is used herein under license. Copyright Esri and its creator.*

Figura 1: *Trayectorias de los huracanes Hugo (1989), Georges (1998), Irma (2017) y María (2017). Datos provistos por la NOAA. La imagen de base es propiedad intelectual de Esri y se usa aquí bajo licencia. Los derechos de autor y reproducción son propiedad de Esri y sus licenciatarios.*

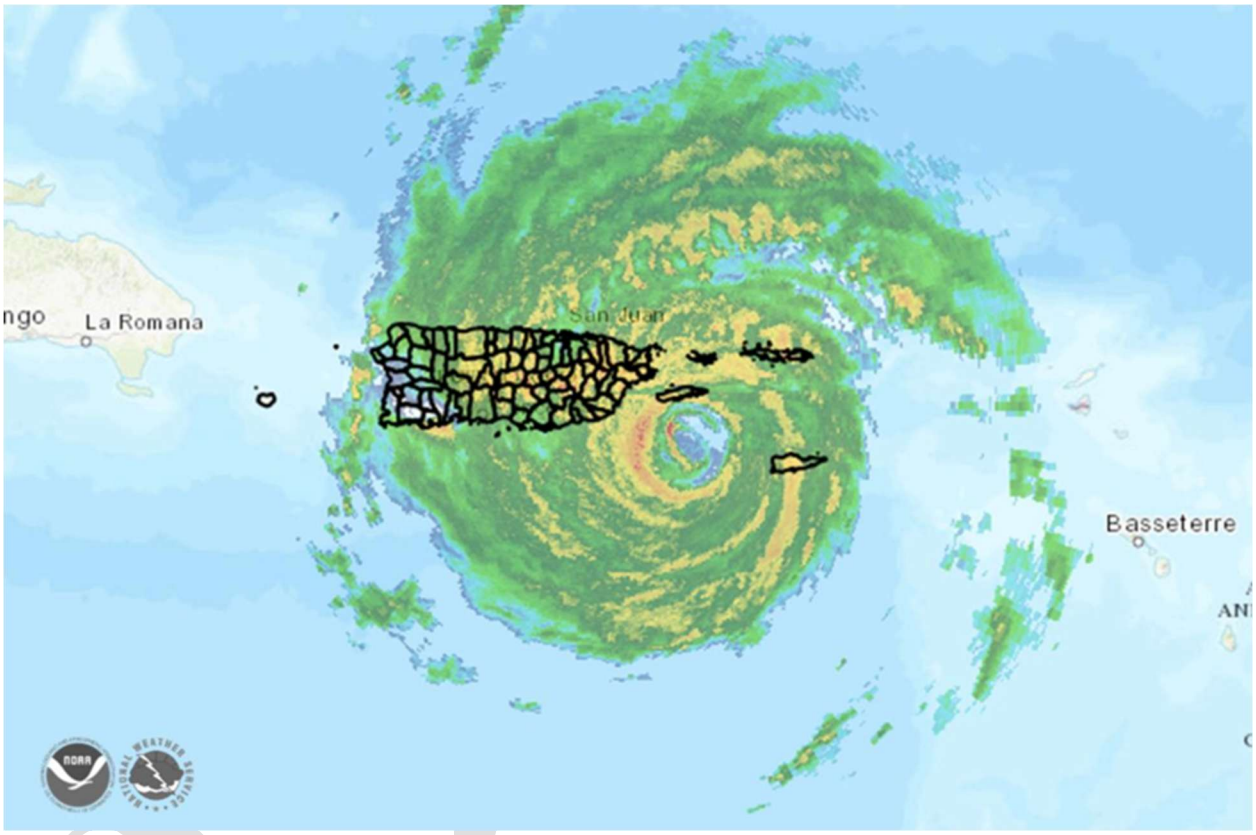
[14] Hortense (1996) and Fiona (2022) are not shown since they were category 1 hurricanes when they hit Puerto Rico.

[15] htt.s://www.usgs/gov/mission-areas/natural-hazards/science/Puerto-rico-natural-hazards-hurricanes-peligros-naturales-de

4.9.1.1 Affected Area (B1-B)

Tropical Cyclones are atmospheric systems that can affect the whole island. For example, Figure 19 shows the size of hurricane María (2017) as it approached Puerto Rico.

Figure 19: Hurricane María (2017) as it approaches Puerto Rico[1]



4.9.1.2 Risk Magnitude (B1-C)

Tropical cyclones are the most frequent natural hazard in Puerto Rico, with hurricanes being the most dangerous. Hurricanes are tropical atmospheric systems characterized by sustained wind speeds exceeding seventy-four (74) miles per hour. They develop over warm ocean waters and result from instability caused by the interaction of warm and cool air masses. Tropical cyclones are classified according to sustained wind intensity as follows:

- Tropical Depression: An organized system of clouds with a defined circulation and maximum sustained winds below 39 mph. This represents the formative stage of a tropical cyclone.

- Tropical Storm: An organized system of clouds with a defined circulation and maximum sustained winds ranging from 39 to 73 mph.
- Hurricane: The most intense form of a tropical cyclone, with sustained winds of 74 mph or greater. Hurricanes have a well-defined center with very low barometric pressure. They are categorized from one (I) to five (V), and the strongest can reach wind speeds exceeding 155 mph (Castro Rivera & López Marrero, Cartilla de los Ciclones, 2018).

Table 35 shows the Saffir - Simpson Scale of Hurricanes and gives historical examples of those hurricanes passing through or near Puerto Rico.

Table 35: Saffir-Simpson Hurricane Scale

Category	Wind Speed	Description	Historical Example
Tropical Storm	39 – 73 mph	Strong enough to cause tree damage, power outages, and localized flooding, but generally less destructive than a hurricane.	Jeanne (2004) Irene (2011) Isaias (2020) Frederik (1979) Claudette (1979) Eloise (1975)
1	74–95 mph	Winds can cause minor damage to roofs, siding, and trees, with potential for power outages.	Santa Clara[16] (1956) Hortense (1996) Fiona (2022)
2	96–110 mph	Strong winds can cause extensive damage to roofs and trees, leading to widespread power loss.	Marilyn (1995)
3	111–129 mph	Devastating winds can destroy roofs and walls of homes, uproot trees, and cause prolonged outages.	Hugo (1989) Georges (1998)
4	130–156 mph	Catastrophic winds can cause severe structural damage, most trees snapped or uprooted, and power outages lasting weeks.	San Ciriaco (1899) San Ciprian (1932) Donna (1960) David (1979) María (2017)
5	157 mph or higher	Catastrophic winds can result in total roof failure and building collapse, rendering areas uninhabitable for weeks or months.	San Felipe II (1928) Irma (2017)

[16] Officially known as Hurricane Betsy

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To assess the vulnerability posed by hurricanes this LHMP will use 100–Year Wind Event and 500-Year Wind Event. A 100-Year wind event refers to a wind speed that has a 1% chance of equaling or exceeding in any given year, while a 500-Year wind event has a 0.2% chance per year. These terms are based on statistical probabilities, not actual time intervals, and are used in engineering, risk assessment, and building codes to design structures that can withstand rare but severe windstorms. The calculation involves analyzing historical wind data and applying extreme value statistical models to estimate wind speeds for specific return periods.

These values are critical for structural design standards like the American Society of Civil Engineers Standard 7 (ASCE 7), which specify wind loads for different risk categories, and for insurance companies assessing potential storm damage. For example, typical 3-second gust wind speeds at 33 ft above ground (Exposure Category C) are about 100 mph for a 100-year event and approximately 110–115 mph for a 500-year event. These design speeds ensure safety for buildings, bridges, and critical infrastructure, and help guide emergency planning and financial risk management.

4.9.1.3 Past Events (B1-D)

The following table shows the extreme wind events that received a declaration of disaster between 1989 and 2025. One column identifies whether the Municipality of Utuado was designated for Public Assistance (PA), Individual Assistance (IA), or both under each declaration. Table 36 shows a list of presidential disaster declarations since 1987.

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Table 36: Tropical Cyclone Disaster Declarations

Event	Date	Disaster Declaration Number	Utuado Included?	Description
Tropical Storm Ernesto	8/14/2024 – 8/16/2024	DR-4850- PR	Public Assistance – No Individual Assistance - No	The storm's slow movement and moisture-rich environment contributed to prolonged precipitation, particularly in central and eastern municipalities. Parts of Central Puerto Rico recorded 12–14 inches of rainfall in localized areas. The municipality of Barranquitas measured 11.20 inches over a 48-hour period, while Villalba reported 10.20 inches. Eastern municipalities, including Vieques and Culebra, observed 8–10 inches of rain. Multiple rivers exceeded their banks, including the La Plata River, resulting in significant inundation of adjacent communities. Flash flooding occurred in urban and rural areas, rendering primary and secondary roads impassable. Floodwater caused structural failures in bridges and washed-out critical road segments, isolating several communities. Stormwater drainage systems in metropolitan areas, notably San Juan, were overwhelmed, leading to localized urban flooding. Emergency Response and Disruptions

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				Evacuations were conducted in flood-prone areas such as Toa Baja to mitigate loss of life.
Hurricane Fiona	9/17/2022 - 9/21/2022	DR-4671-PR	Public Assistance – Yes Individual Assistance - Yes	Hurricane Fiona struck Puerto Rico in September 2022, unleashing torrential rains—up to 31.22 inches of rainfall over 72 hours in Ponce, nearly matching the accumulation from Hurricane Maria. This deluge led to catastrophic flooding, with 7 to 20 inches common across most of the island and localized spots exceeding 30 inches.
Tropical Storm Isaías	7/29/2020-7/30/2020	DR-4560-PR	Public Assistance - No Individual Assistance - No	Although the center of Tropical Storm Isaías did not make landfall on the island, the system left a large amount of rain in its path, causing flooding throughout Puerto Rico. Rainfall accumulation of up to 10 inches was recorded around the island.
Hurricane María	9/20/2017	DR-4339-PR	Public Assistance – Yes Individual Assistance - Yes	Widespread flooding severely affected the whole Island. For example, in San Juan, water levels reached up to 6 feet in some areas and numerous structures losing their roofs. The coastal neighborhood of La Perla was largely destroyed, while Cataño suffered extensive damage, with the Juana Matos community estimated to be 80% destroyed. Strong winds, heavy rains, and flash floods near the La Plata Lake dam in Toa Baja impacted thousands of residents.

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				Survivors reported that floodwater rose 6 feet in just 30 minutes, and some areas experienced depths of up to 15 feet (4.6 m).
Hurricane Irma	9/5/2017	DR-4336-PR	Public Assistance – Yes Individual Assistance - No	On September 5, 2017, Hurricane Irma impacted Puerto Rico; an Emergency Declaration was issued for the Island. On September 6, 2017, a Major Disaster Declaration was issued following Hurricane Irma's passage. Two people died due to torrential rains before the hurricane: a man died in Orocovis after falling from his ladder while repairing his roof; another man on the coast in Capitanejo died after being struck by lightning. Wave heights in Puerto Rico reached 9 meters, and sustained winds of 111 mph were recorded in Culebra.
Tropical Storm María[17]	9/8/2011 – 9/114/2011	DR-4040-PR	Public Assistance - No Individual Assistance - No	Tropical Storm (later Hurricane) Maria formed in early September 2011 and passed near Puerto Rico, bringing significant heavy rainfall and tropical storm conditions to the island. The storm caused widespread flooding that inundated numerous roadways and homes; floodwaters near Patillas destroyed several homes and

[17] Tropical Storm María was a tropical system that pass to the northeast of Puerto Rico in 2011 and that caused flooding in the Island. Not to be confused with the 2017 Hurricane María. The name "María" was retired from the official Atlantic hurricane season list of names after 2017

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				bridges, and approximately 150 houses in Yabucoa were flooded and damaged.
Hurricane Irene	8/22/2011	DR-4017-PR	Public Assistance - Yes Individual Assistance - No	Total rainfall reached 22 inches over three days, with the eastern region being the most affected—the same area that had already received over 6 inches earlier in August during the close passage of Tropical Storm Emily. The Río Grande de Manatí in Manatí recorded its third-highest level in history, surpassed only during Hurricane Hortense (1996) and Hurricane Georges (1998). The Puerto Nuevo River near Hato Rey reached its fourth-highest level on record. Flooding was severe enough to cause infrastructure stress and dangerous conditions across multiple municipalities. Tragically, there was one direct fatality attributed to Irene, due to drowning.
Tropical Storm Jeanne	9/14/2004 – 9/19/2004	DR-1552-PR	Public Assistance - Yes Individual Assistance - Yes	Tropical Storm Jeanne crossed Puerto Rico on September 15, 2004, as a strong tropical storm with maximum sustained winds around 70 mph (110 km/h), producing gusts up to 72 mph (≈116 km/h). The winds caused widespread power and water outages, with numerous reports of structural damage to homes, uprooted trees, fallen utility poles, and significant impacts on infrastructure across the island.

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Event	Date	Disaster Declaration Number	Utuado Included?	Description
				The storm resulted in eight fatalities in Puerto Rico—four direct and four indirect, including deaths during preparations and carbon monoxide poisoning. Damages were estimated at approximately $169.5 million (2004 USD), making Jeanne the most destructive tropical cyclone to impact Puerto Rico since Hurricane Georges in 1998.

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4.9.1.4 Tornadoes

According to NOAA's National Centers for Environmental Information (NCEI), No tornado has been registered in Utuado.

4.9.1.5 Future event probabilities (B1-e)

According to the Colorado State University Tropical Cyclones, Radar, Atmospheric Modeling and Software Team, the following average annual probabilities apply for storms coming ashore or passing within 50 miles of Puerto Rico (Colorado State University, 2026):

- Average probability of a named storm coming ashore or within 50 miles of Puerto Rico: 40%.
- Average probability of a hurricane coming ashore or within 50 miles of Puerto Rico: 24%.
- Average probability of a major hurricane coming ashore or within 50 miles of Puerto Rico: 9%.

4.9.2 Risk Analysis (B2-a, B2-b)

4.9.2.1 Estimated Losses

Table 37 presents the exposure to tropical cyclones, as registered in FEMA National Risk Index.

Table 37: Tropical Cyclone Exposure

Exposure - Impacted Area (sq mi)	Exposure - Building Value	Exposure - Population	Exposure - Population Equivalence	Exposure - Total
116.230772	$3,345,401,459.71	28,265	$327,869,220,497.00	$331,231,004,522.71

The expected annual loss for each Census tract or jurisdiction represents the average yearly economic impact, expressed in dollars, anticipated from natural hazard events.

Table 38 presents the expected annual tropical cyclone-related losses for both buildings and population.

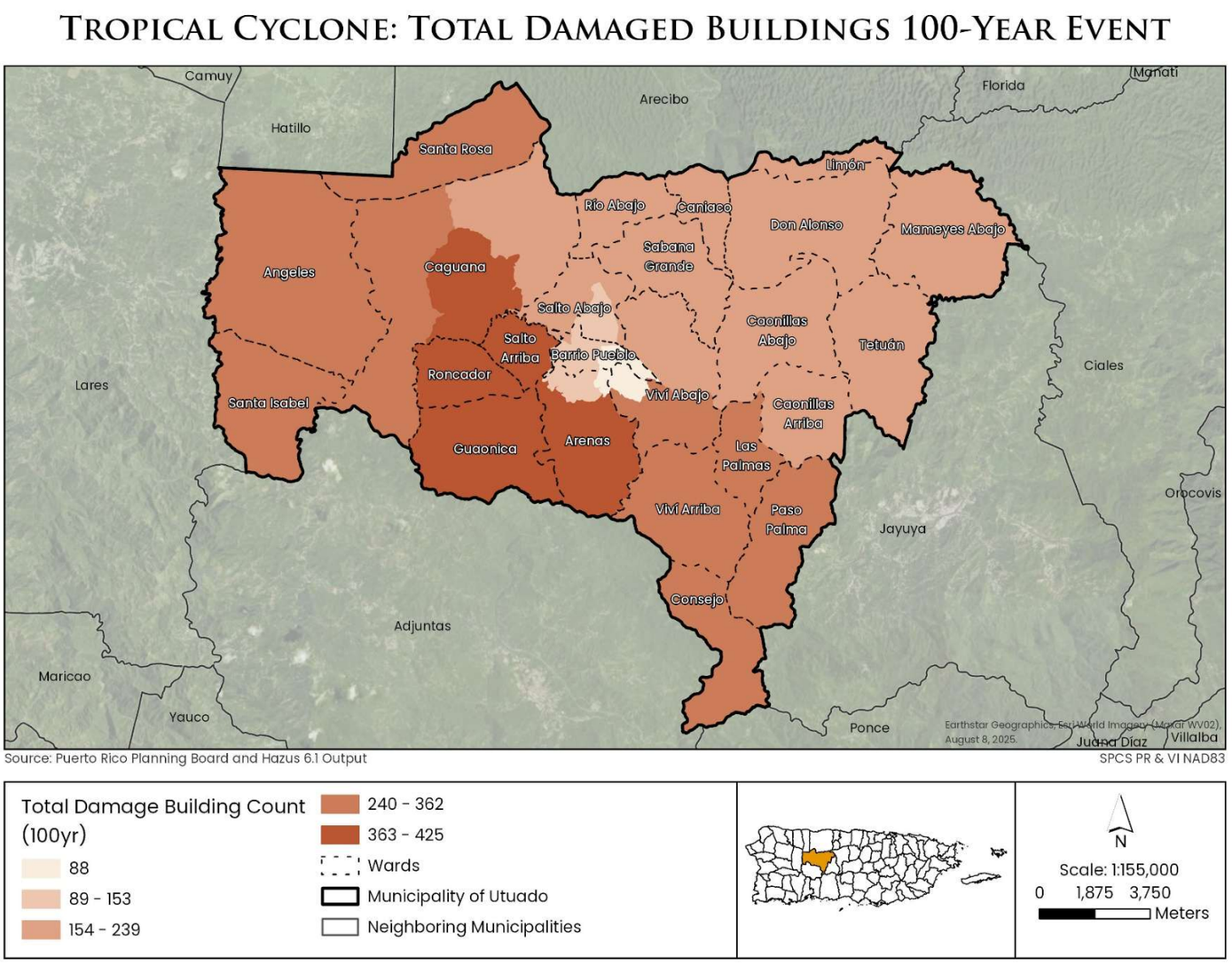
Table 38: Expected Annual Loss to Tropical Cyclones

Expected Annual Loss - Building Value	Expected Annual Loss - Population	Expected Annual Loss - Population Equivalence	Expected Annual Loss -Total
$13,819,818.24	0.047	$544,932.77	$14,560,174.43

The following maps show the expected losses from the impact of a hurricane.

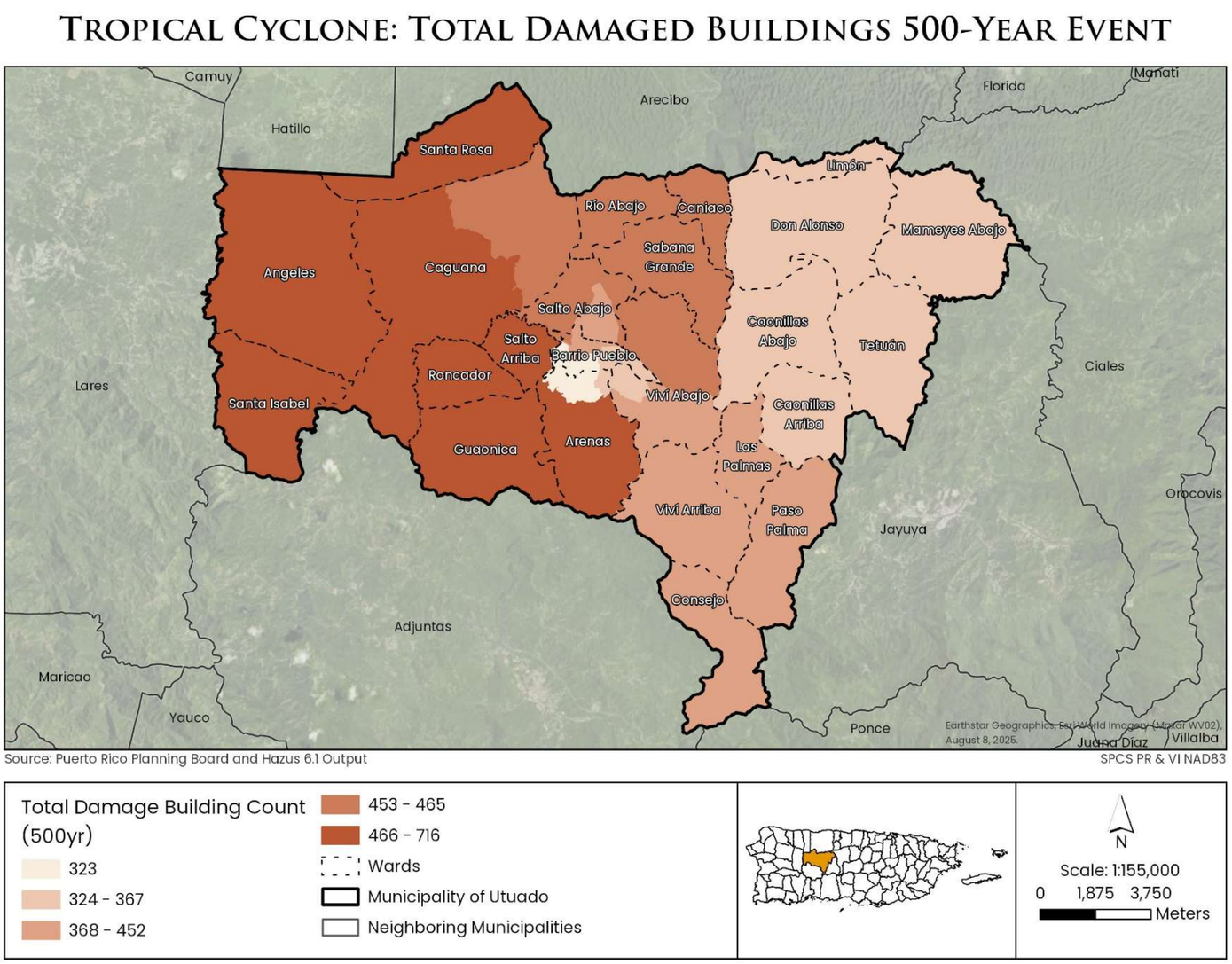
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Map 35: Tropical Cyclone: Total Damaged Buildings 100–Year Event



Map 35 illustrates the estimated number of buildings damaged during a 100-year tropical cyclone event across all wards of Utuado. The highest building damage counts are mapped in Caguana, Roncador, Guaonica, and Arenas, while moderate damage levels are shown in Ángeles, Santa Isabel, Consejo, Viví Arriba, Paso Palma, and portions of Caonillas Arriba and Caonillas Abajo. The lowest building damage count is mapped in and around Barrio Pueblo, with surrounding wards generally exhibiting higher estimated damage counts.

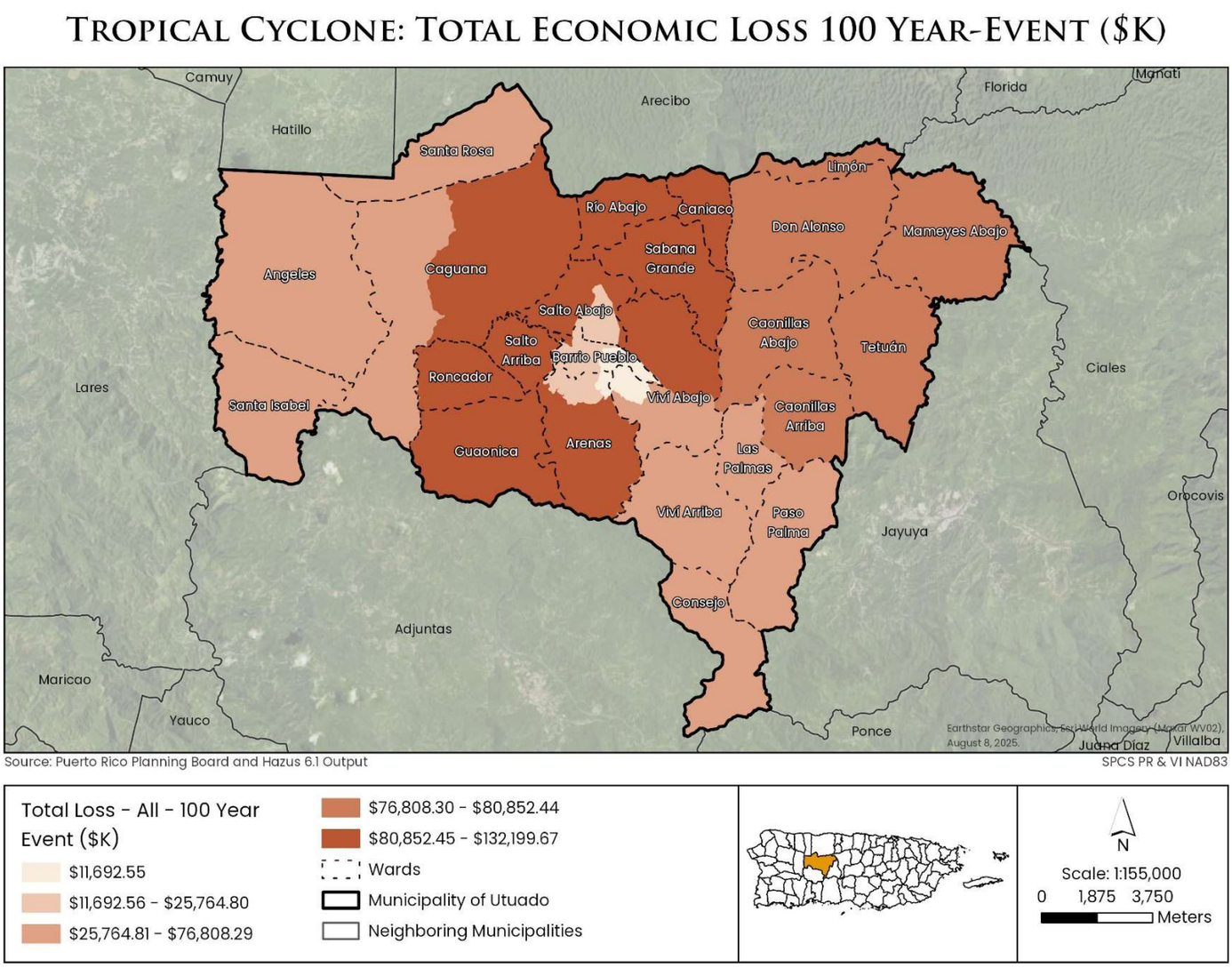
Map 36: Tropical Cyclone: Total Damaged Buildings 500–Year Event



The map shows the estimated number of buildings damaged during a 500-year tropical cyclone event throughout Utuado. The highest building damage counts are concentrated in the western and central wards, including Ángeles, Santa Isabel, Caguana, Roncador, Guaonica, and Arenas. Moderate damage counts are mapped across Sabana Grande, Salto Abajo, Salto Arriba, Viví Arriba, Paso Palma, and Consejo, while the lowest damage counts occur in Barrio Pueblo, Don Alonso, Limón, Mameyes Abajo, Tetuán, Caonillas Arriba, and Caonillas Abajo. Overall, the map indicates higher estimated building damage in the western half of the municipality and lower damage levels toward the eastern wards.

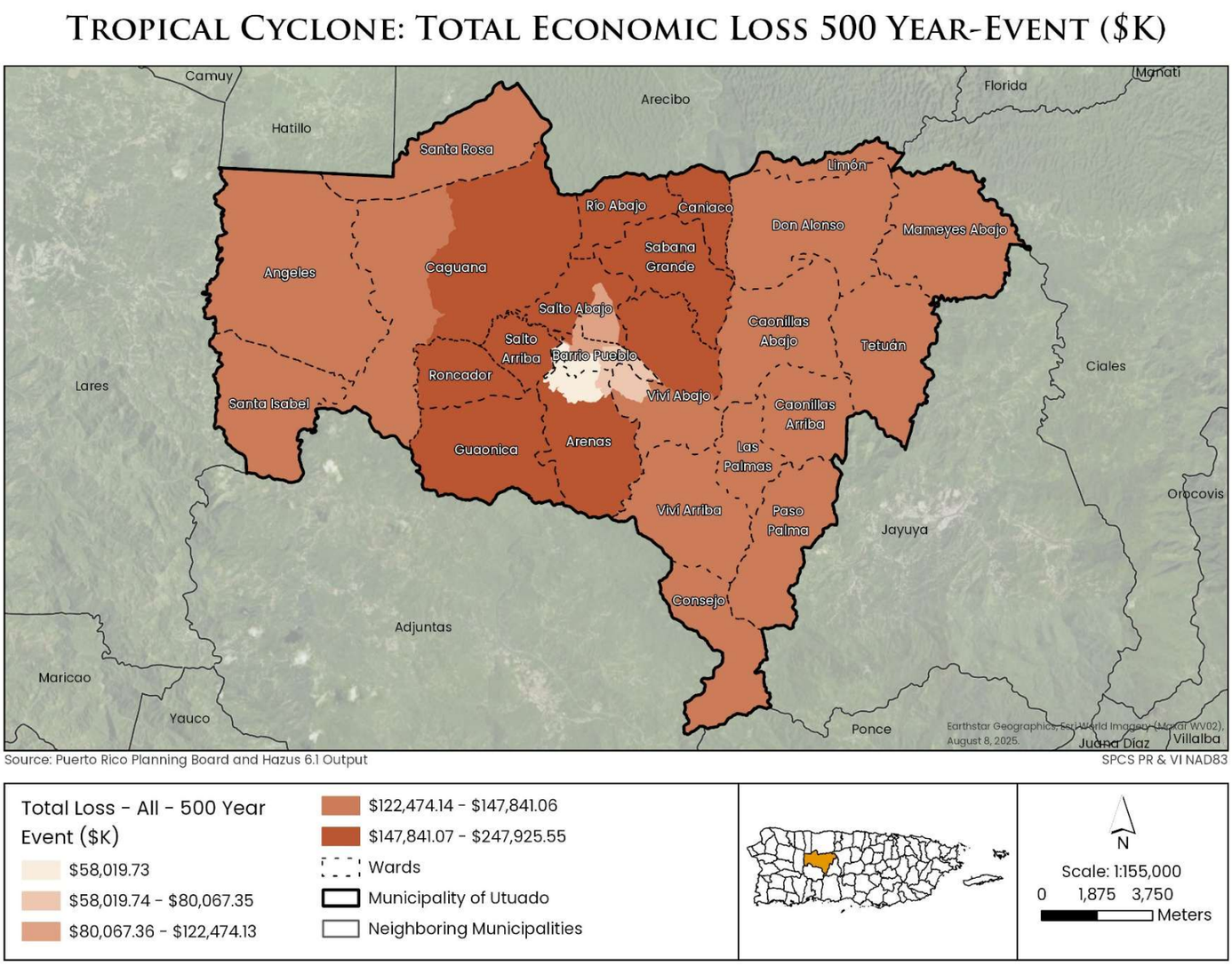
The following maps illustrate the projected economic losses, and asset exposure associated with tropical cyclone wind events in Utuado under various recurrence interval scenarios.

Map 37: Tropical Cyclone Total Economic Loss 100-Year Event



Map 37 illustrates the projected total economic loss associated with a 100-year tropical cyclone event across the municipality of Utuado. The highest economic losses are mapped in Caguana, Roncador, Guaonica, Arenas, Sabana Grande, and Caníaco, while moderate losses occur in Ángeles, Santa Isabel, Limón, Don Alonso, Mameyes Abajo, Salto Abajo, and Salto Arriba. The lowest economic losses are concentrated in and around Barrio Pueblo and portions of Viví Abajo. Overall, the map indicates higher estimated economic losses in the western and central wards and lower losses in the urban center.

Map 38: Tropical Cyclone Total Economic Loss 500-Year Event



Map 38 illustrates the projected total economic loss associated with a 500-year tropical cyclone event across Utuado. The highest economic losses are concentrated in Caguana, Roncador, Guaonica, Arenas, Sabana Grande, and Caníaco, while moderate losses are mapped in Ángeles, Santa Isabel, Limón, Don Alonso, Mameyes Abajo, Salto Abajo, Salto Arriba, Viví Arriba, Paso Palma, and Consejo. The lowest economic losses are in Barrio Pueblo and portions of Viví Abajo. Overall, the highest estimated losses are concentrated in the western and central wards, while lower losses occur in the urban center and adjacent areas.

4.9.2.2 Lifelines and Critical Infrastructure

Hurricane winds have profound effects on all eight FEMA Community Lifelines, disrupting essential services and infrastructure.

- Safety and Security systems are compromised when high winds damage police stations, fire departments, and emergency operations centers, while debris and fallen power lines obstruct emergency routes, delaying rescue efforts.
- Food, Hydration, and Shelter lifelines suffer as winds destroy agricultural fields, damage food storage facilities, and tear roofs off homes and shelters, leaving communities vulnerable and displacing thousands.
- In the Health and Medicine sector, hospitals and clinics experience roof failures and structural damage, forcing evacuations and interrupting critical care, while pharmacies and supply chains face severe disruptions.
- The Energy lifeline is particularly vulnerable, as hurricane winds topple transmission towers, snap utility poles, and damage substations, causing widespread power outages that cascade into other lifelines.
- Communications systems fail when telecommunication towers and antennas are blown down, severing cellular and internet connectivity and hindering emergency coordination.
- Transportation networks are crippled by blocked roads, damaged bridges, and wind-related destruction at airports and seaports, delaying relief efforts and supply deliveries.
- Facilities handling Hazardous Materials face increased risks when wind-driven debris ruptures tanks or pipelines, creating environmental hazards and complicating cleanup operations.
- Finally, Water Systems are disrupted as treatment plants and pumping stations sustain roof and equipment damage, while elevated storage tanks and distribution infrastructure collapse, interrupting access to clean water for drinking and sanitation. These cascading failures underscore the critical need for wind-resistant design standards and proactive planning to protect lifelines and maintain community resilience during hurricane events.

For planning purposes this LHMP shall assume that all critical infrastructure is equally exposed to this hazard.

4.9.2.3 Social Vulnerabilities

As discussed before in Section 4.9.1.1 a tropical cyclone can impact the whole island. For this LHMP we are going to assume that all the population of Utuado is vulnerable to this hazard. For further details on the Municipality's social vulnerability see section 3.4.4.

4.9.2.4 Natural and Cultural Resources

Hurricane winds caused extensive damage to both natural and cultural resources by exerting extreme mechanical forces on landscapes and built environments. In natural settings, strong winds uproot trees, strip foliage, and break branches, leading to deforestation and habitat loss. This disruption affects biodiversity and can alter ecosystem functions for years. Coastal vegetation such as mangroves is particularly vulnerable, as wind-driven forces weaken root systems and reduce their ability to

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protect shorelines. Agricultural areas also suffer severe losses, with crops flattened or destroyed, impacting food supply and local economies.

Cultural resources, including historic buildings, monuments, and archaeological sites, are equally at risk from hurricane winds. High wind speeds can dislodge roofing materials, collapse walls, and damage structural integrity, especially in older or unreinforced constructions. Museums, archives, and heritage sites may experience irreparable harm if protective measures are inadequate. The loss of these cultural assets not only affects community identity but also has economic implications for tourism and preservation efforts. Understanding wind speed thresholds and incorporating them into design standards and conservation planning is essential to mitigate these risks and safeguard both natural and cultural heritage.

4.9.2.5 Future Conditions (E1-a)

The risk of hurricane is a municipal – wide risk. Every part of the recent development approved by the municipality is equally in risk of being affected by a tropical cyclone.

4.10 Extreme Heat

4.10.1 Description (B1-a)

There is no universally accepted definition for extreme heat or heat waves. For the purposes of this Plan, the definition adopted by the Department of Homeland Security (DHS) is used. It is defined as a prolonged period of 48 to 72 hours of intense heat and humidity, with temperatures above 90 ºF. Under these conditions, evaporation is reduced and the body is forced to make a significant effort to maintain its normal temperature, which has caused the death of many people in attempts to stabilize physically. In general, extreme heat represents the highest rate of deaths among weather-related hazards.

The study titled Heat Risk Perception and Vulnerability in Puerto Rico: Insights for Climate Adaptation in the Caribbean, published in the academic journal International Journal of Environmental Research and Public Health, analyzes how Puerto Rico residents perceive health risks associated with extreme heat and how these perceptions relate to vulnerability and protective behaviors during extreme heat events that occurred in the summer of 2020 (Guzmán-Colon, Guido, Amaya-Ardilla, Cabrera-Rivera, & Méndez-Lázaro, 2025). The research was conducted through a cross-sectional telephone survey of 500 adults in metropolitan and non-metropolitan areas. This study defined the metropolitan area as the municipalities of Bayamón, Carolina, Cataño, Toa Baja, and Trujillo Alto. The non-metropolitan zone consists of the remaining municipalities of Puerto Rico.

The questionnaire included sociodemographic variables, health status, prior heat exposure, risk perception, and mitigation strategies. Statistical analysis employed chi-square tests and multinomial and logistic regression models. The results reveal that, although most participants expressed concern about climate change and high temperatures, less than half perceived heat as a high health risk, and only one-fourth considered it likely to suffer a heat-related illness in the next five years. Risk perception was significantly higher among men, people aged 50 to 64, the unemployed, individuals with fair health, multiple chronic conditions, and those who had

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experienced heat-related symptoms. In contrast, older adults (65+) reported low levels of risk perception despite their high vulnerability.

Forty-four percent of respondents indicated having suffered heat-related symptoms during the summer, and 68% reported nighttime thermal discomfort, a factor closely linked to health problems. The most common strategies to mitigate heat were the use of fans (84%) and air conditioning (64%), although economic limitations and instability of the electrical system reduced their effectiveness. Regional differences were also notable: residents in non-metropolitan areas showed greater risk perception than those in metropolitan zones.

The study concludes that there is a significant gap between actual vulnerability and risk perception, especially among older adults. It recommends strengthening risk communication targeted at vulnerable groups, addressing nighttime heat exposure, and improving electrical infrastructure to ensure equitable access to cooling systems. Proposed solutions include decentralized energy systems, cooling centers with backup power, and passive designs that reduce electrical dependence, thus contributing to community resilience in the face of increasing extreme heat events.

4.10.1.1 Affected Area (B1-B)

Extreme heat events can impact the entire municipality, particularly in urbanized areas where the heat island effect may occur. Based on previously presented information, adverse climate effects have been observed, including severe droughts, increased frequency of strong wind events and flooding, higher heat index levels, among others. Due to the municipality's geography and location, the entire region is highly susceptible to extreme heat conditions.

Urban heat island refers to Urbanized areas where structures such as buildings, roads, and other infrastructure absorb and emit the sun's heat more than natural landscapes such as forests and water bodies. Daytime temperatures in urban areas are about 1–7 ºF higher than temperatures in outlying areas; nighttime temperatures are about 2–5 ºF higher (EPA, 2025).

Heat islands develop due to a combination of factors:

- Loss of Natural Landscapes – Urban areas often replace trees, vegetation, and water bodies—natural elements that cool the air through shade, transpiration, and evaporation—with hard, dry surfaces like roads, rooftops, and parking lots. These surfaces provide little shade or moisture, leading to higher temperatures.
- Properties of Urban Materials – Common construction materials such as asphalt and concrete absorb and retain more heat than natural surfaces. They reflect less solar energy and release heat slowly, causing temperatures to remain elevated, especially after sunset.
- Urban Design and Geometry – The layout of buildings affects airflow and heat retention. Dense developments with narrow streets and tall structures create "urban canyons" that trap heat and block cooling winds, turning buildings into thermal masses that release heat gradually.
- Human-Generated Heat – Activities such as transportation, industrial operations, and air conditioning add waste heat to the environment, intensifying the heat island effect.

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- Weather and Geographic Conditions – Clear, calm weather amplifies heat islands by maximizing solar energy absorption and limiting heat dispersion. Conversely, wind and cloud cover help reduce the effect. Geographic features like mountains can also influence wind patterns, either blocking cooling breezes or channeling heat through urban areas (EPA, 2025).

According to the Utuado Municipal Land Use approximately 2.7 percent of the municipality's territory is classified as Urban Land (Suelo Urbano). As a result, only a limited portion of the municipality is likely to be directly affected by urban heat island conditions typically associated with densely developed areas. However, the occurrence and intensity of extreme heat are influenced by a complex interaction of factors, including land cover, vegetation, topography, building density, and population distribution. Therefore, a more detailed urban-scale analysis would be required to fully assess the extent to which extreme heat may affect residents, infrastructure, and developed areas within the municipality.

4.10.1.2 Risk Magnitude (B1-c)

Local NWS offices often work with community agencies to decide when heat alerts should be issued. Because the United States is so geographically and culturally diverse, heat tolerance varies by region. For example, residents of Puerto Rico are generally more accustomed to temperatures above 90°F than those living in Alaska.

Nevertheless, the NWS uses the following standard alerts (NWS, n.d.):

- Excessive Heat Warning – Issued 12 hours before dangerous heat conditions are expected. This occurs when the heat index is forecast to reach 105°F or higher for more than three hours over two consecutive days, or 115°F or higher for any period.
- Excessive Heat Watch – Issued when an extreme heat event is possible within the next 24 to 72 hours.
- Heat Advisory – Issued 12 hours before conditions where the heat index is at least 105°F but less than 115°F for three consecutive days.
- Extreme Heat Outlook – Issued when there is potential for extreme heat within the next three to seven days, providing advance notice for those who need extra time to prepare.

It must be emphasized that Urban Heat islands (UHI) phenomena can occur regardless of whether there is an extreme heat warning event. UHI is a relative temperature difference between urban and surrounding rural areas caused by factors like heat-absorbing surfaces, lack of vegetation, and human activities. It exists year-round, even during mild or cool weather, because cities consistently retain more heat than natural landscapes. Extreme heat events can amplify UHI, making UHI effects more dangerous, but UHI does not require extreme heat to form—it simply means urban areas are warmer than their surroundings under similar conditions.

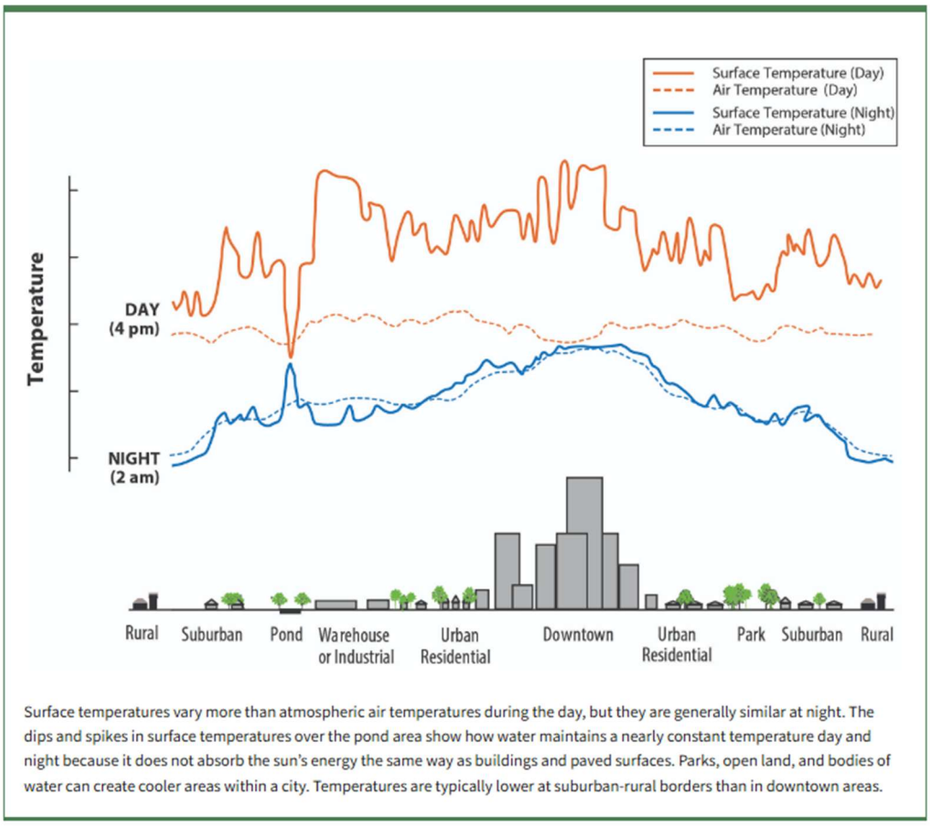
UHIs are typically assessed by comparing temperatures in urban areas to those in surrounding regions. Even within a city, temperatures can vary significantly. Some neighborhoods are hotter due to dense concentrations of heat-absorbing surfaces like buildings and pavements, while areas with trees and greenery remain cooler. These variations create what are known as intra-urban heat islands. In diagrams

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illustrating this effect, urban parks, ponds, and residential zones generally appear cooler than central downtown districts.

The following diagram, taken from an EPA website, shows a diagram of how a heat island effect behaves in temperature.

Figure 20: Heat Island Effect Diagram (EPA, 2025)



4.10.1.3 Past Events (B1-d)

Méndez Lázaro et al. (2015) identified several years in which extreme heat temperatures were recorded in the San Juan metropolitan area. According to their findings, periods of extreme heat occurred in 1983, 1995, 2012, and 2013. Notably, the summer of 2012 was the hottest in a century, with 42 days of extreme temperature values. During June, July, and August, the maximum heat index reached 98.06° F, 98.96° F, and 102.02° F, respectively (Méndez Lázaro et al., 2015).

4.10.1.4 Future event probabilities (B1-e)

Official NOAA assessments in the 2018 Puerto Rico and U.S. Virgin Islands State Climate Summary report an increase in both average temperature (≈1.5°F since 1950) and the frequency of extreme heat events (NOAA, 2022). Additionally, climate projections from CMIP6 (via the World Bank's Climate Change Knowledge Portal) show steady rises in summer and annual maximum temperatures for Puerto Rico, further indicating elevated future risk for heat waves (World Bank, n.d.).

4.10.2 Risk Analysis (B2-a, B2-b)

4.10.2.1 Estimated Losses

Extreme Heat primarily causes material and system stress rather than immediate structural failure. For example:

- Roads and Pavements: Asphalt can soften and deform under prolonged high temperatures, leading to rutting and surface damage (Highways Industry, n.d.) (EPA, 2012).
- Rail Systems: Steel tracks expand in extreme heat, which can cause buckling and derailment risks (USDOT - FRA, 2013).
- Power Infrastructure: Electrical grids experience higher loads from air conditioning demand, and transformers or cables can overheat, reducing efficiency or causing outages.
- Building Materials: Expansion and contraction of concrete, steel, and glass can lead to cracks or joint failures over time. Roofing materials may degrade faster under intense heat.
- Cooling Systems: HVAC systems work harder, increasing energy consumption and risk of failure, which can compromise indoor comfort and safety.

While heat waves rarely cause buildings to collapse, they accelerate wear and tear, increase maintenance costs, and can lead to system failures that disrupt essential services. As of now the municipality does not have a method to calculate losses from extreme heat events.

4.10.2.2 Lifelines and Critical Infrastructure

Extreme heat poses systemic risks across energy, transportation, and communications systems, creating compound failures precisely when demand for services peaks. In Energy Lifeline, high temperatures drive sharp increases in electricity demand for cooling while simultaneously decreasing generation and delivery efficiency. Thermoelectric plants may be forced to curtail output when cooling water is too warm, solar panels produce less electricity at elevated module temperatures, and transmission lines lose carrying capacity as conductors heat and sag—conditions that heighten the likelihood of voltage drops and blackouts during heat waves (Jessen, 2025). The combination of record cooling loads and diminished supply underscores a growing "peak risk" problem for grids that were not designed for today's heat extremes (Jessen, 2025) (American Society of Civil Engineers, 2024).

Similarly, the Transportation Lifeline is similarly vulnerable. Prolonged high surface temperatures soften asphalt, accelerating rutting and deformation; steel rails thermally expand and can buckle, prompting heat-related slow orders that disrupt service; and catenary or other overhead lines can sag in the heat, further constraining operations. Airports face dual constraints: runway pavements can deform under extreme heat, and reduced air density on hot days impairs aircraft performance, affecting takeoff weight and scheduling. These effects are now commonly observed across U.S. systems during sustained heat events, requiring operational restrictions and emergency maintenance that ripple through supply chains and passenger mobility (American Society of Civil Engineers, 2024).

Communication Lifeline also faces mounting heat stress. Data centers, switching facilities, and network nodes rely on continuous cooling; overheating elevates outage

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risks and can degrade equipment lifespans. Heat-related disruptions to power supply and localized microclimate conditions compound these risks, with cascading impacts across other lifeline sectors that depend on connectivity for operations and emergency response. Federal assessments underscore that extreme weather—including extreme heat—can interrupt fiber networks, degrade wireless performance, and limit access to data centers, affecting each of the other critical infrastructure sectors and complicating disaster response coordination (Public-Private Analytic Exchange Program, 2025).

Overall, extreme heat acts as a stress multiplier: it pushes materials beyond design thresholds, reduces equipment efficiency, and narrows operational safety margins, all while increasing demand for services. The evidence from engineering organizations and energy market observers indicates that without targeted adaptation—such as heat-resilient design standards, strategic grid reinforcement, enhanced thermal management for digital infrastructure, and heat-aware operations—systems will face more frequent service disruptions and higher lifecycle costs as heat events intensify (American Society of Civil Engineers, 2024).

4.10.2.3 Social Vulnerabilities

A recent academic study examines the relationship between heat stress and mortality in Puerto Rico (Méndez - Lázaro, et al., 2025). Researchers analyzed hourly 2-meter air temperature data from ERA5 reanalysis for 2015–2020 and derived daily minimum, maximum, and mean values to calculate two heat stress indices: the Heat Index (HI) and the Universal Thermal Climate Index (UTCI). Findings show that extreme heat conditions are common for eight months of the year, with August and September being the hottest months, and that urban heat island effects exacerbate exposure in metropolitan areas (Méndez - Lázaro, et al., 2025). Mortality risk increased significantly on days with high heat stress: deaths were 23% higher in the highest HI tertile and 47% higher in the highest UTCI tertile compared to the lowest. Cardiovascular and cerebrovascular diseases, heart failure, and respiratory conditions were among the leading causes of death associated with heat stress. The study highlights Puerto Rico's socio-economic vulnerabilities, aging population, and limited infrastructure amplifying health risks during extreme heat events (Méndez - Lázaro, et al., 2025).

4.10.2.4 Natural and Cultural Resources

Extreme heat, specifically Urban Heat Islands can pose the following impacts on the natural resources:

- Increased Energy Consumption – Heat islands increase electricity demand for air conditioning and peak energy demand. Increased electricity demand for air conditioning ranges from 1–9% for each 2°F increase in temperature, with the highest increase in countries where most buildings have air conditioning, such as the United States.[3] This increased demand contributes to higher electricity expenses. Peak demand generally occurs on exceptionally hot afternoons, when offices and homes are running air-conditioning systems, lights, and appliances. This increased demand can overload systems and require a utility to institute controlled brownouts or blackouts to avoid power outages.

- Elevated Emissions of Air Pollutants – To meet electricity needs, utility companies typically rely on fossil fuel power plants as a power source.

Increased use of fossil fuels increases emissions of air-borne pollutants, such as carbon dioxide, which can have health concerns, especially in people living with respiratory diseases.

- Compromised Human Health and Comfort – Hot weather events contribute to heat-related deaths and heat-related illnesses. Areas experiencing heat islands further contribute to higher daytime temperatures and reduced nighttime cooling. Heat is of greatest concern for groups such as older adults, young children, populations with low-income, people who work outdoors, and people with chronic health conditions, disabilities, mobility constraints, or taking certain medications. From 2004 to 2018 the Centers for Disease Control and Prevention recorded an average of 702 heat deaths per year.

- Impaired Water Quality – High temperatures of pavement and rooftop surfaces can heat stormwater runoff, which drains into storm sewers. This runoff raises water temperatures as it is released into streams, rivers, ponds, and lakes. Water temperature affects the metabolism and reproduction of many aquatic species.

Rapid temperature changes can also be stressful, and even fatal, to aquatic life. One study found that urban streams have more frequent temperature surges than streams in forested areas. Temperature surges in urban streams were as much as 18°F higher due to heated runoff from urban areas, higher discharge volumes due to impervious surfaces, and warmer baseline stream temperatures (EPA, 2025).

4.10.2.5 Future Conditions (E1-a)

The approved construction permits map (Section 3.6) indicates that many recent developments in Utuado have occurred within or adjacent to existing developed areas, while the Municipality's Land Use Plan identifies additional lands designated for future urban development, including Non-Programmed Land for Development (Suelo Urbanizable No Programado, SUNP), which could contribute to the expansion of the urban footprint over time.

Only a limited portion of the municipality is currently expected to experience urban heat island conditions typically associated with concentrated urban development. However, future changes in land use could alter these conditions. The Land Use Plan identifies areas designated for future urban development, including lands classified as Non-Programmed Land for Development (Suelo Urbanizable No Programado, SUNP), which may contribute to the expansion of the urban footprint over time. In addition, recently approved development permits may result in increased impervious surface coverage and reductions in vegetative cover in specific areas. Collectively, these factors could increase localized heat retention and potentially intensify urban heat island conditions in the future. Therefore, continued monitoring of development trends and more detailed urban-scale analyses are recommended to evaluate the potential effects of future growth on extreme heat exposure and vulnerability. This means that urban heat island effect will continue to be present in the municipality.

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4.11 Drought

4.11.1 Description (B1-a)

Drought is described as a temporary irregularity in rainfall or natural water flow, where a prolonged lack of precipitation leads to a significant hydrological imbalance. This condition may or may not result in interruptions to regular drinking water service, crop failures, and adverse effects on wildlife and vegetation. The severity of a drought is determined by the level of moisture deficiency, its duration, and the geographic extent of the affected area (Colón, 2009).

Drought represents one of the most complex climatological risks and one of the most severe events (DRNA, 2016). Drought is the result of a natural reduction in the expected amount of precipitation over a prolonged period, usually a season or longer. High temperatures, strong winds, and low humidity levels can exacerbate the effects of drought in areas where they are already prevalent. Likewise, drought can lead to severe wildfires (FEMA, 1997). Human actions and the demands they place on water resources can accelerate drought-related impacts. Droughts occur in different forms across the island, meaning that some regions may experience greater impact while others remain normal.

According to FEMA there are three types of droughts (FEMA, 1997):

Table 39: Types of Droughts

Meteorological Drought	A period characterized by a significant deficiency in precipitation compared to normal conditions over a specific timeframe (e.g., monthly, seasonal, yearly).
Agricultural Drought	Occurs when soil moisture becomes insufficient to support crops or livestock needs, typically following meteorological drought.
Hydrological Drought	Defined by reduced water levels in streams, rivers, reservoirs, and groundwater systems, often lagging meteorological drought.
Socioeconomic Drought	Reflects the impact on human systems and the economy, arising when water supply shortages—due to any form of drought—fail to meet societal demand for water and other resources

In 1999, the Federal Drought Monitor program was implemented, a tool that publishes data and maps on drought conditions in the United States, including Puerto Rico and Hawaii. This system integrates information from various agencies, such as NOAA, the United States Department of Agriculture (USDA), and the National Drought Mitigation Center at the University of Nebraska-Lincoln. In addition, the monitor has developed standardized indicators that allow drought categories to be classified at the national level, providing a uniform reference for risk assessment and management.

The short-term drought indicator focuses on precipitation over 1–3 months. The long-term drought indicator focuses on a period of 6–60 months. Additional indices used, especially during the growing season, include the "USDA/NASS Topsoil Moisture," the Keetch-Byram Drought Index (KBDI), and NOAA/NESDIS satellite vegetation health indices. Other indicators include groundwater levels, reservoir capacity, and pasture conditions.

In Puerto Rico, the Puerto Rico Aqueduct and Sewer Authority (PRASA), the Puerto Rico Electric Power Authority (PREPA), and the Department of Natural and Environmental Resources (DNER) are responsible for constantly monitoring the dams and reservoirs

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used for potable water supply. Once critical levels are reached, the first strategy adopted at the supply system level is reducing water pressure. If adequate levels are not restored, water rationing begins. This is implemented in phases lasting 12 hours and, in extreme cases, up to 48 hours. The affected area is divided into sectors, and the different rationing phases of a given duration are initially implemented locally, usually in municipalities with the highest consumption. In extreme circumstances, several municipalities and entire regions may be affected.

4.11.1.1 Affected Area (B1-B)

Utuado's administrative boundary is strongly influenced by the mountainous terrain of the Cordillera Central and the watershed systems that originate within the municipality. The municipality contains the headwaters and upper reaches of several major rivers and tributaries, including the Río Grande de Arecibo, Río Viví, Río Caonillas, Río Limón, Río Tanamá, and Río Caguana, which drain much of the municipal territory. This topographic and hydrologic configuration creates a landscape characterized by steep slopes, narrow valleys, and extensive drainage networks that influence water movement throughout the municipality. The municipality also contains several major reservoirs, including Caonillas, Viví, Dos Bocas, and Jordán, which are integral components of the local hydrologic system.

4.11.1.2 Risk Magnitude (B1-C)

Drought is a slow-onset hazard, but over time, it can have highly detrimental effects on crops, municipal water supplies, recreational uses, and wildlife. If drought conditions persist for several years, the direct and indirect economic impact can be significant. Drought can also potentially provide favorable conditions for another hazard to occur, wildfire.

The National Drought Monitoring Center uses the following categories to describe the magnitude of drought conditions (US Drought Monitor, 2025).

Table 40: US Drought Monitor Categories

Category	Description	Typical Impacts
None	Normal/Wet Conditions	No drought impacts
D0 - Abnormally Dry	Early signs of dryness may slow planting, affect surface water	Short-term dryness; minor stress
D1 - Moderate Drought	Noticeable soil moisture depletion; low water; voluntary restrictions	Crop stress; reduced streamflow
D2 - Severe Drought	Common water shortages; likely crop/pasture losses	Mandatory restrictions possible
D3 - Extreme Drought	Major crop/pasture losses; widespread restrictions	Fire bans; severe water stress
D4 - Exceptional Drought	Exceptional and widespread losses; water emergencies	Emergency measures; critical impacts

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4.11.1.3 Past Events (B1-D)

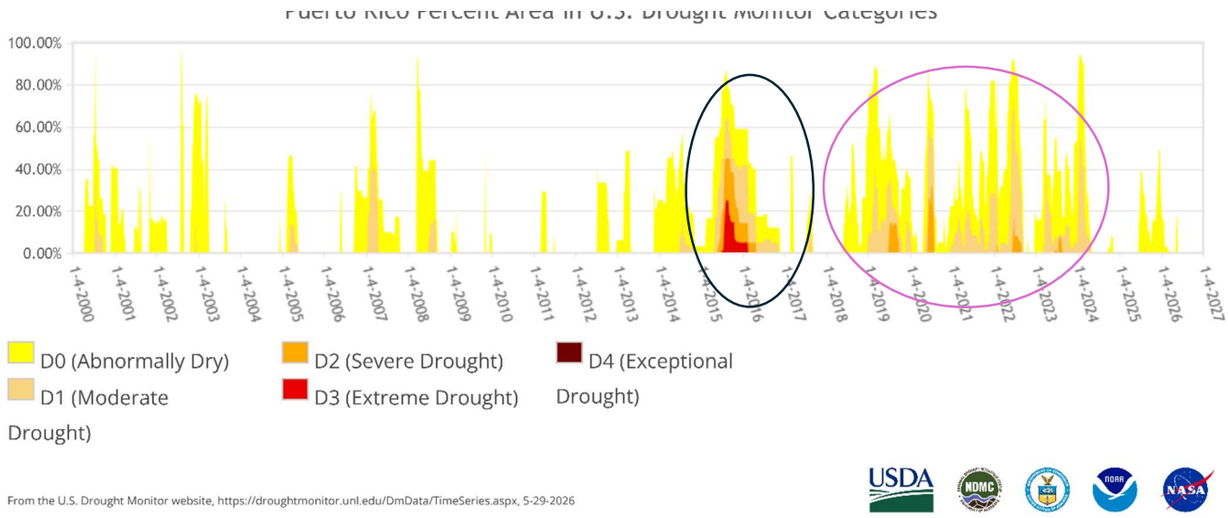
Puerto Rico has a humid tropical climate characterized by two well-defined seasons: a rainy season, which extends from May to November, and a dry season, which runs from December to April. The eastern and western interior regions record the highest annual rainfall, while the northern zone receives significantly more rain than the south. USGS identified that major drought conditions have occur in 1967 – 1969, 1974, 1994, 1997, 2001-2002 and 2013 -2016 (USGS, 2014), (DNER, 2016). According to historical records the federal government has activated its resources to deal with drought conditions;

- Puerto Rico Extreme Drought Conditions (DR-170-PR) – Date of Declaration May 26, 1964.
- Puerto Rico Impact of Drought (EM-3002-PR) - Date of Declaration August 29, 1974.

During the rainy season, precipitation mainly comes from local convection processes, orographic effects, tropical waves, and cyclones. In contrast, rainfall during the dry season is mostly associated with the influence of cold fronts and troughs (CEACC, 2024).

shows the data captured by US Drought Monitor Categories for the period of January 2020 to January 2026 (US Drought Monitor, 2025) for Puerto Rico's entire territory. The graph measures the occurrence, duration, territorial extent and intensity of droughts in Puerto Rico. Intensity is measured with a color gradient ranging between yellow (D0 (abnormally Dry in the legend) as being the lowest intensity and the dark red (D4 Exceptional Drought) representing the highest level of drought. Duration is measured through the width of the data, expressed along the lower axis of the graph. Territorial extent is represented on the horizontal axis of the graph, the higher an event reaches the more Puerto Rico's territory it covers. Occurrence is measured by combining all of the other variables and locating them within the graph.

Figure 21: Puerto Rico Percentage in US Frought Monitor Categories

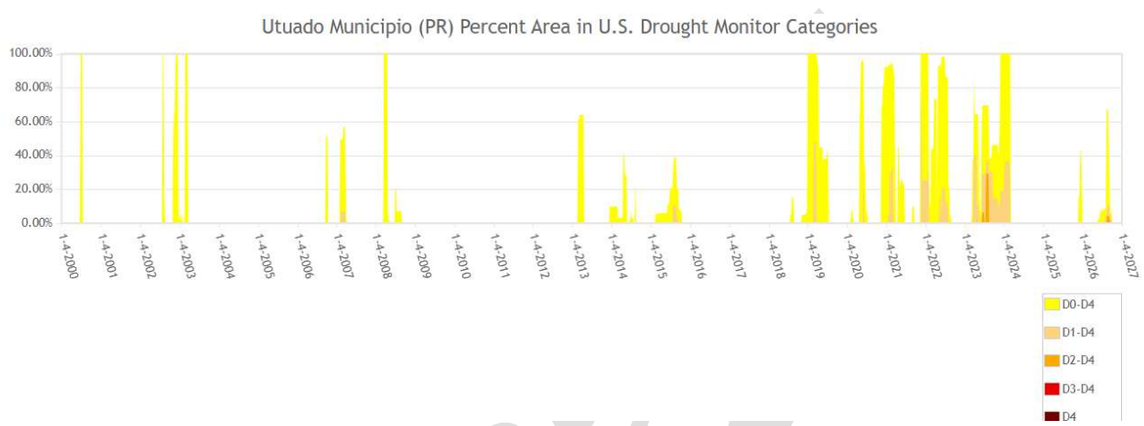


From the graph we may appreciate a sustained trend of increased occurrence, duration and intensity of droughts in Puerto Rico that began as early as 2010 and

solidified by 2014. Between 2015-2017, Puerto Rico experienced the most intense period of drought in recent years, with more than 80% of the Island's territory experiencing at least Abnormally Dry levels while at least 20% of the territory experienced Extreme Drought. The 2017 Hurricane season brough historic volume of precipitation, which explains the brief reduction in drought between 2017-2019. From 2017-2024, Puerto Rico experienced an extended period of drought in the vast majority of its territory.

In the case of Utuado thought there have been an increase in the frequency of drought conditions, it has not been on the level or intensity shown for the whole Island, Figure 22shows the percentage of Utuado classified within U.S. Drought Monitor categories from 2000 through 2026.

Figure 22: Utuado Municipio Percent Area in U.S. Drought Monitor Categories



Source US Drought Monitor

The chart shows the percentage of Utuado's land area classified within U.S. Drought Monitor categories from 2000 through 2026. Most years show little or no drought coverage, while periods of drought are concentrated between 2014 and 2024, when larger percentages of the municipality were classified within drought conditions. The most extensive drought coverage occurred during several periods between 2018 and 2024, when drought categories affected a substantial portion of the municipal area. Overall, the chart indicates intermittent drought conditions varying extent throughout the period of record.

4.11.1.4 Future Event Probabilities (B1-e)

USGS reports that in Puerto Rico, drought has an occurrence of 15 of 18 years (USGS, 2016), (USGS, 2014). Recent scientific data shows that the Caribbean region faces increased vulnerability to drought hazards. (USGCRP, 2018). The probability of drought occurrence is difficult to forecast or foresee in a long-term perspective. Though as figure 20 shows, moderate droughts periods have become more prevalent since 2018.

4.11.2 Risk Analysis (B2-a, B2-b)

If drought results in potable water rationing, the municipality could experience economic losses to the extent that services are immediately affected by the partial or total closure of schools, businesses, industrial areas, and public and private offices.

The potential economic impact of a prolonged drought would arise from the need to mobilize the municipality to meet the basic needs of its population during the

emergency period. This cost is associated with mobilizing resources such as personnel and equipment for the distribution of water to communities and municipal facilities. However, the municipality has not been able to quantify the economic impact of this expense, nor the impact on agriculture, due to a lack of information. Since drought is a hazard that does not directly affect structures, no dollar estimate of structural losses is generated.

Among other effects, it results in increased food prices, loss of agricultural production, impacts on the industrial, commercial, and service sectors, losses in hydroelectric energy, and losses in the tourism industry, whether domestic tourism or foreign visitors.

4.11.2.1 Estimated Losses

Documenting the fiscal impact of a drought is a complex process due to the wide range of ways this climate event affects society (DNER, 2015). For example, during the 2015 drought a potable water rationing plan was implemented for the San Juan Metropolitan Area (SJMA) of which is Utuado is a part of.

Another way to document the losses caused by drought period is by looking at the impact on the agricultural sector. The PR Department of Agriculture reported that the 2015 drought had a net cost of $14,000,000.00 impact on the agricultural sector.

4.11.2.2 Lifelines and Critical Infrastructure

Drought can severely strain critical infrastructure by reducing water availability for municipal systems, forcing rationing and service interruptions. Prolonged water shortages can disrupt operations in schools, hospitals, and businesses, leading to economic losses and reduced public services. Energy infrastructure is also affected, as hydroelectric power generation declines when reservoir levels drop, increasing reliance on costly alternatives. Transportation systems may suffer indirect impacts, such as road damage from soil shrinkage and increased wildfire risk near highways. Communication and emergency services face challenges when water scarcity limits cooling systems and firefighting capabilities. Overall, drought creates cascading effects across infrastructure networks, amplifying vulnerabilities and requiring coordinated mitigation strategies.

As mentioned above, if a drought occurs that results in potable water rationing, the municipality will suffer economic losses to the extent that the normal functioning of government operations is immediately affected by the partial or total closure of schools, businesses, industrial areas, and public and private offices. This has a direct effect mainly on the normal operations of assets, since the services they provide are negatively impacted by rationing or lack of water services. As drought events increase, their impact on these operations becomes greater. However, drought does not have a direct effect on the municipality's critical facilities and assets.

4.11.2.3 Social Vulnerabilities

As mentioned in Section 3.4.2 the estimated vulnerable population of Utuado is 43.95%. If the pattern that began in 2019 continues, the vulnerable population of Utuado will continue to face major challenges regarding access to potable water. Communities will experience a decrease in water availability, which is essential for industrial and

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agricultural production, as well as for personal use by residents. It can also affect public health. This results in a reduction in quality of life, mental and physical stress, and social discomfort, with potential risks of malnutrition, dehydration, and disease. Since the effects of a drought period can have effects on the whole population (even drought periods that do not directly affect the municipality's territory), it is recommendable for the municipal administration to consider the whole population of Utuado as exposed to this hazard.

4.11.2.4 Natural and Cultural Resources

When a region experiences prolonged and cumulative periods of little or no rainfall, a drought begins. This natural hazard has adverse effects on biodiversity and water supplies. For instance, a precipitation deficit reduces water levels in surface water bodies, including rivers, streams, and reservoirs, affecting local ecosystems and associated flora and fauna. Damage to vegetation directly affects animal habitats, creating an imbalance in food availability for wildlife. Agriculture in the area is also severely affected due to the lack of water.

When rainfall is significantly below normal levels, it causes severe hydrological imbalances that negatively affect land productivity systems. Similarly, crop growth and harvests decline, along with the availability and quality of drinking water. Drought can also lead to ecosystem degradation, loss of biodiversity and species, wind erosion, and increased wildfire risk.

4.11.2.5 Future Conditions (E1-a)

In the long term, the challenges posed by droughts might grow due to changes in rainfall patterns. This means that when droughts occur, they could be more intense, last longer, and cover larger geographic areas than those experienced in the past, thereby increasing population vulnerability.

Although Utuado experienced an overall population decline, the proportion and number of residents aged 65 and older increased, indicating a continued aging trend within the municipality (see Section 3.4). This increase in the elderly population, a sector that is particularly vulnerable, requires special attention when addressing drought risk.

As future structures are developed, it is critical to note that approving projects near sinkholes or those using septic systems increases the potential for contamination. In drought conditions, this greatly limits the use of groundwater. Another factor reducing groundwater availability as an alternative source during drought is soil surface impermeabilization and the obstruction or filling of sinkhole openings. These actions often increase surface runoff and reduce natural aquifer recharge.

4.12 Wildfire (E1-a)

4.12.1 Description (B1-a)

Wildfires are uncontrolled fires that spread through vegetative fuel, threatening and potentially consuming structures, while also impacting human health and ecosystems. These fires often start unnoticed and spread rapidly. They are typically characterized by dense smoke covering surrounding areas. Wildfires can occur under

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various weather conditions at any time of the year, but the highest activity happens when fine fuels are dormant and at their driest due to low precipitation.

In 2021, the Puerto Rico Department for Natural and Environmental Resources published its Forest Action Plan (DNER, 2021). In this document, the agency argues Wildfire management is a pressing issue at both local and global levels due to the complex interactions among human activity, fire dynamics, and natural landscapes. While research has established that fire influences ecosystem structure and function, its effects on ecosystem services remain uncertain because of interrelated factors such as land cover changes, invasive species, and extreme climate (Gould, 2008).

A clear understanding of the ecological and social impacts of wildfire in Puerto Rico's natural ecosystems is essential for guiding effective conservation and management strategies. Prevention efforts must extend to private forest owners and the public, as most fires on the island are human caused (Gould, 2008). Historically, fire monitoring and research in the region have received limited attention. Currently, fires occur predominantly in dry forest zones, where the risk is highest. However, extreme climate, prolonged droughts, and human-induced landscape fragmentation could expand fire-prone conditions into moist and wet tropical forests, as well as into areas traditionally unaffected by fire (Gould, 2008).

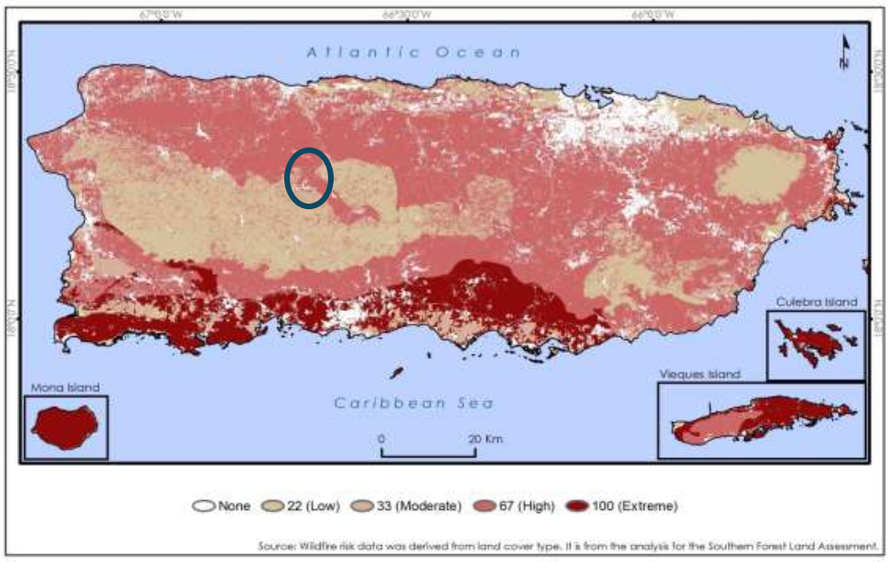
Most fires are found in dry forest areas. However, increasing temperatures, more frequent droughts, and the spread of invasive species are making forests more susceptible to wildfires. This shift is already evident throughout Puerto Rico, where fires are becoming more frequent and occurring in areas with no prior history of such events (Robbins, Eckelmann, & Quiñones, 2009). Extreme climate, prolonged droughts, and landscape fragmentation caused by human actions have expanded fire-prone areas, including humid tropical forests and non-forested regions that traditionally faced little fire risk (DNER, 2021).

Increasing temperatures, more frequent droughts, and the spread of invasive species are making forests more susceptible to wildfires. This shift is already evident in Puerto Rico, where fires are becoming more frequent and occurring in areas with no prior history of such events (Robbins, Eckelmann, & Quiñones, 2009).

4.12.1.1 Affected Area (B1-B)

Figure 23 (DNER, 2021) provides an overview of areas in Puerto Rico, Vieques, and Culebra under varying levels of wildfire incidence, as defined by Southern Federal Land Assessment (SFLA). This information provides the state of knowledge of what is known as fire-prone landscapes. The combination of human presence, dry fuels, and climatic conditions accounts for the high number of fires in the southern coastal plain.

Figure 23: Overview of areas of Puerto Rico, Vieques and Culebra under different levels of wildlife incidence accounting to SFLA



Utuado is located within an area mapped predominantly as Moderate wildfire risk. The municipality is situated near the transition between Moderate and High wildfire risk zones, with areas of High risk mapped to the south. No areas of Extreme wildfire risk are shown within the municipality. Areas of extreme susceptibility are mapped primarily to the south of Utuado, while areas of moderate and low susceptibility occur in other portions of the island.

In Puerto Rico, the areas potentially affected by wildfires include the dry southern coastal plains, wildland–urban interface zones, and communities located near grasslands, forests, or other fire-prone vegetation. Within these areas, wildfires may affect residential structures, critical facilities, utility infrastructure, communications systems, and evacuation routes. Development located close to combustible vegetation may face increased exposure, particularly during drought conditions and periods of strong winds. The extent of the affected area may expand rapidly when vegetation, weather, and development patterns facilitate the spread of fire.

4.12.1.2 Risk Magnitude (B1-C)

The United States Forest Service main classification for fire types (USFS, n.d.) are;

- **Ground Fire** - Fire that burnt in the organic material below the litter layer, mostly by smoldering combustion. Fires in duff, peat, dead moss and lichens, and punky wood are typically ground fire. This type of fire affects low vegetation (grasslands, shrubs, and tree bases). Depending on environmental factors (vegetation composition and density, slope orientation and steepness, wind speed, among others), these fires can vary in intensity but generally release less thermal energy than fires that spread through tree canopies.

- **Crown Fires** – Fire that burnt in the crowns of trees and shrubs. This type of fire is usually ignited by a surface fire. Crown fires are common in coniferous forests and chaparral-type shrublands In Crown Fires, Fire climbs through lower branches until reaching the tree canopy. However, its spread remains primarily

surface-based, often because trees are sparse and their canopies are too far apart.

- **Surface Fire** - Fire that burnt in litter and other live and dead fuels at or near the surface of the ground, mostly by flaming combustion.

While FEMA follows a four-classification typology (FEMA, 1997):

- **Wildfires** – Fueled almost exclusively by natural vegetation. They typically occur in forests and national parks, where federal agencies are responsible for fire management and suppression.

- **Interface or Intermixed Fires** – Fires that occur in urban and/or wildland areas where vegetation and integrated surroundings provide the fuel.

- **Firestorms** – Events of such extreme intensity that effective suppression is virtually impossible. Firestorms occur under severe weather conditions and generally burn until conditions change, or available fuel is exhausted.

- **Intentional and Prescribed Burns** – Fires caused by human intervention and natural fires intentionally allowed to burn vegetation for management purposes.

Another typology is the distinction between wildfires and wildland-urban interface (WUI) fires. Wildfires occur in areas with minimal development, except for infrastructure such as roads or power lines. WUI fires, on the other hand, involve situations when fire spreads into areas with structures or other human developments. In WUI fires, flames feed on both vegetation and structural elements of urban areas. The US Fire Administration defines WUI as the zone or area where human structures and developments meet or intermingle with wildland vegetation and fuels (US Fire Administation, 2025).

Wildfires tend to be associated with template climate areas, like California or Canada. However, the recent experience in the State of Hawai'i showed that rapid and deadly wildfire can occur even in tropical humid locations. The catastrophic Lahaina Fire of August 2023 sent swift, devastating flames through densely built neighborhoods, revealing severe vulnerabilities in early warning systems, evacuation planning, and community preparedness. Fueled by dry vegetation, strong winds, and record-setting drought conditions, the blaze rapidly ignited structures and overwhelmed emergency response efforts. Independent investigation by the Fire Safety Research Institute highlights that inadequate infrastructure resilience, insufficient communication networks, and a lack of coordinated interagency planning significantly amplified the disaster's impact.

Wildfires in Puerto Rico may increase rapidly in magnitude when dry vegetation, drought conditions, and strong winds coincide, particularly in densely developed wildland–urban interface areas. Under these conditions, a fire could spread into residential neighborhoods, damage homes and critical facilities, disrupt electrical and communications infrastructure, obstruct evacuation routes, and overwhelm local emergency-response capabilities. The Lahaina Fire demonstrates that tropical or humid locations can experience catastrophic wildfire impacts when extreme weather conditions combine with vulnerable infrastructure, limited warning capacity, and

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constrained evacuation options. Consequently, a major wildfire in Puerto Rico could result in extensive structural losses, service disruptions, displacement, injuries, and loss of life.

4.12.1.3 Past Events (B1-d)

Citing data from the Puerto Rico Firefighters Bureau (PRFB), The Puerto Rico Forest Action Plan states that a total of 7,099 wildland fires were reported across Puerto Rico between 2018 and 2020. The highest number of incidents occurred in 2020, with 5,077 recorded fires. The regions most affected were Ponce, Guayama, and Mayagüez (DNER, 2021).

Within the Department of Natural and Environmental Resources (DNER) Protected Natural Areas, fire incidence increased in 2019 compared to 2018. Notable affected sites included Guánica State Forest, Boquerón Wildlife Refuge, Punta Cuchara Natural Reserve, Caño Tiburones Natural Reserve, and Tortuguero Lagoon Natural Reserve. Most of these fires were linked to human activities, such as unattended campfires, discarded cigarettes, intentional burning, improper waste burning, and poorly managed prescribed burns in pasturelands (DNER, 2021).

The high frequency of wildfires in Puerto Rico highlights the urgent need for targeted education and public outreach efforts to raise awareness. When combined with active land management and a landscape-scale conservation approach, these initiatives can help reduce the occurrence of fires and mitigate additional pressures on forest ecosystems.

Based on the information available from the Puerto Rico Fire Bureau, wildfire incidents were reported during 2024. Because the records may not represent a complete accounting of all wildfire occurrences, the following table summarizes the incidents for which information was available at the time of this Plan update.

Table 41: Registered Wildfires

Case Number	Discovery Date	Containment Date	Incident Coordinates
PR012024-962	2024-01-20 17:55:21.736000	2024-01-20 23:24:39.537000	-66.70659, 18.2671
BPR012124-123	2024-01-21 03:36:37.881000	2024-01-21 04:37:54.487000	-66.7052, 18.2689
BPR012224-687	2024-01-22 13:37:52.493000	2024-01-22 14:12:32.347000	-66.7052, 18.2689
BPR021524-702	2024-02-15 13:49:40.175000	2024-02-15 14:06:27.942000	-66.7052, 18.2689
BPR022024-1103	2024-02-20 20:39:27.523000	2024-02-20 21:55:10.705000	-66.7052, 18.2689
BPR120124-754	2024-12-01 17:06:26.063000	2024-12-01 21:28:59.609000	-66.7052, 18.2689
BPR120924-935	2024-12-09 17:16:49.097000	2024-12-09 17:56:05.935000	-66.5924, 18.2126
BPR121024-495	2024-12-10 11:46:53.323000	2024-12-10 12:46:09.288000	-66.8024, 18.2845
BPR012924-680	2024-01-29 14:04:41.293000	2024-01-29 14:16:10.821000	-66.7052, 18.2689

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Source: Puerto Rico Fire Bureau

4.12.1.4 Future Event Probability (B1-e)

Long-term trends in rain patterns, such as those caused by fluctuations in the El Niño–Southern Oscillation (ENSO), may lead to extended dry periods (CCOF, 2026), reduced soil moisture, and increased vegetation stress. When combined with rising temperatures, these conditions accelerate evapotranspiration and further dry out fuels, significantly increasing the likelihood of ignition and fire spread. As a result, areas that have not historically been prone to wildfires may become increasingly susceptible under these changing climate conditions.

4.12.2 Risk Analysis (B2-a, B2-b)

4.12.2.1 Estimated Losses

Wildfires are caused by both natural factors, such as certain plant species, and intentional actions, where humans deliberately use fire. These variables play a critical role in determining the magnitude of a wildfire event. Potential losses increase based on population density, the number of structures, and ecosystems located within the affected area. The extent and severity of wildfire largely depend on climate conditions and human activity.

Currently insufficient data to estimate monetary losses from building damage caused by this hazard. Likewise, at the time of updating this Plan, the municipality did not have an official damage estimate. The municipality will take a proactive approach and include this information in the next Plan update, if available.

4.12.2.2 Lifelines and Critical Infrastructure

Wildfires pose a significant threat to critical infrastructure, creating cascading impacts across power systems, communications, water supply, transportation, and the built environment. The electric grid is particularly vulnerable. Research from Sandia National Laboratories (Sandia National Laboratories, n.d.) and other institutions shows that wildfire can both damage grid components and be ignited by them, as seen in the 2018 Camp Fire, which caused $9.3 billion in damages. To address this, the U.S. Department of Energy has invested $3.46 billion through its Grid Resilience and Innovation Partnerships program (DOE, 2023), funding projects that include undergrounding power lines, installing fire-resistant poles, and deploying advanced sensors.

Communications infrastructure faces similar risks. A study conducted by University of Wisconsin–Madison researchers found that although cell towers often remain physically intact during fires, service disruptions are widespread because of power outages (Anderson, Barford, & Barford, 2020).

Water systems and watersheds are also significantly affected. After a fire, vegetation loss and the development of water-repellent soils increase the likelihood of flooding and debris flow. These processes can introduce sediment, nutrients, and heavy metals into water supplies.

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Transportation infrastructure experiences both direct and indirect impacts. Roads, bridges, and drainage systems are frequently damaged or weakened by post-fire flooding and debris flows. At the same time, buildings and other structures located in the wildland–urban interface face increasing risk as climate change and urban expansion continue to raise exposure to wildfire hazards.

Overall, wildfires create complex and interconnected threats to critical infrastructure. Addressing these risks requires a combination of engineering solutions, advanced modeling, policy reforms, and active community engagement. Both academic and governmental sources highlight the importance of proactive measures such as strengthening infrastructure, improving land management practices, and implementing resilience planning to reduce vulnerability and support recovery.

Wildfires in Puerto Rico occur most frequently during drought periods, particularly in the southern region of the island. These events have substantial social and economic consequences, mainly due to damage or loss of property and infrastructure. When affected areas function as economic or employment centers, fires can result in job losses and broader economic disruption. In addition, increased wildfire risk often leads to higher insurance premiums as demand for coverage rises to offset potential losses. Collectively, these impacts place significant strain on local economies and communities and contribute to broader social decline.

4.12.2.3 Social Vulnerability

Social vulnerabilities play a critical role in shaping how communities experience and recover from wildfire events. Research consistently shows that populations with higher levels of poverty, older adults, individuals with disabilities, limited English proficiency, and households without reliable transportation face greater challenges preparing for, evacuating from, and recovering after wildfires. The CDC/ATSDR Social Vulnerability Index (SVI) identifies these demographic and socioeconomic conditions as key factors that increase susceptibility to disaster impacts, including wildfires, by constraining a community's adaptive and coping capacity before, during, and after an event. National-scale studies further demonstrate that U.S. communities experiencing wildfire occurrence or exposure tend to have systematically higher levels of social vulnerability, including higher unemployment, lower educational attainment, and greater concentrations of medically or socially dependent populations (Schumann, III, et al., 2024).

Wildfires also exacerbate existing inequalities through indirect impacts such as prolonged displacement, loss of livelihoods, and health effects from smoke exposure. Peer-reviewed studies show that socially vulnerable populations experience disproportionate health burdens from wildfire smoke, including higher rates of respiratory and cardiovascular illness and increased mortality risk, due to pre-existing health conditions and limited access to medical care. FEMA and the U.S. Fire Administration emphasize that older adults, low-income households, people living in mobile homes, and individuals without access to private vehicles face heightened risk of injury or death during wildfire evacuations, underscoring the importance of incorporating social vulnerability into wildfire mitigation, evacuation planning, and recovery strategies (Dennin, Nock, Muller, Akindele, & Adams, 2025). A significant portion of Utuado population is considered vulnerable (43.95%), and increased wildfire risk may disproportionately impact these residents by threatening homes, limiting access to essential services, and exacerbating health risks associated with heat and

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smoke exposure.

4.12.2.4 Natural and Cultural Resources

The severity, scale, and consequences of wildfire can be grouped into the following categories:

- Impact on Landscape - The most visible effect after a wildfire is the loss of scenic quality caused by the destruction of vegetation cover and its regression to earlier ecological stages.

- Impact on Wildlife - Wildfires immediately affect fauna, killing animals unable to escape—such as invertebrates, small vertebrates, young animals with limited mobility, and even large herbivores and carnivores trapped by flames and fencing. Fires also lead to migration due to the loss of pastures, habitats, and endangered species.

- Impact on Soil - Wildfires alter soil structure and greatly increase its vulnerability to erosion. Organic matter is lost through combustion, destabilizing soil aggregates and causing progressive disintegration. Solid particles are then removed by rain or wind erosion. Hydrophobic layers often form, caused by water-repellent organic substances and changes in mineral composition, preventing water infiltration and accelerating erosion. Significant losses of soil and organic matter reduce nutrient levels, lowering fertility. Heat also kills many organisms, reducing biological activity and disrupting biogeochemical cycles. However, not all effects are negative. Naturally occurring fires (now increasingly rare) can benefit forest health by mobilizing nutrients and controlling pests. Low-intensity fires help retain carbon in the soil, preventing its release as carbon dioxide.

- Alteration of the Water Cycle - Soil loss drastically changes the hydrological cycle. Reduced infiltration lowers groundwater reserves that feed aquifers essential for agriculture and urban use. Surface runoff increases, intensifying erosion and contributing to flooding after heavy rain.

- Increase in Carbon Emissions - Combustion during wildfires releases carbon dioxide (CO_2), methane (CH_4), and suspended particles. These emissions cause significant environmental damage and negatively affect people with respiratory illness (Asthma, COPD, etc.).

Wildfires can lead to numerous environmental consequences, including the destruction of vegetation cover, the death or displacement of wildlife, the loss of fertile soil, and an increase in erosion events. They can also cause significant loss of life and property, resulting in substantial economic costs associated with firefighting and recovery efforts.

The impact of wildfires on ecosystems is severe and varies depending on the magnitude and frequency of these events. They cause extensive damage to vegetation, disrupt ecosystems, and lead to the loss of wildlife in affected areas. Additionally, wildfires contribute to increased soil erosion, alterations in the hydrological cycle, and higher emissions of carbon dioxide into the atmosphere. These factors collectively accelerate environmental and soil degradation.

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As for cultural resources, Wildfires pose a serious threat to cultural resources, including historic buildings, and archaeological sites. Intense heat and flames can destroy irreplaceable structures, artifacts, and archives, erasing centuries of heritage in a matter of hours. Smoke and water used in firefighting efforts can further damage delicate materials, while erosion and flooding after fires may expose or wash away archaeological remains. In addition, the loss of cultural landmarks disrupts community identity and traditions, impacting tourism and local economies. Protecting these resources requires proactive planning, fire-resistant measures, and collaboration between emergency agencies and cultural preservation experts.

Beyond physical damage, the loss of cultural landmarks disrupts can community identity and traditions, while also affecting tourism and local economies. Protecting these resources requires proactive planning, fire-resistant measures, and collaboration between emergency agencies and cultural preservation experts.

4.12.2.5 Future Conditions (E1-a)

Puerto Rico already experiences a high annual probability of wildfire-supporting conditions. According to the World Bank–supported Think Hazard! platform, Puerto Rico's wildfire hazard is classified as High, meaning there is a greater than 50% probability in any given year of weather conditions capable of supporting a significant wildfire that could cause impacts to life or property. This assessment incorporates historical fire occurrence, climate variables, vegetation type, and drought conditions and is widely used in infrastructure and hazard mitigation planning worldwide (World Bank, n.d.).

Taken together, the best available scientific evidence indicates that Puerto Rico currently faces a probability exceeding 50% annually of wildfire-supportive weather conditions, with future probability and severity expected to increase due to rising temperatures, expanded drylands, and longer seasonal droughts. While precise ignition probability percentages cannot be reliably projected at the municipal scale, confidence is high that wildfire occurrence, fire weather days, and burned area will increase by mid-century, particularly in southern, western, and interior regions of the island (World Bank, n.d.).

4.13 Pandemic/Epidemic

4.13.1 Description (B1-a)

An epidemic occurs when the incidence of a disease or health-related event rises suddenly and significantly above what is expected in a specific community or region. According to the CDC, an epidemic represents a sudden increase in cases over the normal baseline in a population, and outbreaks—often used interchangeably—refer to such events in more limited geographic areas (CDC, 2012).

A pandemic is essentially an epidemic that has expanded to span multiple countries or continents, affecting a large portion of the global population. The CDC describes it as an epidemic with broad geographic spread, while the World Health Organization defines it as the worldwide transmission of a new disease to which people generally have little or no immunity (CDC, 2012).

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These terms emphasize both the magnitude of cases and their geographical distribution: an epidemic is localized, but a pandemic reaches across international borders and impacts global public health systems. Emergency responses must therefore be scaled from regional interventions during epidemics to coordinate global action in pandemics.

4.13.1.1 Affected Area (B1-b)

This LHMP considers that all areas of the municipality are equally vulnerable to the Epidemic/Pandemic Hazard.

4.13.1.2 Risk Magnitude (B1-c)

Though all can cause loss of life and economic disruption it is important to clarify terms:

- Epidemic refers to a sudden increase in the number of disease cases beyond what is normally expected within a specific population and geographic area.
- Outbreak shares the same definition as epidemic but is typically used for a more localized area.
- Cluster describes a grouping of cases in a particular place and time that appears to exceed the expected number, even if that expected number is unknown.
- Pandemic refers to an epidemic that has spread across multiple countries or continents, usually affecting a large population (CDC, 2012).

4.13.1.3 Past Events (B1-d)

The following table listing epidemics and pandemics in Puerto Rico has been collected from various sources. This list does not intend to be exhaustive:

Table 42: Pandemics and Epidemic in Puerto Rico (1855 – 2020)

Disease	Date	Classification	Description
Cholera Epidemic	1855 - 1856	Epidemic	Between 1855 and 1856, Puerto Rico suffered a major cholera outbreak that claimed over 25,820 lives, representing approximately 4–10% of the island's population at the time. (Vega Lugo, 2021)
Measles and Malnutrition	1917 - 1918	Epidemic	A severe measles outbreak occurred between 1917 and 1918, resulting in nearly 9,000 cases and approximately 2,000 deaths. High infant mortality—59% of deaths within six months were in children under two—was driven by malnutrition and poor living conditions (Rigau-Pérez & Vallejo - Calzada, 2020).
Spanish Flu (A/H1N1 influenza pandemic)	1918 - 1919	Pandemic	Puerto Rico was affected by the global A/H1N1 influenza pandemic, also known as the Spanish flu. Beginning around June 1918, community spread produced as

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Disease	Date	Classification	Description
			many as 1,000 cases in four days in areas like Puerta de Tierra. Misdiagnosis as dengue initially obscured the true impact (Rosario Urrutia, 2021).
Poliomyelitis	1960	Epidemic	The 1960 polio epidemic in Puerto Rico was the most severe paralytic polio outbreak in the Western Hemisphere at the time. It impacted 68 of 76 municipalities, causing 495 cases of paralysis, predominantly among school-age children (Timothee, Morris, Filiberti, & Mainardi, 1963).
Dengue	2013, 2024	Outbreak	Dengue is endemic in Puerto Rico, with significant outbreaks occurring in 2013 and again in 2024. The 2024 outbreak triggered a public health emergency, with 6,291 confirmed cases, a 4.2% rate of severe dengue, and 11 deaths reported (Rodríguez, et al., 2024) (Ware-Gilmore, et al., 2025)
Chikungunya	2014	Epidemic	The first locally acquired chikungunya case in Puerto Rico was confirmed on May 5, 2014, triggering expanded surveillance efforts using Puerto Rico's dengue infrastructure. Between May 5 and August 12 of that year, 10,201 suspected cases (approximately 282 per 100,000 residents) were reported, of which 1,975 (68%) were laboratory-confirmed. During this period, four deaths were also recorded. (Sharp, et al., 2014)
Zika	2015 - 2016	Epidemic	The first locally transmitted Zika case in Puerto Rico was reported in December 2015. By April 2016, over 6,000 suspected cases had been evaluated, with 683 confirmed cases. Pregnant women and related neurological issues (e.g., Guillain-Barré syndrome) were of particular concern. (Thomas, et al., 2016) (Dirlikov, et al., 2016)
COVID - 19	2020 - 2022	Pandemic	See narrative below

COVID-19 Pandemic

Puerto Rico confirmed its first COVID-19 case—a European tourist—on March 8, 2020, leading the governor to declare an emergency on March 12 and implement early measures including airport screening and mandatory isolation, as outlined in the Puerto Rico Department of Health's epidemic situation reports (PRDH, 2022), (COR3, n.d.). By April 6, 2022, official data reported 270,485 confirmed cases and 4,171 deaths

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due to COVID-19 in Puerto Rico, according to detailed government spreadsheets and dashboards maintained by the Puerto Rico Health Department (PRDH, 2022), (COR3, n.d.).

The territory experienced significant economic and social disruptions: a Bayesian analysis revealed a clear causal relationship between rising COVID-19 infections and increased unemployment, and engineering studies from the University of Puerto Rico–Mayagüez estimated that unemployment soared above 17%, also noting elevated operating costs for businesses due to PPE and safety measures (Hernández - Padilla & Méndez-Piñero, 2020).

Subsequent public health research revealed widespread mental health consequences: one study found that 31% of healthcare workers scored in the range of depressive symptomatology following combined stress from prior disasters (e.g., hurricanes) and the pandemic; another identified high levels of anxiety (26.9%) and stress (69.9%) among physicians during the second COVID-19 wave (Hernández - Torres, et al., 2023), (Sánchez - Plazas, García - De Jesús, Martínez - González, Amaya - Ardila, & Almodóvar - Rivera, 2024).

4.13.1.4 Future Events Probability (B1-e)

Puerto Rico's susceptibility to future pandemics or epidemics is underscored by its subtropical climate, population distribution, and healthcare infrastructure. A university-developed emergency preparedness model—commissioned by Puerto Rico's Department of Health—simulated influenza pandemics and demonstrated how variations in disease transmissibility, healthcare capacity, and mitigation efforts can significantly influence outbreak trajectories and the likelihood of healthcare system overload. Furthermore, the U.S. Department of Health and Human Services' Hospital Preparedness Program (HPP) in Puerto Rico operates under the Assistant Secretary for Preparedness and Response, with coordinated health care coalitions and special pathogen systems explicitly designed to reduce pandemic risk by strengthening surge capacity and infection-control readiness. These combined efforts reflect a data-driven recognition that, without sustained investment in public health infrastructure and preparedness modeling, Puerto Rico remains at an elevated probability for experiencing another epidemic or pandemic (Hirsh & Centeno - Marín, 2015), (ASPR, n.d.).

4.13.2 Risk Analysis (B2-a, B2-b)

4.13.2.1 Estimated Losses

The COVID-19 pandemic resulted in significant mortality across Puerto Rico, underscoring the importance of public health hazards in local mitigation planning. Official data from the Puerto Rico Department of Health indicate that COVID-19 mortality is tracked through an epidemiological surveillance system that compiles death certificate data and case investigations and is made publicly available through government data portals. At the territorial level, thousands of deaths have been attributed to COVID-19 since 2020, as reported in official datasets and federal summaries. However, cumulative mortality totals for individual municipalities, including Utuado, revision are not consistently published as single static figures in official reports. Instead, municipality-level death counts must be obtained by querying downloadable datasets provided by the Puerto Rico Department of Health, which

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allow users to filter results by municipality.

These datasets are considered provisional and subject to due to reporting delays and ongoing validation of death records, as acknowledged by public health authorities. Consequently, while Utuado -specific COVID-19 mortality was not recorded as fixed published figure. Based on the currently available data, the total number of COVID-19-related deaths in the municipality cannot be reliably determined.

4.13.2.2 Lifelines and Critical Infrastructure

The most affected lifeline in the case of a pandemic or epidemic is the healthcare and medicine lifeline. This is so because in response to a pandemic/epidemic hospitals, clinics and other healthcare facilities can be overwhelmed by the high demand of services. There are shortages of PPE, medical devices (ventilators in the case of COVID-19) and medical staff. Since the pandemic/epidemic is the priority there will be delays in non-related medical care. Finally, there can be serious challenges in the management of mortality services.

However other lifelines can be affected such as the Food, Hydration and Shelter Lifeline, due to increase food insecurity from unemployment and economic shutdowns ort closed or reduced shelters due to infection control requirements. The Safety and Security Lifelines can be affected by high absenteeism due to illness, quarantine or caregiving responsibilities and increase levels of stress and burnout among first responders and law enforcement officers.

Other lifelines and critical infrastructures can be affected by increased demand, like increased residential water demand) or the lack of trained personnel to maintain existing operations.

4.13.2.3 Social Vulnerability

For this hazard, the whole population of Utuado is considered equally vulnerable. Nonetheless, besides factors of age and poverty, the 2024 ACS shows that a total of 1,430 people in Utuado did not have health insurance coverage (US Census Bureau, 2025). This means that 5.2% of the total population is uninsured.

Of those most of the uninsured group belonged to the 55-to-64-year cohort (264 persons) followed by the cohort of 26 to 34 years (221 persons). The results given by the ACS show that the adults and young adults comprise the age groups with the largest number of uninsured residents in Utuado, which may increase their vulnerability during a pandemic or epidemic due to limited access to healthcare services.

Table 43 shows the breakdown of uninsured people in Utuado according to the 2020-2024 ACS.

Table 43: Number of People in Utuado without Healthcare Coverage

Age Cohort	Number of people uninsured
Under 6 years	13
6 to 18 years	125

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Age Cohort	Number of people uninsured
19 to 25 years	66
26 to 34 years	308
35 to 44 years	232
45 to 54 years	185
55 to 64 years	445
65 to 74 years	44
75 years or older	12

Source: US Census 2020-2024 American Community Survey

This would be considered population at risk in case of a pandemic or epidemic. Further information regarding social vulnerability can be found in Section 3.4.4.

4.13.2.4 Natural and Cultural Resources

The scientific literature shows that the COVID-19 Pandemic was a mixed bag for the environment. On one hand the unprecedented pandemic-related lockdowns had negative effects on the physical environment. These impacts included increased pollution from the widespread use of personal protective equipment, deforestation, illegal poaching and logging, overfishing, and disruptions to conservation programs and projects. The findings also note that the spread of pandemics may be intensified by environmental pollution and rapid global population growth (Muche, Yemata, Molla, Muasya, & Tsegay, 2022), (Guo & Lee, 2021).

At the same time, despite these adverse impacts, the period of reduced human activity—often referred to as the *anthropause*—also produced several positive effects on natural resources. These included short-term reductions in indoor and outdoor air pollutants ($PM_{2.5}$, PM_{10}, NO_2, SO_2, CO, and CO_2) and decreases in noise pollution from ships, boats, vehicles, and aircraft. Collectively, these changes benefited aquatic ecosystems and water quality, influenced bird behavior, supported wildlife biodiversity, and contributed to temporary ecosystem recovery. (Muche, Yemata, Molla, Muasya, & Tsegay, 2022).

When it comes to cultural and heritage sites a report from UNESCO states that crisis has produced both negative and positive effects across different types of World Heritage properties (UNESCO, 2021). The sudden cessation of travel and tourism disrupted visitor flows and eliminated a critical source of revenue for many sites, where tourism income is essential to supporting conservation activities, routine maintenance, and staff salaries. Local communities surrounding these properties were similarly affected, with widespread loss of employment and income.

Conversely, in some cases the reduced level of human activity enabled rehabilitation and restoration efforts to proceed more efficiently, while anthropogenic pressures were temporarily reduced across many natural areas. This contrast highlights the diverse and uneven impacts of the crisis on World Heritage properties. At the same time, it presents an opportunity to build on the benefits associated with the easing of specific pressures at certain sites, while advancing targeted research and strategic recovery planning (Guo & Lee, 2021) (Guibert & Hyde, 2021), (UNESCO, 2021).

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4.13.2.5 Future Conditions (E1-a)

Puerto Rico faces structural and environmental conditions that elevate its exposure and vulnerability to future pandemics relative to many mainland U.S. locations. As a tropical island with high population density in urban corridors, frequent international travel, and climatic conditions favorable to vectors and pathogens, Puerto Rico is particularly susceptible to emerging and re-emerging infectious diseases, especially those with zoonotic or vector-borne origins. The CDC and peer-reviewed research document ongoing transmission of diseases such as dengue and previous outbreaks of Zika and Chikungunya, demonstrating the island's continued exposure to pathogens with outbreak and epidemic potential. This exposure holds regardless of the development pattern of the municipality.

4.14 High Hazard Potential Dams

The Robert T. Stafford Act, as amended by the Disaster Mitigation Act of 2000 (DMA2K), established mitigation planning as the cornerstone for reducing disaster risk. Local governments with a mitigation plan that identifies natural hazards, assesses risks and vulnerabilities, and outlines strategies for implementing mitigation actions are eligible for FEMA mitigation grants. Specific requirements for these plans are detailed in the Code of Federal Regulations[18] and further supported by FEMA policies and guidance (FEMA, 2024).

The National Dam Safety Act, as amended, created the Rehabilitation of High Hazard Potential Dams (HHPD) Grant Program. Funding for HHPD projects first became available in Fiscal Year 2020 (FY20) and has increased since then. Eligibility criteria for these grants, as they relate to mitigation planning, are outlined in FEMA's Local Mitigation Planning Policy Guide (FEMA, 2024).

It is important to emphasize that a dam with HHPD status does not necessarily mean that a dam failure is imminent.

The Association of State Dam Safety Officials (ASDSO), provided the following classification of dam hazard (ASDSO, 2022):

- High Hazard Potential – "Typically defined as a dam whose failure or mis-operation will cause loss of human life and significant property destruction".
- Significant Hazard Potential – "Typically defined as a dam whose failure or mis-operation will cause significant property destruction".
- Low Hazard Potential – "Typically defined as a dam whose failure or mis-operation will cause minimal property destruction".

According to ASDSO, out of the 37 dams reported in Puerto Rico, 36 are considered HHPD.

4.14.1 Description (B1-a)

Act 133-1986 as amended defines a dam as an artificial barrier, together with its accessory works, built for the purpose of retaining, storing, or diverting water or any other liquid or semi-liquid, and whose height exceeds twenty-five (25) feet from the

[18] 44 CFR § 201.6

natural bed of the water body or the natural ground level. While a reservoir is defined as an artificial basin where the waters of a river or stream, or stormwater runoff, are collected and that exceeds a volume of fifty (50) acre-feet.[19] Dams can represent a potential hazard in cases of dam failure (breach) or mis-operation (such as unscheduled or uncontrolled releases (FEMA, 2024).

4.14.1.1 Affected Areas (HHPD2-a)

As stated in Section 3.3.3, the Municipality of Utuado contains an extensive network of rivers and streams distributed throughout its territory. The hydrography map identifies major water features, including the Río Grande de Arecibo, Río Viví, Río Caguana, Río Tanamá, Río Limón, Río Yunes, Río Camuy, Río Criminales, and Río Grande de Jayuya. The map also shows the Dos Bocas and Caonillas reservoirs in the northern and eastern portions of the municipality, respectively.

The following tables summarize the available information from the National Inventory of Dams (NID) for dam structures associated with these watersheds and their respective subwatersheds. The following tables show the available information in the National Inventory of Dams for the dam structures that could have an impact on Utuado in the event of a dam breach in (USACE, 2022).

Caonillas Reservoir

Table 44: Caonillas Dam NID Data

Caonillas Dam	
Watershed	Caonillas River
Purposes	Hydroelectric, Recreation
Main Body of Water	Caonillas River
Municipality	Jayuya
Date of Completed Construction	1948
Dam Type	Concrete, Gravity
Hazard Potential Classification	High
NID ID	PR00011
Coordinates as per NID	18.1693629, -66.6513594
Estimated Coordinates using Google Earth	18.276743, -66.656305
Height as per NID	235 Ft.
Storage as per NID	54,970 Acre Ft.
Emergency Action Plan	Yes
Last Recorded NID Inspection	09/04/2019
Condition Assessment	Satisfactory
Operator	Puerto Rico Electric Power Authority (PREPA)

Figure 24 shows the Caonillas Reservoir as it appears in the latest USGS Topographic map.

[19] 22 L.P.R.A. § 401

Figure 24: Caonillas Reservoir USGS[1] 2026 Topographic Quadrangle

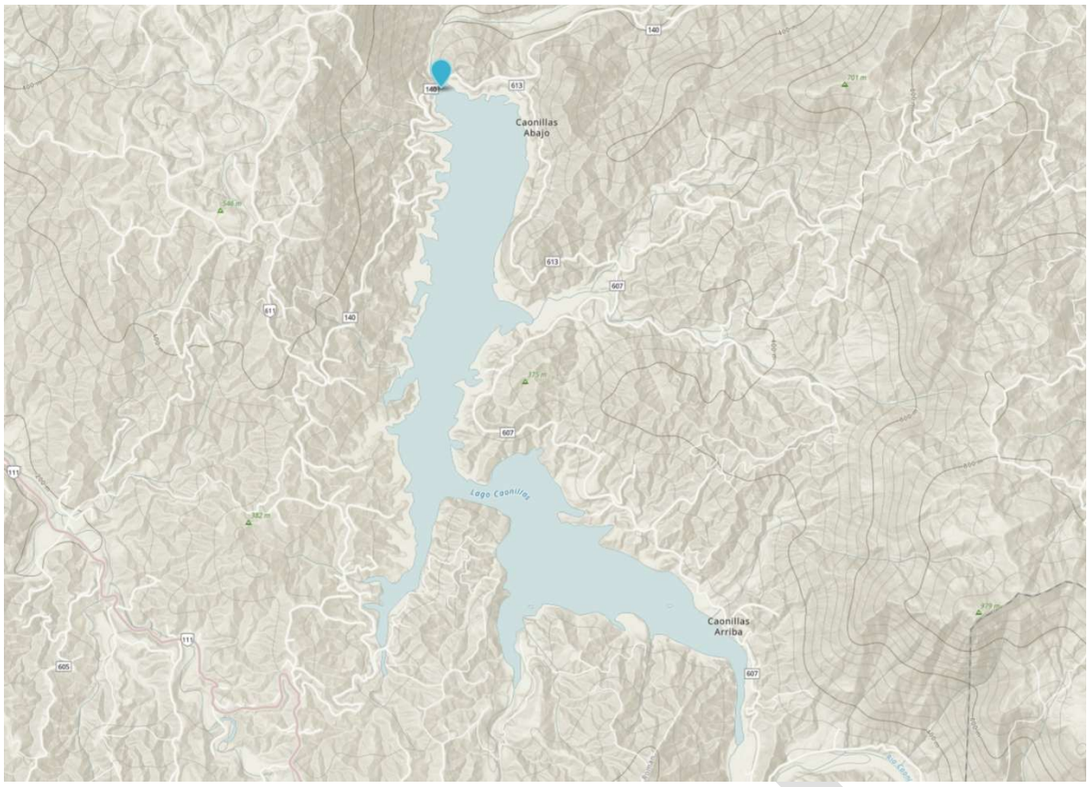
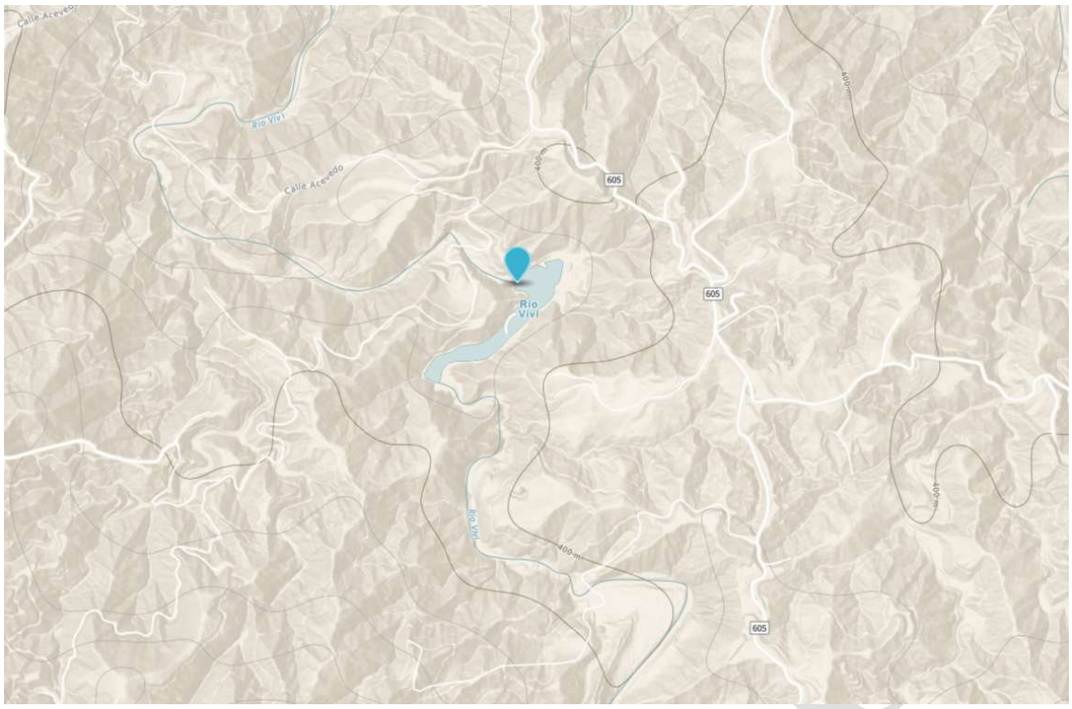


Table 45: Viví Dam NID Data

Viví Dam	
Watershed	Viví River
Purposes	Hydroelectric
Main Body of Water	Viví River
Municipality	Utuado
Date of Completed Construction	1950
Dam Type	Gravity
Hazard Potential Classification	High
NID ID	PR00010
Coordinates as per NID	18.2290397, -66.6788631
Height as per NID	85 Ft.
Storage as per NID	380 Acre Ft.
Emergency Action Plan	Yes
Last Recorded NID Inspection	01/10/2020
Condition Assessment	Satisfactory
Operator	Puerto Rico Electric Power Authority (PREPA)

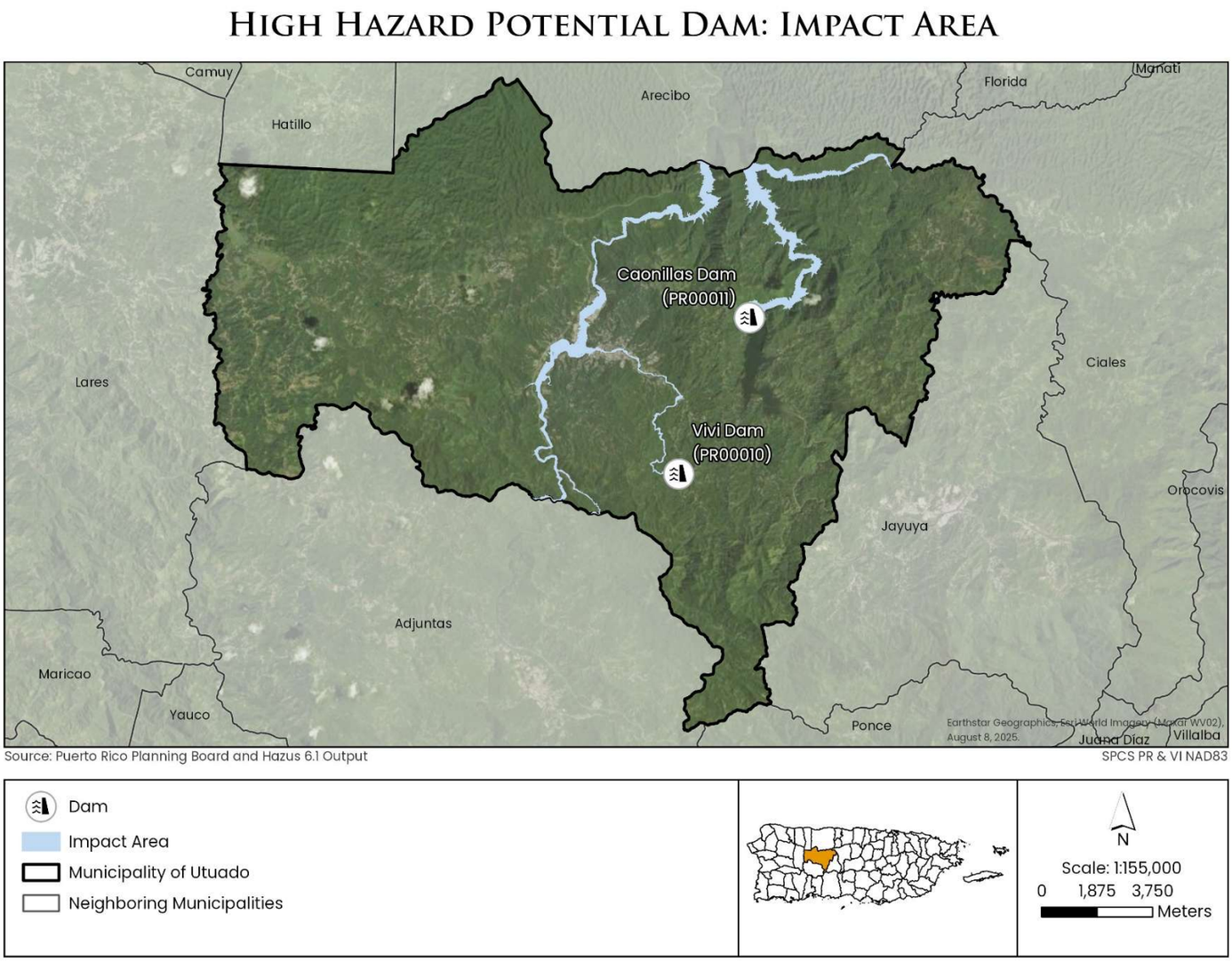
Figure 25 shows the Viví Reservoir as it appears in the latest USGS Topographic map.

Figure 25: Viví Dam USGS[1] 2026 Topographic Quadrangle



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Map 39: High Hazard Potential Dam: Impact Area



Map 39 shows the Sunny Day Dam Breach scenario for impact areas associated with the Caonillas Dam (PR00011) and Viví Dam (PR00010) in the municipality. The impact areas are shown as light-blue corridors extending downstream from each dam and following the mapped river and drainage network. The largest impact area originates from Caonillas Dam in the northeastern portion of the municipality and follows a branching path that extends westward and southward through central Utuado. A second impact area extends downstream from Viví Dam into the south-central portion of the municipality and connects with the broader river network.

The mapped impact areas are concentrated within the central and eastern portions of Utuado and remain primarily within municipal boundaries, although some segments extend toward the northern boundary of the municipality. The map also shows the locations of both high-hazard-potential dams, the extent of the potential downstream impact areas, neighboring municipalities, and the municipal boundary of Utuado, providing a geographic overview of areas that could be affected by a dam-related incident.

4.14.1.2 Risk Magnitude (B1-B)

Multiple factors influence both the exposure to and the overall impact of dam-related risks. Each dam is unique and requires an individual assessment to understand the risks it poses and those it faces. Dams may also operate in series, where water

released from an upstream dam affects the performance of a downstream dam. In such cases, modeling the dams together is recommended (AtkinsRéalis, 2024).

Risk exposure can result from hazard creep, upstream flooding, large reservoir releases, controlled or partial breaches, design or construction flaws, cascading storm impacts, seismic activity, landslides, wildfires, and deferred maintenance or rehabilitation. These risks can affect populations, infrastructure, critical facilities, economic stability, environmental and social resources, and may lead to multi-jurisdictional consequences (AtkinsRéalis, 2024).

Dam risk consists of three primary components: incremental risk, non-breach risk, and residual risk.

- Incremental risk refers to the likelihood and consequences for the reservoir area and downstream floodplain that result from the presence of the dam if it fails—whether due to overtopping, structural malfunction, or mis-operation. These consequences go beyond what would occur without a dam breach and typically involve downstream flooding, though loss of the reservoir can also significantly impact upstream areas.
- Non-breach risk is the risk associated with normal dam operations or scenarios where the dam overtops without failing. For example, a gated dam may release water ahead of a storm to manage inflows, which could lead to downstream flooding if releases exceed channel capacity.
- Residual risk is the remaining risk after all mitigation and risk-reduction measures have been implemented. FEMA defines this as "risk remaining at any time," meaning the remote risk tied to conditions judged not to be credible dam safety issues after prudent actions have been taken (AtkinsRéalis, 2024).

Although dams are not natural hazards themselves, they can be affected by natural hazard events. Under extreme conditions, a dam may fail, causing flooding in the downstream inundation zone. Hazards such as flooding, landslides, wildfires, earthquakes, high winds, and drought can all compromise dam safety. Each hazard introduces risks that may lead to cascading impacts associated with dam incidents.

- **Flooding:** Puerto Rico's dams have historically been vulnerable to flooding. Heavy rainfall from tropical cyclones, severe thunderstorms, or stalled systems can affect multiple dams simultaneously, creating hydrologic emergencies. When several dams are impacted at once, resources are strained, and prioritizing response becomes difficult without clear information on dam conditions and potential consequences. Many dams in Puerto Rico are arranged in series, meaning releases from an upstream dam can affect downstream dams, requiring coordinated emergency actions.
- **Landslides:** Landslides can alter stream channels upstream or downstream, affecting reservoir inflows and outflows. Slides near a dam can undermine its stability, potentially leading to failure. Landslides within the reservoir can also generate overtopping waves that damage or breach the dam.
- **Wildfires:** Fires can change watershed characteristics by removing vegetation, reducing water absorption, and increasing runoff speed and volume. Post-fire conditions heighten risks of flash floods, mudslides, and debris flows, all of which can threaten dam operations and structural integrity.

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- **Seismic Events:** Earthquakes can compromise dam stability and, like floods, may impact multiple dams across a wide area.
- **Wind:** Hurricanes and tornadoes can uproot trees, weaken dam structures and increase seepage or erosion risks. Combined with heavy rainfall, wind damage can significantly threaten dam safety.
- **Drought:** Extended droughts lower reservoir levels, potentially rendering water supply dams inoperable. Drought also reduces vegetation cover, increasing susceptibility to flash flooding and debris flows when rains return—like post-wildfire conditions.
- **Dam Deficiencies:** Beyond natural hazards, structural deficiencies pose serious risks. Aging dams require increased maintenance; without it, they may develop cracks, seepage, or erosion issues. Malfunctioning gates can prevent controlled releases before floods or remain open, causing low reservoir levels and downstream flooding. Mis-operation can also compromise structural integrity or trigger downstream impacts.

Failure Modes

Failure modes are plausible physical processes that can lead to dam failure due to an existing weakness or defect. These may stem from natural foundation conditions, design flaws, construction issues, material deficiencies, operational or maintenance problems, or aging, and can result in an uncontrolled release of the reservoir. For example, a crack in the dam may worsen under extreme rainfall, ultimately causing failure. While failure mode analysis is highly technical and requires detailed investigation, for hazard mitigation planning purposes, failure modes are generally grouped into three categories: static, hydrologic, and seismic.

Static failure modes include (but are not limited to):

- Internal erosion
- Slope stability issues such as sinkholes, landslides, and cracks
- Gate or equipment malfunction
- Scour or erosion

Hydrologic failure modes include (but are not limited to):

- Overtopping
- Elevated reservoir levels exceeding structural capacity
- Rapid drawdown
- Spillway failure
- Impact loads during flooding

Seismic failure modes include (but are not limited to):

- Liquefaction
- Slope failures

4.14.1.3 Past Events (B1-C)

Built in 1928, the Guajataca Dam is 984 feet long, 120 feet tall earthen dam, located in the island's northwestern region between the municipalities of San Sebastián, Camuy, Quebradillas and Isabela. On September 20, 2017, Hurricane Maria caused the failure of the spillway structure and damaged both the water supply line and the dam outlet works. On October 3, 2017, FEMA assigned USACE a Mission Stafford Act to prevent the dam's failure, which posed an immediate threat to about 1,000 residents downstream

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and risked cutting off water to over 250,000 people. The Stafford Act provided USACE with the authority and funding to execute these measures (USACE, 2023).

USACE addressed the situation at Guajataca Dam in three risk-based stages:

- Stage 1: Threat of Imminent Flooding
- Stage 2: Implementation of Interim Risk Reduction Measures (IRRMs)
- Stage 3: Permanent Repairs

During Stage 1, USACE performed limited emergency stabilization to prevent dam failure. However, the spillway remained at an unacceptable risk of failure during future flooding events. Consequently, six critical IRRMs were implemented in Stage 2:

- Grouting voids beneath the concrete spillway
- Installing anchors to stabilize the spillway
- Repairing outlet gates
- Reconnecting the water-supply line
- Reinforcing the spillway and channel
- Stabilizing slopes near the inlet tower

By the end of 2018, four IRRMs were completed, achieving approximately a 100-year level of flood protection. The remaining two were finalized in September 2019, increasing protection to about a 1,000-year level and further reducing public risk. The estimated cost of these works was between $900 million and $1.1 billion (USACE, 2023).

Figure 26: Social Media Post from NWS warning about the Guajataca Dam Breach[1]

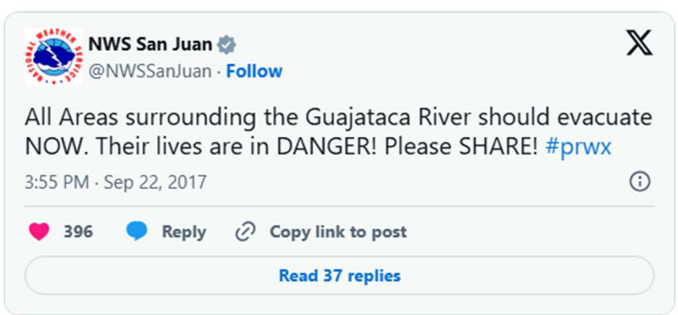


Figure 27: Guajataca Dam Breach 9/23/2017[1]



4.14.1.4 Future Event Probabilities (B1-E)

Puerto Rico faces significant risks of future dam failures due to aging infrastructure, environmental hazards, and operational challenges. The island has 36 dams, all classified as high-hazard potential, meaning that any failure could result in severe loss of life and property (National Inventory of Dams, 2022). Many of these structures are decades old and have been rated in poor or unsatisfactory condition, indicating critical deficiencies that require immediate attention (Puerto Rico Dam Safety Program, 2022).

Climate-related threats further exacerbate these risks. Hurricanes and extreme rainfall events, such as those experienced during Hurricanes Maria (2017) and Fiona (2022), have placed immense stress on dam systems. Although no failures occurred during these storms, emergency water releases were necessary to prevent overtopping. Future projections of more intense precipitation events will increase the likelihood of flash floods, challenging spillway capacity and structural resilience (Argonne National Laboratory & FEMA, 2023; Torres-Alavez et al., 2023).

Seismic activity adds another layer of vulnerability. Puerto Rico lies in a seismically active zone with an estimated 5–10% annual probability of a magnitude 7.0 earthquake. Such events could compromise dam foundations and structural integrity (FEMA, 2022). Additionally, satellite-based studies have detected subsidence and differential settlement in some dams, signaling gradual instability that could lead to failure over time (De la Paz-Bonilla et al., 2021; Virginia Tech, 2022).

Monitoring and early-warning systems have improved since Hurricane Maria, with FEMA supporting the installation of sensors, communication upgrades, and sirens for

high-risk dams. However, coverage remains incomplete, leaving gaps in real-time monitoring and emergency preparedness. Budget constraints and limited staffing further hinder consistent inspections and maintenance, increasing operational risk (FEMA, 2022; USACE, 2023).

In summary, Puerto Rico's dams face converging hazards: aging infrastructure, climate-driven flooding, seismic threats, and geotechnical instability. While modernization efforts, structural repairs, and risk management programs are underway, comprehensive upgrades and robust emergency planning are essential to safeguard communities and ensure the long-term reliability of these critical water and energy assets.

4.14.2 Risk Analysis (B2-a, B2-b)

The following section discusses an analysis of sunny day – scenario breach at the Carite Dam. The risk analysis for this hazard differs from the other hazards because it is following a different recommended format developed for Puerto Rico.

4.14.2.1 Risk Assessment Methodology and Limitations (HHPD2-a & HHPD-b)

This analysis corresponds to a sunny-day scenario executed between September 23, 2017, and September 25, 2017, to quantify the effects of possible dam breaches in Puerto Rico due to Hurricanes Irma and Maria. STARR II engineers and GIS specialists prepared these files, reports, and graphics at the request of FEMA Region. II under Contract Number HSFE60-15-D-0005, Task Order Number HSFE60-17-J-0008.

The decision support system for water infrastructure security parentheses (DSS-WISE) is a FEMA funded, web-based system for automatic dam break and levy failure flood modeling mapping and human consequence analysis to support emergency planning and infrastructure resiliency. Developed by the National Center for Computational Hydroscience and Engineering (NCCHE) at the University of Mississippi, DS- wise provide 2-dimensional flood modeling and mapping without requiring advanced numerical modeling expertise from users. It is funded and supported by FEMA to enhance emergency preparedness hazard assessment, and risk informed decision making.

DSS-WISE models dam-break events using a scenario-based decision support framework rather than acting as a stand-alone hydraulic flood model. First, users define dam-failure scenarios (such as overtopping, structural failure, or earthquake-induced collapse) along with dam characteristics, reservoir levels, and triggering conditions. DSS-WISE then incorporates dam-break outputs from external hydraulic models (for example, flood extent, depth, velocity, and arrival time generated by specialized flood modeling software) as input datasets. These results are evaluated within DSS-WISE using risk and consequence metrics, including impacts to population, critical infrastructure, environmental resources, and economic assets. The tool applies multi-criteria decision analysis to compare dam-break scenarios, mitigation options, and emergency response strategies under uncertainty. By integrating modeling results with expert judgment and stakeholder priorities, DSS-WISE helps decision-makers understand relative risks and trade-offs associated with dam-break hazards. In essence, DSS-WISE translates technical dam-break

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modeling outputs into actionable planning and safety decisions.

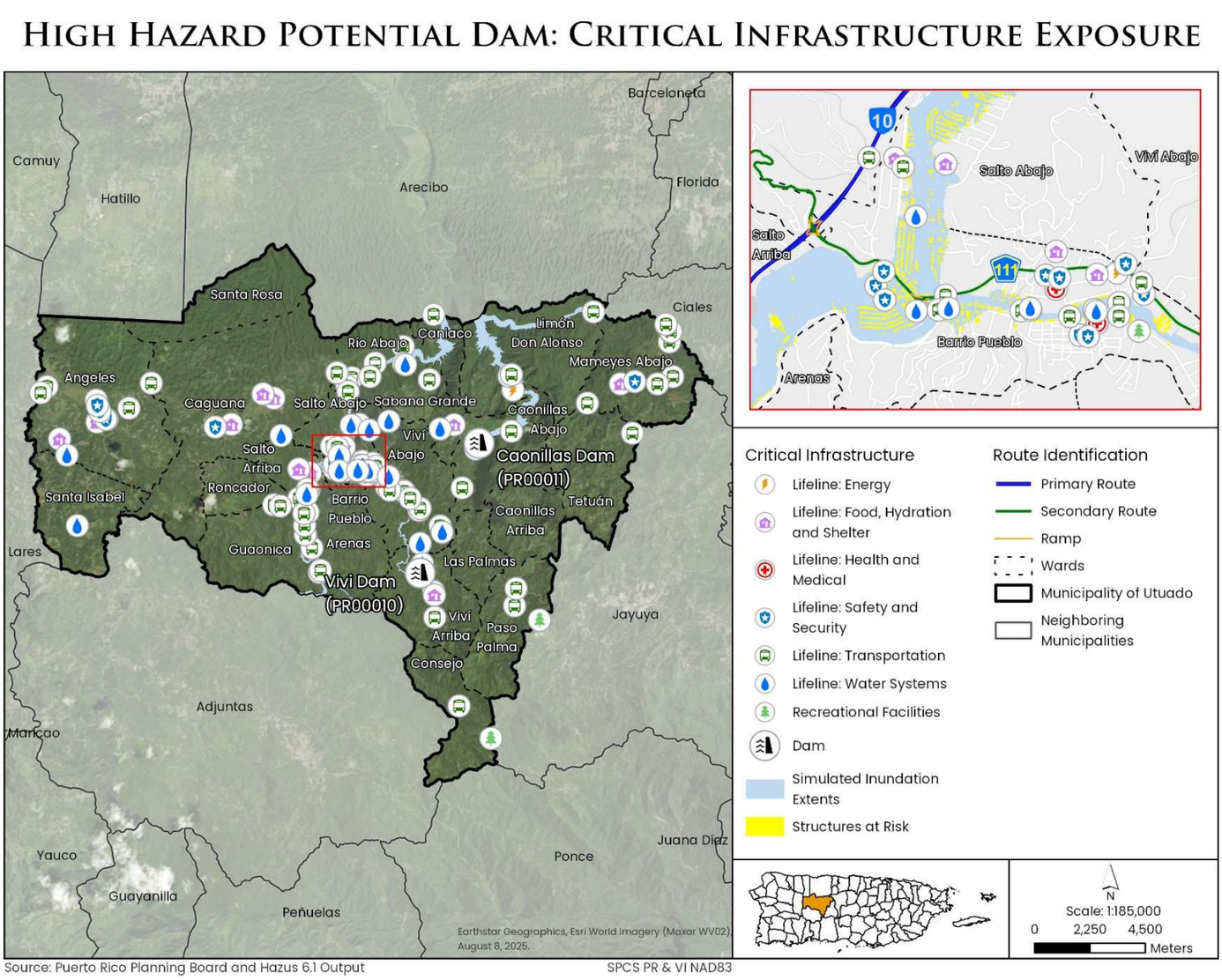
In the case of the 2017 modeling exercise, input data for the simulations was obtained from 2013 United States Geologic Survey (USGS) LIDAR for Puerto Rico, with a 10-meter cell spacing, and from the databases contained within DSS-WISE for dam sizes, bridge sizes, and terrain. There were occasional conflicts between these two sources of information. However, all were able to be successfully resolved to generate dam breach simulations. The most frequent conflict was differences in the top elevation of the dam from the LIDAR data versus the DSS-WISE reservoir elevation data. This was resolved by computing a hydrograph using the following spreadsheet from the U.S. Natural Resources Conservation Service (NRCS).

4.14.2.2 Estimated Losses (HHPD2-a)

The sunny day scenario ran in 2026 does not include an estimation of losses. It is recommended that this be done as a future project for this municipality.

4.14.2.3 Critical Infrastructure (HHPD2-a)

Map 40: High Hazard Potential Dam: Critical Infrastructure Exposure



According to map 40 the locations of critical infrastructure in relation to the simulated inundation extents associated with the Caonillas Dam (PR00011) and Viví Dam

(PR00010) in Utuado. Critical infrastructure assets displayed on the map include facilities associated with the Energy, Food, Hydration and Shelter, Health and Medical, Safety and Security, Transportation, and Water Systems lifelines, as well as recreational facilities.

The highest concentration of mapped critical infrastructure is located within and around Barrio Pueblo, where numerous facilities, transportation routes, and structures at risk are shown adjacent to the simulated inundation extent. Additional critical infrastructure assets are distributed throughout the municipality, particularly along the primary and secondary roadway network. The inset map provides a closer view of the central urban area, highlighting the proximity of multiple critical facilities and structures at risk to the mapped inundation extent.

4.14.2.4 Social Vulnerability

Social vulnerability strongly influences how communities experience flooding resulting from a dam breach, often determining who is most at risk of injury or loss of life. Research shows that low-income households, elderly populations, and people with disabilities are more likely to live in high-hazard areas and face greater challenges in receiving warnings and evacuating quickly (Cutter, Boruff, & Shirley, 2003). Language barriers and limited access to transportation further reduce the effectiveness of emergency communications during rapidly developing dam-break floods (Baker, Cohen, Coulson, Durden, & Rossman, n.d.). The Social Vulnerability Index (SoVI), developed by Cutter and colleagues, highlights how socioeconomic status, age, and housing conditions increase susceptibility to flood impacts (Cutter, Boruff, & Shirley, 2003). FEMA and USACE guidance emphasize that socially vulnerable populations often have less capacity to respond during the short warning times typical of dam-failure events. As a result, dam-breach risk is not only a hydraulic issue but also a significant social and equity concern (Cutter, Emrich, Morath, & Dunning, 2013).

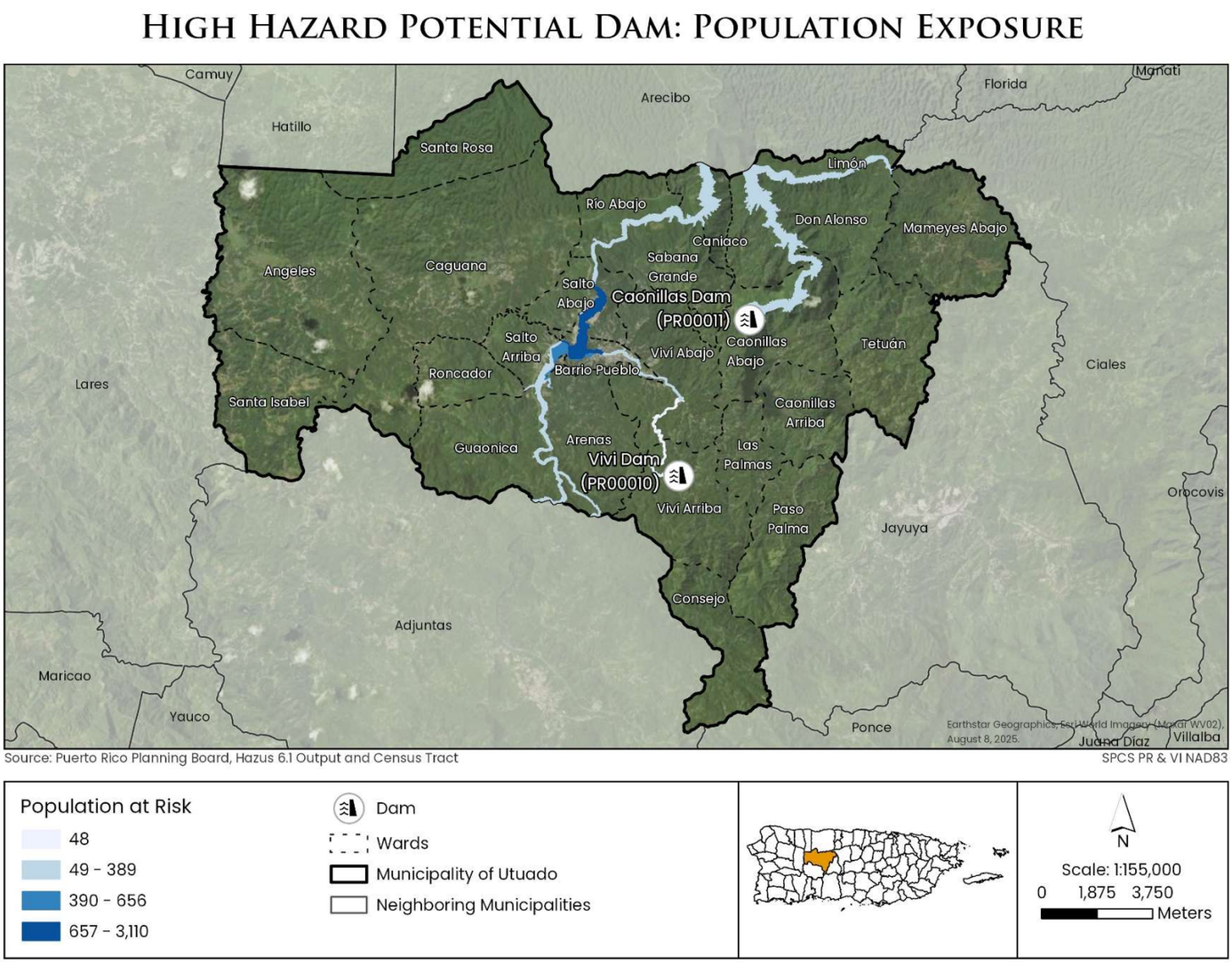
Following a dam-breach flood, socially vulnerable communities often experience disproportionate and prolonged recovery challenges. Studies show that low-income and rented households face greater difficulties accessing disaster assistance, replacing lost housing, and returning to normal economic activity. Disruptions to healthcare, education, and critical infrastructure tend to have lasting effects in communities that already lack robust social support systems. Academic research demonstrates that flood losses compound existing social inequalities by increasing poverty and reducing long-term resilience. USACE guidance stresses the importance of identifying and engaging socially vulnerable populations during dam safety planning to reduce inequitable outcomes. Incorporating social vulnerability into dam-breach risk assessments helps decision-makers design more effective emergency planning, mitigation, and recovery strategies (Aqilah, Karmilla, Tamanna, Ali, & Mat, 2024).

Map 41 displays population exposure within the simulated inundation extents associated with Caonillas Dam (PR00011) and Viví Dam (PR00010) in Utuado. Population at risk is categorized into four classes and shown along the mapped inundation corridors extending through the central, northeastern, and south-central portions of the municipality.

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The highest population exposure category is mapped in Barrio Pueblo, where the inundation extent overlaps an area classified within the 657-3,110 population range. Additional areas intersected by the inundation extent are mapped within lower population exposure categories, including portions of Salto Arriba, Salto Abajo, Sabana Grande, Viví Abajo, Arenas, and nearby wards. The map also identifies ward boundaries, dam locations, and neighboring municipalities.

Map 41: High Hazard Potential Dam: Population Exposure

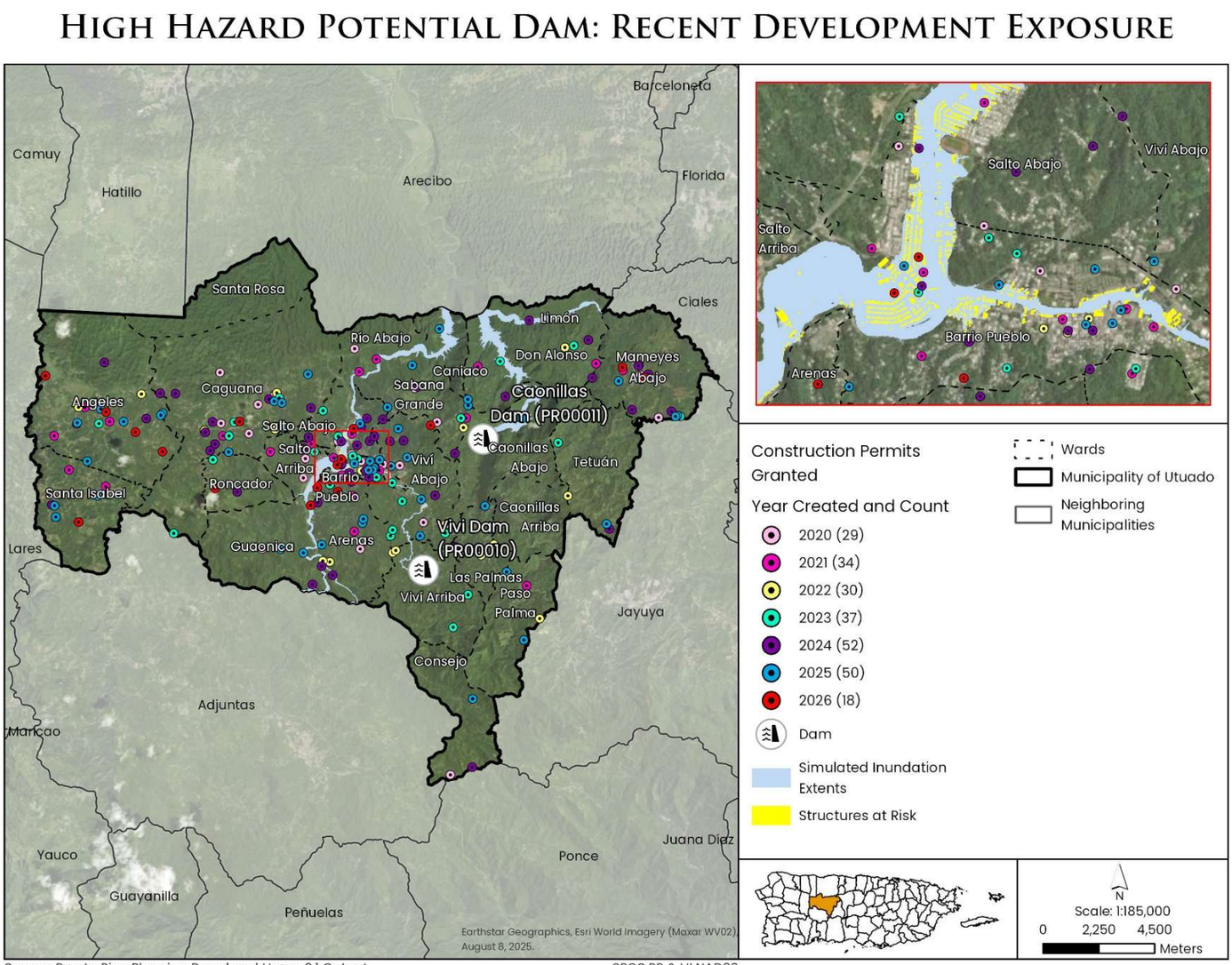


4.14.2.5 Future Conditions (E1-A)

The following map displays the locations of construction permits granted between 2020 and 2026 in relation to the simulated inundation extents associated with Caonillas Dam (PR00011) and Viví Dam (PR00010). Recent development permits are distributed throughout Utuado, with the highest concentration occurring in and around Barrio Pueblo, where numerous permits are located adjacent to and within areas identified as structures at risk.

Additional permitted developments are mapped across multiple wards throughout the municipality, including areas surrounding the two dams and along the inundation corridors. The inset map highlights the central urban area, showing a concentration of recent development permits near the mapped inundation extent and structures at risk.

Map 42: High Hazard Potential Dam: Recent Development Exposure



4.14.2.6 Special Considerations: Coordination with Local Dam Owners and State Dam Safety Agencies (HHPD1-a & HHPD1-b)

Effective interagency coordination is widely recognized as essential for preventing, mitigating, and managing dam breaks and levee breaches, because these events involve rapid onset, cascading impacts, and shared responsibilities across jurisdictions. Federal guidance emphasizes that dam and levee risks cannot be managed by a single entity and instead require collaboration among dam owners, state dam safety offices, emergency management agencies, hydrologic forecasting organizations, and local governments (FEMA, 2025) (USACE, n.d.). Best practices begin during preparedness, when agencies establish clear roles and responsibilities through Emergency Action Plans (EAPs), memoranda of understanding, and formal communication protocols (FEMA, 2013). Research has shown that jurisdictions with predefined coordination frameworks experience faster decision-making and fewer communication breakdowns during flood emergencies (Cutter, Emrich, Morath, & Dunning, 2013). Regular joint training, tabletop exercises, and scenario simulations help agencies build shared understanding and operational trust. These preparatory actions form the foundation for effective prevention, response, and recovery.

Prevention and mitigation activities benefit from coordinated, risk-informed planning across agencies. The USACE Dam Safety Program promotes the use of shared risk

assessment frameworks that integrate structural condition, hydrologic loading, and downstream consequences, with life safety identified as the highest priority (USACE, 2016; USACE, 2020). Academic literature indicates that using common analytical tools—such as inundation mapping and consequence analysis—improves transparency and consistency in prioritizing mitigation investments (Cutter et al., 2015). Coordination with land-use planners and transportation agencies reduces future exposure by discouraging development in high-hazard inundation zones (FEMA, Reducing Damage from Localized Flooding, 2025). Joint risk communication by technical and emergency management agencies improves public understanding and trust, particularly for low-probability, high-consequence events such as dam failures. When mitigation strategies are developed collaboratively, they are more likely to address both physical risk and social vulnerability.

During imminent failure threats or actual dam breaks and levee breaches, interagency coordination must transition rapidly to operational alignment. FEMA guidance identifies the Incident Command System (ICS) as the standard framework for managing multi-agency flood emergencies, enabling unified objectives, shared situational awareness, and coordinated resource deployment (FEMA, National Incident Management System, 2021). USACE dam safety guidance stresses the importance of timely information sharing between technical experts and emergency managers, particularly regarding breach development, flood arrival times, and risk to downstream populations (USACE, 2016). Studies of flood disasters consistently show that unclear command structures and fragmented communication are major contributors to increased loss of life during rapidly developing events (Cutter et al., 2017). Coordinated evacuation planning involving law enforcement, transportation, and public works agencies is critical to ensuring safe and timely movement of at-risk populations. Consistent public messaging across agencies further reduces confusion and increases compliance with emergency directives.

Recovery and long-term learning are equally important components of interagency coordination. FEMA and USACE both recommend structured after-action reviews following dam- or levee-related incidents to document lessons learned and update EAPs, mapping products, and communication procedures (FEMA, 2013); (USACE, 2020). Research indicates that coordinated recovery efforts accelerate infrastructure repair and reduce long-term social and economic impacts, particularly for socially vulnerable communities (Fox, Agyemang, Hawker, & Neal, 2024). Integrating post-event findings into training and planning supports adaptive risk management and continuous improvement. Transparency and interagency collaboration during recovery also help rebuild public trust. Ultimately, best practice treats dam and levee safety as a shared, continuous responsibility rather than a sequence of isolated agency actions.

The dam and reservoir infrastructure within the Municipality of Utuado includes the Caonillas and Viví facilities. These facilities are owned and/or operated by the Puerto Rico Electric Power Authority (PREPA) and are primarily associated with hydroelectric power generation. The ownership and operational responsibility of each facility are relevant to dam-safety inspections, maintenance, emergency action planning, warning procedures, and coordination with municipal, Puerto Rico, and federal emergency-management agencies.

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4.15 Hazard Prioritization

After receiving feedback from the public and stakeholders (see sections 2.6-2.7) along with their own expertise the planning committee has determined that the following is the prioritization for the hazard discussed in this LHMP.

Table 46: Hazard Prioritization

Hazard	Priority
Earthquake	Low Priority
Landslide	High Priority
Flooding	Mid Priority
Tropical Cyclones and Extreme Winds	High Priority
Extreme Heat	Low Priority
Drought	Mid Priority
Wildfire	Low Priority
Pandemics	Mid Priority
High Hazard Potential Dam	High Priority

4.16 Planning Mechanism

Understanding and recognizing regulatory and planning capacities enables more effective management of land use and economic growth. These capacities consist of the legal frameworks and public policy provisions that influence land use to guide sustainable development, while also supporting actions that mitigate the vulnerability of communities and their resources to natural hazards.

Besides the Public Policies already discussed in Section 1.1, what follows is a list in chronological order of the regulatory and planning mechanisms available to the municipality for the implementation of this LHMP.

4.15.1 Karst Special Planning Area Plan and Regulation (PRAPEC, by its Spanish Acronym) – 2014)

Figure 28: (PRAPEC, by its Spanish Acronym) Coversheet



In compliance with Act 292-1999, this plan and regulation establish two overlayed districts in the karst zones of Puerto Rico. The Restricted Karst Special Planning Area (APE-RC) overlayed district aims to protect the land within the Restricted Karst Area. According to Act 292-1999, lands under this district cannot be used for the extraction of materials from the earth's crust, except in cases where such activities had already been recognized by the competent authorities at the time of the adoption of PRAPEC. Additionally, the APE-RC imposes other restrictions, such as prohibitions on subdivision in certain underlying districts.

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On the other hand, the Special Planning Area for the Karst Zone (APE-ZC) overlayed district includes lands within the karst physiography that are not part of the APE-RC. Its purpose is to allow the extraction of materials from the earth's crust for commercial purposes under appropriate conditions, in areas of the karst zone that are not within the APE-RC, and to address lands that, although part of the karst physiography, are not included in the restricted area.

4.16.2 Joint Regulation for the Evaluation and Issuance of Permits Related to Development, Land Use, and Business Operations (2023)

Figure 29: Joint Regulation Cover



The Joint Regulation for the Evaluation and Issuance of Permits Related to Development, Land Use, and Business Operations (*Reglamento Conjunto* in Spanish) is a regulatory instrument created by the Planning Board in compliance with Law No. 161, as amended. Its main purpose is to regulate land use, territorial planning, and the granting of permits related to development, construction, and business operations within a uniform and centralized framework. The Joint Regulation aims to harmonize public policy on land use planning with the principles of sustainable development, seeking a balance between economic growth, environmental protection, and social well-being. This regulation establishes the rules to classify land, define zoning districts, regulate zoning, and determine the permitted uses in each category. Additionally, it sets the procedures to evaluate projects, issue permits, and monitor compliance with the applicable provisions. Its purpose is to provide a uniform regulatory framework for the evaluation and issuance of permits, ensure the proper use of land, protect natural resources, and facilitate economic development under criteria of competitiveness and sustainability, integrating planning with permit management.

Of particular importance in the Joint Regulation is the zoning district *Distrito de Riesgo para Espacios Abiertos*– Open Space (RE-A).[19] The RE-A zoning district is established to identify lands designated as open space in accordance with federal regulations (44 CFR Part 80) or another federal program, due to the presence of a risk condition resulting from a natural event. These spaces may include, but are not limited to, severe flooding and landslides. There are conditions in these areas that are unfavorable or harmful to health, safety, or general welfare, and there may be a risk of loss of life and property. Land within this district may be susceptible to one or more of the identified hazards.

The purpose of the district is to preserve the open space condition established in perpetuity by federal regulation, which the government or the community must uphold, with the objective of protecting health, life, and property; preventing severe losses and repetitive use of affected properties; reducing the investment of public and federal funds in mitigation; and limiting rescue efforts, among other goals.

4.16.3 Special Flood Hazards Areas Regulation (2021)

The 2021 regulation was adopted by the Puerto Rico Planning Board under its authority

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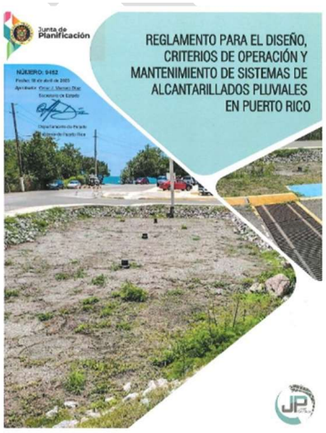
from Public Law No. 75 of 1975 and Public Law No. 3 of 1961 to control development in flood-prone zones. It aligns Puerto Rico's floodplain management requirements with the minimum standards of the National Flood Insurance Program (NFIP), administered by FEMA. The regulation establishes updated criteria for construction, land use, and development within Special Flood Hazard Areas (SFHAs), including requirements such as elevating structures above Base Flood Elevation and submitting technical certifications. It applies to new construction, substantial improvements, and land-use changes across designated flood zones such as AE and VE, using FEMA Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FIS) for zone identification. The revision clarifies and expands regulatory provisions to enhance public safety and prevent harmful development in high-risk areas.

4.16.4 Puerto Rico Building Code

The Puerto Rico Building Code sets minimum requirements for the design, construction, modification, and upkeep of buildings to ensure the safety, health, and well-being of the public. It is derived from nationally and internationally recognized model codes and is updated periodically to incorporate improvements in construction practices and lessons learned from past hazard events. The code includes provisions addressing structural safety, fire protection, accessibility, energy conservation, and resistance to natural hazards such as earthquakes, hurricanes, floods, and strong winds. Adherence to the Building Code is mandatory for all new construction and substantial renovations throughout Puerto Rico. Enforcement is carried out through local permitting, planning review, and inspection processes to verify compliance with established standards. Overall, the Puerto Rico Building Code is a key instrument for advancing resilient, safe, and sustainable development across the island.

4.16.5 Regulation for the Design, Operation Criteria and Maintenance of Stormwater Systems in Puerto Rico

Figure 30: Regulation 40 Cover Page



Adopted in 2023 as Planning Regulation No. 40, this regulation updates and replaces the island's outdated 1975 standards to address current engineering practices, environmental considerations, and increased flood risk. The regulation is designed to provide developers, engineers, contractors, and municipalities with modern technical criteria for designing, operating, and maintaining public and private stormwater systems, incorporating updated scientific knowledge and methodologies necessary for managing stormwater infrastructure under present-day conditions. Its objectives include minimizing flood-related damage, improving the capture and management of runoff, reducing impacts to water resources and ecosystems, and supporting safer, more resilient community development. The regulation integrates risk management principles and aligns with Puerto Rico's climate adaptation policies, requiring consideration of urban flooding, karst hydrology, low-impact development practices, and stormwater control structures such as retention and detention systems. It also establishes minimum design considerations for all land development projects and provides a comprehensive framework for planning, monitoring, and maintaining stormwater systems across the island.

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4.16.6 Utuado Land Use Plan (2023)

Figure 31: Utuado Land Use Cover Page



Pursuant to the Puerto Rico Municipal Code and the territorial planning framework established by the Puerto Rico Planning Board (JP), the Municipality of Utuado adopted its Territorial Plan in 2023 and is currently undertaking a partial review of the Plan. The Territorial Plan serves as the municipality's comprehensive and strategic land-use planning mechanism, establishing the classifications, policies, programs, and actions that guide the orderly development and management of the entire municipal territory. The Plan also provides a framework for coordinating future development with infrastructure capacity, environmental protection, and hazard mitigation considerations.

4.16.7 Utuado Emergency Operation Plan

This Emergency Operation Plan (EOP) describes how emergency operations are structured through the Incident Command System, enabling unified command and efficient allocation of resources. It details the activation levels of the Municipal Emergency Operations Center, which escalates from routine monitoring to full 24/7 multi-agency disaster response. The municipality highlights the importance of interagency collaboration, including coordination with state and federal agencies when local capabilities are exceeded. Community involvement, public information, and support for vulnerable populations—such as individuals with disabilities, children, and the elderly—are essential components woven into all phases of emergency management. Additionally, the plan incorporates long-term recovery strategies, emphasizing damage assessments, restoration of critical services, and alignment with federal assistance processes. Ultimately, it presents a structured, community-centered approach to ensure Utuado can respond to, withstand, and recover from a wide range of emergencies.

4.16.8 National Flood Insurance Program

The National Flood Insurance Program falls within the category of planning mechanisms, as it imposes certain floodplain management requirements. FEMA provides flood insurance to communities that are following the NFIP criteria. This includes adopting and enforcing floodplain management practices that promote appropriate development in these flood-prone areas.

The National Flood Insurance Program of the Federal Emergency Management Agency allows homeowners, business owners, and renters in participating NFIP communities to purchase federally backed flood insurance. This insurance helps cover the costs of repairing damage caused by flooding to buildings and their contents. This is an insurance program established to help property owners, renters, and businesses recover more easily and at a lower cost. Likewise, the program aims to reduce the impact of flooding on both public and private structures. These efforts help mitigate the effects of flooding on new and improved structures within each community.

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The NFIP has several components, including:

- Floodplain management — for which the community must adopt and enforce measures for managing flood-prone lands in accordance with NFIP regulations;
- The preparation of Flood Insurance Rate Maps (FIRMs); and
- Flood insurance.

The Municipality of Utuado has a collection of FIRM maps that can be consulted to determine whether your property is in a high-risk area or in a low- to moderate-risk zone. FIRMs refer to the official map developed and approved by FEMA and adopted by the Puerto Rico Planning Board to designate areas at risk of a 100-year flood (or a 1% annual chance of occurrence). In addition, these maps serve as a tool for managing special areas due to their susceptibility to flooding events.

While the Write Your Own Program (WYO) began in 1983 as a partnership between insurance companies and FEMA. This arrangement allows property and casualty insurance companies to underwrite and service federal flood insurance policies in their own company name. A key feature of this type of policy is that all companies participating in the WYO program provide the same coverage, and their rates must comply with NFIP rules and regulations.

Communities, for their part, adopt and require compliance with the NFIP's minimum standards for construction and development in designated Special Flood Hazard Areas. However, many communities seek to achieve a higher level of safety and protection for their residents beyond the NFIP minimum standards. For this purpose, communities have the option of participating in the NFIP's Community Rating System (CRS), which allows them to obtain reductions in flood insurance premiums.

This is because the CRS recognizes additional community efforts to: 1) Reduce flood damage to insurable property; 2) strengthen and support NFIP insurance provisions; and 3) encourage a comprehensive approach to floodplain management. These additional efforts provide residents with greater safety, reduce property damage, enhance community resilience, and promote a better quality of life. The municipality's participation in the NFIP will be discussed in Section 6.5.

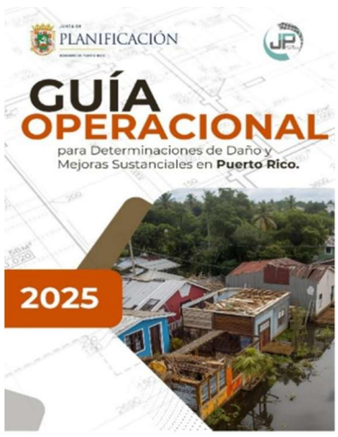
4.16.9 National Pollutant Discharge Elimination System (NPDES)

The NPDES is a program authorized under the United States Clean Water Act and administered by the Environmental Protection Agency (EPA). This program requires Municipal Separate Storm Sewer Systems (MS4s) to obtain a permit for the discharge of stormwater into water bodies. In the case of Puerto Rico, the EPA issued a general permit in 2016, under which municipalities can obtain coverage by submitting a Notice of Intent (NOI) and adopting a Stormwater Management Program (SWMP). If any of the mitigation measures listed in Section 6.5 modify the NOI or the SWMP, they will be properly amended.

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4.16.10 Operational Guidelines for Determining Damages and Substantial Improvements in Puerto Rico (2025)

Figure 32: Operational Guides



The Floodplain Administrator or the Participating Community may review, require, and audit permits in accordance with the provisions of Act No. 3 of September 27, 1961, known as the "Floodplain Building Control Act"; Act No. 75, the "Puerto Rico Planning Board Organic Act"; Act No. 161 of December 1, 2009, as amended, the "Puerto Rico Permit Process Reform Act"; and Act No. 38 of June 30, 2017, the "Uniform Administrative Procedure Act of the Government," as amended, and in compliance with the regulations of the National Flood Insurance Program (NFIP) of the Federal Emergency Management Agency (FEMA), Title 44 of the Code of Federal Regulations (CFR), Part 60.3 [d, e, and Subpart B], and its related sections.

As of the effective date of this guidance, an evaluation of substantial damage or substantial improvement will be required as part of the permitting requirements in Special Flood Hazard Areas. The Floodplain Administrator will require that both new structures and substantial improvements be constructed in a manner that minimizes or prevents damage during a regulatory flood.

4.16.11 Green Infrastructure and Nature Based Solutions

Section 502 of the United States Clean Water Act defines green infrastructure as the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvesting and reuse, or landscaping to store, infiltrate, or evapotranspiration stormwater and reduce flows to sewer systems or surface waters.

Green infrastructure is a cost-effective and resilient approach to managing wet weather impacts that provide many benefits to the community. While conventional single-purpose gray stormwater infrastructure (such as pipe drainage and water treatment systems) is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while providing environmental, social, and economic benefits.

Stormwater runoff is a major cause of water pollution in urban areas. When it rains on rooftops, streets, and parking lots in cities and suburbs, the water cannot soak into the ground as naturally would. Instead, stormwater drains through gutters, storm sewers, and other collection systems and is discharged into nearby water bodies. This runoff carries trash, bacteria, heavy metals, and other pollutants from the urban landscape. Higher flows resulting from heavy rainfall can also cause erosion and flooding in urban streams, damaging the environment, property, and infrastructure.

When rain falls in undeveloped natural areas, the water is absorbed and filtered by soil and vegetation. Stormwater runoff is cleaner and less problematic. Green infrastructure uses vegetation, soil, and other elements and practices to restore some of the natural processes needed to manage water and create healthier urban

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environments. At the municipal scale, green infrastructure is a network of natural areas that provide habitat, flood protection, cleaner air, and cleaner water. At the neighborhood, development, or sector scale, managing stormwater systems in a way that mimics natural processes help absorb and store runoff that can otherwise cause localized flooding (EPA, 2019).

Some green infrastructure measures that may be considered to mitigate flooding problems include:

- Rainwater harvesting
- Rain gardens (bio-retention/bio-infiltration)
- Urban rain gardens ("planter boxes")
- Bioswales
- Porous pavements
- Green streets
- Green parking lots
- Green roofs
- Land conservation
- Creation or maintenance of urban tree canopy
- Wetland restoration
- Riparian area rehabilitation
- Sand dune restoration, among others.

The Municipality will consider green infrastructures measures when developing or championing flood control measures with the state or the federal government. In addition to flood control, green infrastructure provides benefits such as improved water quality, enhanced water supply, reduced stormwater management costs (public and private), improved habitat quality, increased spaces for recreation and physical activity, job creation in the maintenance of natural areas, and increased property values (EPA, 2019).

4.16.12 Four – Year Investment Program

The Puerto Rico Four-Year Investment Program (*Programa de Inversiones de Cuatro Años*, or PICA by its Spanish acronym) is prepared by the Puerto Rico Planning Board pursuant to Act No. 75 of June 24, 1975, as amended. The current PICA covers fiscal years 2025–2026 through 2028–2029 and was adopted by the Puerto Rico Planning Board on August 20, 2025, following public hearings, and subsequently approved through Executive Order OE-2026-004. The program establishes the Government of Puerto Rico's priorities for capital improvements and coordinates proposed public investments in infrastructure, transportation, communications, education, housing, public safety, essential services, and other programmatic areas. The Municipality of Utuado may use the PICA to identify planned government investments that support hazard mitigation, infrastructure resilience, continuity of essential services, and implementation of mitigation actions identified in this LHMP.

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5. Municipal Capacities

5.1 Regulatory and Planning Mechanism (C1-a)

These capabilities refer to the legal provisions that influence land used to manage economic growth and that could support the municipality in its efforts to mitigate the vulnerability of its communities and resources to natural hazards. The municipality identified existing regulations and planning documents that could support its actions, as well as opportunities to promote the development of studies or plans for the same purpose of advancing its mitigation goals. These regulatory and planning tools are described in Section 4.16.

5.2 Technical and Administrative Capacities (C1-a)

The Municipality of Utuado possesses the administrative capacity necessary to implement this LHMP, supplemented by contract services and external technical resources when specialized expertise is required. Copy of this organigram can be found as part of Appendix E.

Table 47 shows the Municipality's Technical and Administrative Capacity

Table 47: Municipal Technical and Administrative Human Resources

Personnel Team / Resources	Yes	No	Future Positions	Department or Agency	Opportunities to Integrate into LHMP	Comments
Planners with experience in land use and mitigation		X	Through contract services if needed	N/A	N/A	
Engineers or professionals trained in construction practices related to buildings and infrastructure		X	Through contract services if needed	N/A	N/A	
Planners or engineers with a broad understanding of natural hazards		X	Through contract services if needed	N/A	N/A	
Emergency Manager	X		Director of the Municipal Emergency Management Office	Municipal Emergency Management Office, Department of Public Safety	The LHMP may be used to update the EOP	None
Scientists familiar with natural hazards		X	Through contract services if needed	University of Puerto Rico, Puerto Rico Seismic Network, other		

Personnel Team / Resources	Yes	No	Future Positions	Department or Agency	Opportunities to Integrate into LHMP	Comments
				universities in Puerto Rico		
Personnel with expertise or education regarding the vulnerabilities and natural hazards affecting the community	X		Community Representative	N/A	N/A	
Resource development staff or grant writers	X		Director of Municipal Federal Programs	Municipal Federal Programs Office	This staff may write and administer grants to cover the mitigation strategies mentioned below.	N/A

5.3 Financial Capacity (C1-b)

The Municipality has experience administering federal funds from various streams and maintains a dedicated office responsible for the administration and oversight of federally funded programs.

5.3.1 FEMA Funding Streams

For hazard mitigation projects the municipality has identified the following FEMA – administered possible funding streams which it could draw from.

Stafford Act - Section 404

Section 404 refers to Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, which authorizes the Hazard Mitigation Grant Program (HMGP), administered by FEMA. Its primary purpose is to reduce future disaster losses by funding long-term mitigation projects after a major disaster is declared.
Under Section 404, funding is made available to states, territories, tribes, and local governments to implement mitigation measures that lessen the impacts of future hazards such as floods, earthquakes, hurricanes, wildfires, and droughts. Unlike Section 406, Section 404 projects do not have to be tied to facilities that were damaged by the declared disaster. This allows communities to take a proactive approach by investing in mitigation actions that address known risks before damage occurs.

Eligible projects under Section 404 may include activities such as elevation or acquisition of flood-prone structures, drainage improvements, seismic retrofits, safe rooms, wildfire mitigation measures, and hazard mitigation planning. Projects must be cost-effective, technically feasible, and consistent with an approved Hazard Mitigation

Plan. The program typically provides up to 75 percent federal funding, with the remaining share provided by non-federal sources.

Under Section 404 is also the Hazard Mitigation Grant Program (HMGP) that can support plan development, data collection, risk assessments, and engagement activities required to maintain FEMA approval following a presidential disaster declaration.

Stafford Act – Section 406

Section 406 of the Stafford Act supports mitigation projects by allowing hazard-mitigation measures to be incorporated directly into the repair or replacement of public facilities damaged during a declared disaster. This provision enables communities to strengthen damaged infrastructure against future hazards, such as elevating flood-damaged buildings, reinforcing structures to withstand high winds, or improving drainage systems during repairs. Mitigation measures funded under Section 406 must be cost-effective and directly related to the damaged facility. By integrating mitigation into recovery activities, Section 406 helps reduce the likelihood of repetitive damage and future repair costs. Overall, it ensures that rebuilding efforts contribute to long-term resilience rather than simply restoring pre-disaster conditions.

Stafford Act - Section 428

Section 428 of the Stafford Act can support mitigation projects by allowing communities to integrate hazard-resilient and risk-reduction measures directly into disaster recovery projects funded through FEMA's Public Assistance Program. Through its alternative procedures, Section 428 enables flexible project design, fixed-cost funding, and consolidation of damaged facilities, making it easier to incorporate mitigation improvements such as relocation, elevation, floodproofing, or structural hardening. Applicants may also reinvest cost savings from efficiently managed projects into additional mitigation features, if project objectives are met. By emphasizing outcomes rather than strict cost reimbursement, Section 428 encourages rebuilding that reduces future risk rather than simply restoring pre-disaster conditions. This approach allows mitigation to become an integral part of recovery, strengthening resilience and reducing the likelihood of repetitive losses.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) Program reduces flood hazards by providing funding to help communities identify and implement measures that lessen long-term flood risk to National Flood Insurance Program (NFIP) insured properties. The program focuses on projects such as elevating, acquiring, relocating, or floodproofing flood-prone structures, with priority given to repetitive loss and severe repetitive loss properties. By mitigating flood damage before disasters occur, FMA helps protect lives and property, reduces future flood insurance claims, and lowers the overall cost of disaster assistance. The program encourages proactive risk reduction by aligning mitigation investments with floodplain management and local hazard mitigation planning.

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Stafford Act – Section 203 (BRIC)

The Building Resilient Infrastructure and Communities (BRIC) program supports mitigation projects by providing pre-disaster funding to help communities reduce risks from natural hazards before disasters occur. Administered by FEMA, BRIC focuses on long-term, cost-effective investments that enhance the resilience of critical infrastructure, lifelines, and communities. The program funds activities such as infrastructure retrofits, flood control projects, seismic upgrades, and nature-based solutions, as well as hazard mitigation planning and capacity building. BRIC emphasizes innovative, large-scale projects that address multiple hazards and provide measurable community benefits. By investing in mitigation prior to disasters, the BRIC program helps protect lives and property, reduce future disaster costs, and support more resilient and sustainable development.

5.3.2 Non-FEMA Federal Funding Streams

Non-FEMA federal Funding Streams can include:[20]

CDBG-DR

The Department of Housing and Urban Development's Community Development Block Grant–Disaster Recovery (CDBG-DR) program can fund hazard mitigation planning and projects by supporting activities that reduce long-term disaster risk and address unmet recovery needs following a major disaster. CDBG-DR funds may be used to develop or update hazard mitigation plans, conduct risk assessments, and support resilience and mitigation planning efforts that guide future investments. In addition, the program can finance mitigation projects such as drainage improvements, flood control infrastructure, elevation or acquisition of flood-prone properties, utility hardening, and other measures that reduce vulnerability to natural hazards. Unlike some recovery programs, CDBG-DR allows communities to target mitigation actions even if facilities were not damaged in the most recent disaster, if the activities address identified risks.

CDBG-MIT

The Department of Housing and Urban Development's Community Development Block Grant–Mitigation (CDBG-MIT) program supports hazard mitigation planning and projects by providing federal funding specifically dedicated to reducing future disaster risks in communities that have experienced major disasters. CDBG-MIT funds can be used for mitigation planning activities such as risk assessments, data analysis, and development of strategies that guide long-term resilience investments. The program also finances a wide range of mitigation projects, including flood risk reduction, stormwater management, wildfire mitigation, resilient infrastructure upgrades, and nature-based solutions. CDBG-MIT emphasizes addressing identified vulnerabilities and repetitive loss areas, even if they were not directly damaged in a recent disaster. By focusing on forward-looking risk reduction, the program helps communities proactively adapt to climate impacts and future hazards. Overall, CDBG-MIT integrates mitigation into long-term recovery and development efforts, strengthening community resilience and reducing future disaster losses.

[20] Please note that the following list is not intended to be exhaustive.

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It should be noted that CDBG-DR and CDBG-MIT differ primarily in their purpose and how they support hazard mitigation planning and projects. CDBG-DR focuses on post-disaster recovery, with mitigation activities integrated into rebuilding efforts to address unmet needs and reduce future risk as communities recover. Under CDBG-DR, mitigation planning and projects must be closely tied to disaster recovery goals and justified by disaster impacts or recovery assessments. In contrast, CDBG-MIT is specifically dedicated to hazard mitigation and long-term risk reduction, allowing communities to fund mitigation planning and projects even if areas or facilities were not damaged in the most recent disaster.

Resilience and Emergency Relief Programs

The Federal Highway Administration (FHWA) Resilience and Emergency Relief Programs support Hazard Mitigation Plans by promoting the identification and reduction of risks to transportation infrastructure from natural hazards. Through the Emergency Relief Program, FHWA allows mitigation and resilience measures—such as improved drainage, roadway elevation, and bridge reinforcement—to be incorporated into post-disaster repairs. FHWA resilience initiatives also encourage vulnerability assessments and risk-based planning that align with the risk assessment and mitigation strategy components of FEMA-approved HMPs. By integrating hazard mitigation and climate resilience into transportation planning, these programs help ensure that roads and bridges are addressed as critical lifelines. Overall, FHWA programs complement Hazard Mitigation Plans by supporting transportation-focused mitigation actions that reduce future disruption and repair costs.

National Resources Conservation Service

The Environmental Quality Incentives Program (EQIP) and the Watershed and Flood Prevention Operations (WFPO) program support hazard mitigation projects by addressing risks at the landscape and watershed scale through conservation and infrastructure improvements. EQIP, administered by the USDA Natural Resources Conservation Service (NRCS), provides financial and technical assistance to landowners to implement conservation practices that reduce erosion, manage runoff, improve soil health, and mitigate risks from flooding, drought, and wildfires. These practices—such as vegetation management, streambank stabilization, and water retention—help lessen downstream flood impacts and enhance resilience to climate variability. The Watershed and Flood Prevention Operations program support larger-scale mitigation through structural and non-structural measures, including small dams, floodwater retarding structures, channel improvements, and watershed planning. Together, these programs reduce hazard exposure upstream, protect communities and infrastructure downstream, and integrating natural resource management into long-term flood and drought mitigation strategies.

5.3.3 Local Funds

Utuado, like other municipalities in Puerto Rico, receives revenue from the Municipal Revenue Collection Center (MRCC). Other funding sources include revenue from the Sales and Use Tax (IVU, by its Spanish acronym), legislative funds that might be assigned from time to time and other sources. Depending on the state of municipal finances, the municipality might determine that there are some funds that can be used to pay for or cover local funds match for mitigation projects.

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However, most major capital improvement projects depend on federal funds transfers. The use of federal funds varies widely from year to year. In some cases, these funds are used to cover costs associated with the creation and monitoring of specific programs (for example, Section 8 or housing programs). In other cases, the funds are used to finance major capital improvement projects.

5.4 Outreach and Communications (C1-a)

Building robust outreach and communication capacity is essential to the successful implementation of a Hazard Mitigation Plan, as effective risk communication enables residents to recognize their risks, actively participate in planning processes, and make informed decisions to reduce potential impacts. FEMA guidance underscores the importance of early and thoughtfully designed engagement strategies to ensure that key stakeholders exchange information at the right time, promoting shared awareness of hazards and broad support for mitigation actions. Communication is a fundamental preparedness capability because it provides timely, practical information that helps individuals and communities act to limit harm. Research further demonstrates that outreach efforts are most successful when messages are clearly defined, customized for specific audiences, and conveyed through trusted sources. Communities that prioritize outreach—by collaborating with local leaders, leveraging a variety of communication channels, and tailoring messages to different population groups—tend to achieve higher public involvement and more effectively incorporate community feedback into hazard mitigation planning. These practices ultimately contribute to more effective plans and more resilient communities (FEMA, 2025).

The Municipality demonstrates adequate capacity to conduct effective outreach and communication activities. The Office of the Mayor is responsible for coordinating these efforts, and an organizational chart for this office is provided in Appendix E. The Municipality utilizes both social media platforms for real-time communication and traditional methods to disseminate information to the public. In addition, the Planning Office administers the Community Board responsible for land-use decisions, which is largely composed of municipal residents. This board serves as an important forum for public engagement and provides an opportunity to further expand and strengthen the Municipality's outreach and communication capacity.

Table 48 details the communication tools available to the municipality.

Table 48: Outreach and Communications Tools

Tool or resource	Present or not present	Description	Agency in Charge	Comments
Municipal social media	X	Facebook Page	Municipality	N/A
Planning Board Print Material	X	Print Material regarding hazard mitigation, focused on flood hazard	Planning Board	N/A
Community Meetings	X	Community Outreach Meeting to reach people that do not have access to social media		N/A

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5.5 Capacity Development (C1-b)

Strengthening institutional and technical capacity is vital to the successful implementation of a Hazard Mitigation Plan, as communities must have the expertise, resources, and organizational frameworks needed to move from planning to sustained risk-reduction actions. FEMA guidance stresses that effective mitigation planning relies on well-coordinated teams, access to reliable technical data, and the ability to collaborate across agencies and stakeholders—all of which directly affect the execution of mitigation strategies. National evaluations have shown that local and state governments often face challenges in implementing mitigation projects not due to a lack of commitment, but because of limited technical assistance, constrained administrative capacity, and insufficient engagement with federal support programs. Studies focused on low-capacity communities further demonstrate that gaps in technical knowledge, training, and leadership involvement can significantly hinder mitigation outcomes. These findings highlight the importance of strengthening workforce skills, enhancing guidance and tools, and reinforcing institutional support to achieve long-term resilience.

The Municipality continues to enhance its mitigation capacity by retaining qualified professionals as staff or contractors as needs arise. It also actively participates in training and continuing education opportunities offered through Commonwealth agencies and academic institutions to build and maintain the technical and institutional expertise necessary to support hazard mitigation efforts.

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6. Mitigation Action Plan

The goals, objectives, and mitigation actions outlined in this Plan are based on discussions held by the designated Mitigation Plan Committee, as well as the public-participation activities conducted to date.

6.1 Mitigation Goals (C3-a)

6.1.1 Municipal Goals and Objectives

The Municipality of Utuado adopts the following goals as part of their mitigation efforts:

- Protect life and property by strengthening municipal and state infrastructure to minimize damage to structures and reduce the loss of life among residents.
- Increase public awareness and preparedness through improved education, outreach, civic responsibility, and community participation in natural hazard mitigation activities.
- Improve disaster preparedness, response, and recovery capabilities by enhancing emergency management operations, coordination, and continuity of essential services.
- Protect the environment and natural resources through land use planning and resource management practices that discourage development in hazard-prone areas, reduce repetitive losses, and support sustainable community resilience.
- Promote mitigation efforts through existing programs and partnerships by strengthening coordination and collaboration among municipal, state, federal, private-sector, and community stakeholders.

6.1.2 National Mitigation Investment Strategy

The Municipality also adopts the National Mitigation Investment Strategy and the following goals.

- **Goal 1**: Show How Mitigation Investments Reduce Risk - The whole community will build a shared understanding of mitigation investment and its value. Specifically, the whole community will understand how effective mitigation investments can protect people, homes, neighborhoods, cultural and historic resources, ecosystems and lifelines (for example, communications, energy, transportation and water). The federal government and its non-federal partners will create a shared vocabulary and common measures to communicate information about risk and find opportunities to educate, hire, train and develop a base of qualified mitigation professionals.

- **Goal 2**: Coordinate Mitigation Investments to Reduce Risk - The whole community will coordinate mitigation investments through shared risk information, reinforced strategies for risk reduction, and easier access to existing funding. Such coordination will help the whole community justify mitigation investments and choose the most cost-effective and reasonable actions.

- **Goal 3**: Make Mitigation Investment Standard Practice. The whole community

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will factor mitigation into investment decisions, especially for buildings and infrastructure. The federal government and its non-federal partners will use and expand financial products and approaches for mitigation investment, including funding, incentives and financial risk transfer opportunities. The federal government and its non-federal partners also will make mitigation standard professional practice critical to safeguarding lifelines, services, and national safety and security.

6.2 Mitigation Strategy Selection Criteria

The following methodologies were used to select the mitigation actions:

- The Planning Committee reviewed mitigation actions from the previous Mitigation Plan.

- The Committee evaluated those actions and determined which ones were appropriate to include in the current Plan. Actions were excluded if:
    - The measure had already been implemented during the previous plan's period and was not a recurring or ongoing action.
    - The measure was no longer necessary or useful based on new information. This applies to mitigation actions linked to identified hazards, risks, and vulnerabilities.

- The Committee considered the Letters of Intent (LOIs) submitted by the municipality to COR3 in 2019 to participate in the Hazard Mitigation Grant Program. These projects were incorporated into the current Plan, ensuring no duplication of projects included in the previous Plan.

- Committee members evaluated and added new measures. These new actions were proposed based on the Committee members' professional experience and suggestions received from community members.

The mitigation strategies of the Municipality of Utuado were evaluated by the Committee using the STAPLEE tool. This tool provides the selection criteria used to assess the projects included in the preceding section. The technique applies to seven evaluation criteria:

- S – Social: The proposed action must be socially acceptable.
- T – Technical: The proposed action must be technically feasible.
- A – Administrative: The community must have the capacity to implement the action (for example, determining whether the responsible agency can supervise the mitigation project).
- P – Political: Mitigation actions must be politically acceptable.
- L – Legal: The community must have the authority to implement the proposed action.
- E – Economic: Economic considerations must include the current economic base, projected growth, and opportunity costs.
- E – Environmental: The environmental impact must be considered, given statutory requirements and the public's interest in maintaining sustainable and environmentally healthy communities.

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6.3 Mitigation Strategy Categorization

The 2025 Local Hazard Mitigation Planning Handbook established the following categorization:

Local Planning and Regulations (LP)- These activities aim to keep hazards from creating or worsening problems. These actions are typically carried out through government programs or regulatory measures that guide land-use development and building practices. Prevention is especially effective for reducing future vulnerability in areas that have not yet been developed. Examples include:

- Planning and zoning
- Building codes
- Open-space preservation
- Floodplain regulations
- Stormwater management regulations
- Maintenance of drainage systems
- Capital improvement programming
- Riverbank realignment
- Projects addressing fault zones

Structure and Infrastructure Projects – These actions involve modifying existing structures and infrastructures to protect them from a hazard or remove them from a hazard area. This could also apply to public or private structures as well as critical facilities and infrastructure. Since these are the bulk of the strategies presented in this LHMP, the municipality has made the decision to subdivide these types of projects into two subcategories:

- **Property Protection (PP)** – measures involve modifying existing buildings and structures so they can withstand natural hazards, or removing structures located in high-risk areas. Examples include:
  - Acquisition of properties
  - Relocation
  - Elevating structures
  - Protection of critical facilities
  - Structural retrofits (wind protection, floodproofing, seismic techniques)
  - Safe rooms, shutters, impact-resistant windows
  - Insurance policies

- **Structural Improvements (SI)** – Projects aim to reduce the impact of disasters by controlling or altering the natural flow of hazard events through engineered construction. These projects are usually designed by engineers and maintained by public works teams. Examples include:
  - Reservoirs
  - Dams, levees, and retaining walls
  - Diversion, detention, and retention systems
  - Channel modifications
  - Stormwater drainage systems

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- Installation of storm drains and related infrastructure

Natural Resource Protection (NR) – activities reduce the impact of natural disasters by preserving or restoring natural areas that offer protective benefits. These areas include flood plains, wetlands, steep slopes, and sand dunes. Parks, recreational agencies, and conservation organizations commonly implement measures such as:

- Flood protection
- Watershed management
- Riparian buffers
- Forest and vegetation management (including wildfire and fuel-load control)
- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization

Emergency Services (ES) - Although not typically classified as mitigation, emergency management measures reduce the human and property impacts of natural hazards. These actions occur immediately before, during, or after a disaster. Examples include:

- Warning systems
- Evacuation management and planning
- Emergency response drills and training
- Flood-fighting measures
- Installation of shutters

Education and Awareness Programs (EA) - Efforts to help inform residents, elected officials, business owners, homebuyers, and visitors about hazard-prone areas and mitigation techniques they can use to protect themselves and their property. Examples include:

- Outreach projects
- Demonstration events and guest presentations
- Hazard information materials
- Property-specific risk information
- Library materials
- Educational programs for children
- Exposure to risk-related information

Although these are not considered hazard mitigation actions, the municipality deems it necessary to also document projects related to emergency services in this LHMP. In this sense, the interaction between the LHMP and the annually updated EOP is streamlined and cross-referenced.

6.4 Mitigation Strategies (C4-a, C4-b, C5-a, C5-b, E2.b)

To improve tracking and updating each mitigation strategy has been giving a unique id. The following figure shows the meaning of the nomenclature.

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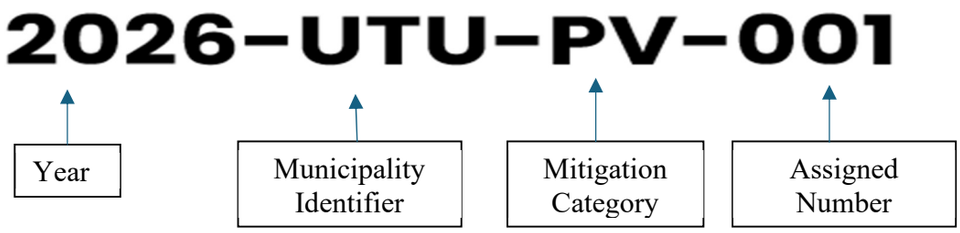


Figure 33: Unique Id Nomenclature

Each identified mitigation strategy shall include:

- New 2026 Mitigation ID
- Old 2020 ID if applicable
- Description
- Mitigated hazard(s): If a mitigation action is applicable to all hazards, it will be identified by the word "all"
- Priority of the strategy according to the planning committee
- Assigned FEMA Lifelines
- Municipal Office in charge of execution
- Possible funding sources
- Implementation Horizon: For this LHMP horizon time frames are as follows:
    - Immediate: Any action that will be executed in a period of one year or less.
    - Short – Term: Any action that will be executed in a period of two to three years.
    - Mid – Term: Any action that will be executed in a period of four to five years.
    - Long – Term: Any action that will be executed in a period beyond five years.
    - Note: Should funding for a specific strategy become available, the municipality may execute it even if it is not in the assigned time horizon.
- Current status and expected benefits

Strategies from the 2020 LHMP that are no longer needed will be identified as "Suppressed from this LHMP" to indicate that they should not be carried forward into the 2031 LHMP update. Tables 48-53 have the details of the mitigation strategies adopted by this LHMP.

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Table 49: Mitigation Strategies – Prevention

New ID	Old ID	Description	Hazard	Priority	Lifeline	Leading Municipal Office	Possible Funding Source	Implementation Term	Current Status and Expected Benefits
2026-UTU-LP-001	P-1	Develop, implement, and enforce through an ordinance program that will reduce and eliminate the impact of runoff from construction activities that result in land disturbance greater than or equal to 1 acre. It also mitigates inefficiencies in urban stormwater channels, especially on municipal brick streets. (Reformulated to integrate BMPs, sediment control, and green infrastructure.)	Flooding	High	Transportation, Water Systems, Safety and Security	Lead: Public Works Support: Planning, DRNA	Municipal, HMGP, CDBG-MIT	Short	Current Status: Ongoing execution. Runoff Plan and ordinances approved; project in progress with the cooperative. Expected Benefits: Reduces urban flooding and sedimentation; protects drainage systems and roadways; improves NFIP/CRS compliance.
2026-UTU-LP-002	P-2	Post Construction Runoff Control for Development Projects. A program that reduces the impact of runoff from new developments and redevelopments greater than 1 acre. (Reformulated as a maintenance plan for the urban stormwater system, incorporating post-construction criteria and green infrastructure.)	Flooding	High	Transportation, Water Systems	Lead: Public Works Support: Planning	Municipal, Federal, HMGP, CDBG-MIT	Short	Current Status: Ongoing execution. Maintenance of the urban stormwater system. Expected Benefits: Sustains hydraulic capacity; reduces runoff peaks and pollutant loads.
2026-UTU-LP-003	P-3	Monitoring and Tracking System for Municipal	Flooding	High	Safety and Security, Transportation	Lead: Public Works Support: Human	Municipal		Current Status: Ongoing execution

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		Operations: Training for municipal employees and security personnel on stormwater protection, storm sewer maintenance, and daily operational activities.				Resources			Provide training to field crews; document dates, attendance, and topics. Expected Benefits: Strengthens operational capacity; reduces failures due to inadequate maintenance.
2026-UTU-LP-004	P-4	Integrated flood mitigation measures for the Jesús María Lago Residential Community: inspection of the existing retaining wall, replacement of the pumping system with level-activated controls, and selective cleaning of internal drainage channels and streams leading to the river. (Reformulated to evaluate cost-effective alternatives before undertaking major construction work.)	Flooding	High	Food, Hydration, Shelter, Water Systems, Safety & Security	Lead: Public Works Support: Recreation and Sports	HMGP, FEMA PA, Municipal	Short	Current Status: In design. Active project to replace the pumping system (level-activated operation). CORRECTION NOTE: The correct location is Jesús M. Lago Residential Community (Urbanization Jesús M. Lago); the 2020 LHMP incorrectly identified it as "Residencial San José." The reference is retained for FEMA traceability purposes. Expected Benefits: Protects public housing and vulnerable populations; reduces recurring flood-related damage.
2026-UTU-LP-005	P-5	Strengthen a municipal process for technical review and coordination of consultations, projects, and development proposals to verify consistency with the LHMP, the 2023 Land Use Plan (POT 2023), and hazard maps. (Reformulated as an interdepartmental process, as no formal planning office currently exists.)	All Hazards	High	Safety & Security	Lead: Municipal Secretariat	State, Municipal	Short	Current Status: In design. Expected Benefits: Ensures that development activities do not increase risk; institutionalize mitigation practices and hazard-informed decision-making.

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2026-UTU-LP-006	P-6	Georeferenced inventory of public structures (and, where feasible, critical community facilities), identifying condition, year of construction, code compliance, shelter use, and hazard exposure. (Modified to include a referral mechanism to OGPe for structures that do not comply with applicable building codes.)	Earthquakes	High	Safety & Security, Health & Medical	Lead: Public Works Support: OGPE, OMME	State, Municipal	Medium	Current Status: In design. Georeferenced inventory with referrals to OGPe for non-compliant structures. Housing stock consists predominantly of structures built between 1960 and 1999. Expected Benefits: Identifies seismic vulnerability; supports prioritization of retrofit and resilience projects; protects building occupants and critical facility users.
2026-UTU-LP-007	P-7	Incorporation of mitigation measures into municipal endorsement and review processes: evaluation of hazard exposure, site access, drainage, slope stability, base flood elevation requirements, and continuity of essential services. (To be formalized through a standardized checklist.)	Flooding, Landslides	High	Safety & Security	Lead: : Municipal Secretariat Support: OMME, Public Works	Municipal	Short	Current Status: Ongoing implementation. Formalize a mitigation checklist for municipal endorsements, permit reviews, and development consultations. Expected Benefits: Prevents the creation of new risk through development activities; involves minimal implementation cost while providing a high preventive return on investment.
2026-UTU-LP-008	P-8	Municipal system for the collection and analysis of damages to structures, roads, bridges, drainage systems, water infrastructure, electric power systems, and communications networks, including photographs, coordinates, repair costs, and recurrence data. The system	All Hazards	High	Transportation, Energy, Communications, Safety & Security	Lead: OMME Support: Public Works, Federal Programs	Municipal		Current Status: Ongoing Execution. Initial baseline established with an inventory of 459 georeferenced damage sites from Hurricane María. Expected Benefits: Prioritizes investments based on documented evidence and historical damage data; strengthens the justification for Benefit-Cost Analyses (BCA) and supports

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		will be activated annually one month before the start of hurricane season and developed into a GIS-based database.							applications for Hazard Mitigation Grant Program (HMGP) funding and other mitigation assistance programs.
2026-UTU-LP-009	P-9	Coordination, notification, and early warning protocols for critical failures or service interruptions involving major dams, water intake dams, raw water transmission lines, and balancing/storage tanks; including a municipal evacuation protocol. (Reformulated using collaborative language to reflect coordination with Commonwealth agencies, including PRASA and PREPA/LUMA, as applicable.)	Flooding	High	Water Systems, Communications, Safety & Security	Lead: OMME Support: AAA, PRASA, AEE-LUMA, NMEAD	State, Municipal	Short	Current Status: In Design. Expanded to include critical water infrastructure with coordination at the Commonwealth level. Dos Bocas Reservoir has lost approximately 64% of its storage capacity due to sedimentation. Expected Benefits: Saves lives and reduces risk for downstream populations through improved warning, coordination, and evacuation procedures; protects the reliability and continuity of the raw water supply by strengthening preparedness for failures or disruptions affecting critical water infrastructure.
2026-UTU-LP-010	P-10	Program for the coordination of resilient housing improvements for vulnerable and low-income communities, including roof strengthening, structural anchoring, drainage improvements, elevation measures, and electrical safety enhancements for generators. The program is focused on the municipality's 29 Special Communities	Tropical Cyclones, Flooding, Earthquakes	High	Food, Hydration, Shelter, Safety & Security	Lead: OMME Support: Citizen Assistance Office, Housing Department, ODSEC, INSEC, Habitat for Humanity Puerto Rico (Habitat PR)	HUD CDBG-MIT, CDBG-DR, HMGP	Medium	Current Status: Funding secured/in progress. Active Nuisance Property (Active nuisance) Program and ongoing affordable and resilient housing projects. Expected Benefits: Reduces social vulnerability; protects low- and moderate-income (LMI) populations.

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		(Comunidades Especiales), including Mameyes, Judea, Cuba, Caníaco, San Antonio, among others. (Reformulated to replace the original list of Palmarito, Cumbre Alta, Cuba, and San Carlos.)							
2026-UTU-LP-011	P-11	Hydrologic-Hydraulic (H&H) and geomorphological study of the Viví River in Pérez Matos Subdivision (Urb. Pérez Matos), the urban center, Archilla, and La Playita to evaluate mitigation alternatives, including river restoration and nature-based solutions prior to any channelization efforts. (Reformulated to replace the channelization-focused approach.)	Flooding	High	Transportation, Water Systems, Health & Medical	Lead: Federal Programs Support: DRNA, USACE, Department of Housing	HMGP, CDBG-MIT, USACE CAP	Medium	Current Status: In design. Watershed project in the design phase; analysis of H&H and nature-based solution (NBS) alternatives. Expected Benefits: Provides a sound technical basis for appropriate investment decisions; helps avoid oversized or unnecessarily costly infrastructure projects.
2026-UTU-LP-012	P-12	Evaluate the hydrology, hydraulics, erosion, and stability of the stream east of the vocational school to reduce flooding, scour, and damage to educational and roadway infrastructure.	Flooding	High	Food, Hydration, Shelter, Transportation	Lead: Public Works Support: DRNA, ACT	Municipal	Short	Current Status: There was an intervention by the Highway and Transportation Authority. The intervention caused stormwater runoff problems on a parcel located further downstream.
2026-UTU-LP-013	P-13	Evaluate structures, access routes, slopes, drainage systems, and areas adjacent to the bridge leading to Adjuntas along PR-10 (near	Flooding	High	Transportation, Safety & Security	Lead: ACT Support: Municipality, FHWA, DTOP	ACT, FHWA-ER, FEMA	Medium	Current Status: A temporary bridge was constructed. Construction of the permanent bridge is currently in the study and design phase.

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		UPR-Utuado) for susceptibility to flooding, scour, roadway isolation, and structural damage.							Expected Benefits: Maintains critical connectivity with Adjuntas; prevents community isolation.
2026-UTU-LP-014	P-14	Training program for the construction sector on hazard-resistant construction techniques and mitigation measures tailored to the risk profile of each site. (In coordination with regulatory agencies and partners such as INSEC and Habitat PR.)	Flooding, Earthquake	Medium	Safety & Security	Lead: OMME Support: OGPe , INSEC, Habitat PR	Municipal, Federal, State	Medium	Current Status: In design. Coordination and follow-up with regulatory agencies. Expected Benefits: Improves construction quality; reduces future damage to housing.
2026-UTU-LP-015	P-15	Adopt higher regulatory standards for flood risk management (increased freeboard above the base flood elevation, accumulated substantial damage/improvements), aligned with Regulation No. 13 (8th Revision, 2021) and aimed at improving the municipality's NFIP Community Rating System (CRS) classification.	Flooding	High	Water Systems; Food, Hydration, Shelter	Lead: Municipal Secretariat Support: Public Works, OGPe	Municipal, NFIP-CRS	Short	Current Status: In design. Addressing streams adjacent to the urban center; to be linked with Regulation No. 13 (2021) and the Community Rating System (CRS). Expected Benefits: Reduces future flood-related damage; generates flood insurance premium discounts through improved Community Rating System (CRS) classification.
2026-UTU-LP-016	P-16	Support the implementation, monitoring, maintenance, and updating of the plan, in accordance with Section 7.0 (2026 review cycle; next review in 2031).	All Hazards	High	Safety & Security	Lead: OMME Support: Secretariat Department	Municipal, HMGP (Planning)		Current Status: Ongoing implementation. 2026 review cycle active; table submitted on June 12, 2026. Expected Benefits: Maintains federal

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									eligibility; institutionalizes mitigation efforts.
2026-UTU-LP-017	P-17	Develop, enhance, and implement existing emergency plans, with annual updates and the incorporation of post-Fiona (DR-4671, 2022) and multi-hazard scenarios.	All Hazards	High	Safety & Security, Communications	Lead: OMME Support: NMEAD, Municipality	Municipal, State		Current Status: Ongoing implementation. Annual update in progress; verify the incorporation of Hurricane Fiona scenarios into the Operational Plan (2020). Expected Benefits: Improves emergency response and coordination; reduces the impact of emergencies.
2026-UTU-LP-018	P-18	Structural evaluation of the primary access bridges to the municipality and public road bridges for potential collapse due to seismic events and extreme flooding; expand to a complete bridge inventory with ACT follow-up.	Flooding, Earthquakes	High	Transportation	Lead: ACT Support: DTOP, Municipality, Public Works, FHWA	ACT, FHWA-ER, DTOP, Municipal	Medium	Current Status: In design. Follow-up-through requests to ACT; incorporate the condition assessment of MRP bridges. Expected Benefits: Prevents isolation of the municipality; protects emergency response routes.
2026-UTU-LP-019	New	Formal integration of the LHMP with the Municipal Recovery Plan (MRP) and the 2023 Land Use Plan (POT): coordination and joint review mechanism among planning instruments for the 2026–2031 cycle.	All Hazards	High	Safety & Security; Government Services	Lead: OMME Support: Federal Programs	Municipal, HUD (CDBG-DR)	Short	Current Status: New Strategy. Incorporated under the requirement for integration among planning instruments (44 CFR §201.6). Expected Benefits: Ensures consistency among the LHMP, MRP, and POT; avoids duplication.

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Table 50: Mitigation Strategies - Property Protection

New ID	Old ID	Description	Hazard	Priority	Lifeline	Leading Municipal Office	Possible Funding Source	Implementation Term	Current Status and Expected Benefits
2026-UTU-PP-01	PP-1	Coordinate and follow up with PREPA/LUMA on improvements to electric power lines traversing forested areas near the Jardines de Caguana Substation, the Jareales sector, and adjacent areas (including selective undergrounding, vegetation management, and system hardening), incorporating critical feeders (8101, 80, and Fernando Luis García). (Reformulated as a coordination action.)	Tropical Cyclones	High	Energy	Lead: Public Works Support: AEE, LUMA, Hydroelectric Coop	AEE, LUMA, FEMA PA, HMGP	Medium	Current Status: In Design. Coordinate with and monitor implementation of LUMA/PREPA plans and the Mountain Hydroelectric Cooperative regarding improvements to electrical infrastructure in the area. Approximately 87.8% of residents report experiencing power outages. Expected Benefits: Reduces prolonged power outages; protects power supply to the hospital and the town.
2026-UTU-PP-02	PP-2	Voluntary acquisition, relocation and/or demolition of structures around the Viví River (Av. Esteves, section PR-878 to La Playita) with repetitive and severe losses as a priority. Phase 1: Identify candidates by cost-effectiveness (BCA). Phase 2: Implement with FEMA funds and counterpart.	Flooding	High	Food, Hydration, Shelter; Water Systems	Lead: Federal programs Support: Municipality, FEMA	FEMA HMGP (acquisition), FMA, CDBG-MIT, Local	Medium	Current Status: In Design. High Priority; identification of RL/SRL candidates. Linked to UTU-PP-07. Expected Benefits: Eliminates risk permanently; savings to the NFIP; protects lives.
2026-UTU-PP-03	PP-3	Study the relocation or	Flooding	Medium	Safety & Security,	Lead: Municipality	Municipal,	Long	Current Status: In design. Evaluate

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		reinforcement of the Police headquarters and the government center outside the flood zone, within the Traditional Urban Center Area Plan (CUT) of the POT 2023; determine cost-effective alternative (retrofit vs. relocation). (Reformulated as a study.)			Government Services	Support: Secretariat, FEM, HMGP	State, HMGP		within the CUT Area Plan (POT 2023). Expected Benefits: Ensures consistency between LHMP, MRP and POT; Avoid duplication.
2026-UTU-PP-04	PP-4	Improve the tree cutting and pruning program and communication with PREPA/LUMA to reduce power outages. (Correction: The main hazard is Tropical Cyclone/Wind, not Flood.)	Tropical Cyclones	High	Energy	Lead: Public Works Support: PREPA, LUMA	Operational Fund, PREPA	Ongoing	Current Status: Ongoing execution. Operational activity coordinated with LUMA. Expected Benefits: Reduces line outages and blackouts; Protects energy.
2026-UTU-PP-05	PP-5	Acquisition or relocation of structures in hazard-prone areas with severe repetitive losses as a priority. Phase 1: identify candidates by cost-effectiveness. Phase 2: implement with FEMA funds; manage through the Land Bank.	Landslides	High	Food, Hydration, Shelter; Safety & Security	Lead: Federal Programs Support: FEMA, Habitat Reconstruction Center	FEMA HMGP, FMA, CDBG-MIT, Local	Medium	Current Status: In Design. High Priority; link with UTU-PP-07 (Land Bank) and Center for the Reconstruction of Habitat. Expected Benefits: Eliminates permanent risk; protects lives; savings to recovery.
2026-UTU-PP-06	PP-6	Elevation of the wall of the Cabrera Urbanization and reinforcement of the headquarters of the Command; validate with BCA and design. Damage	Flooding	High	Safety & Security, Food, Hydration, Shelter	Lead: Public Works Support: OMME, FEMA	Municipal, State, HMGP, FEMA PA (Cat. D)	Short	Current Status: In Design. Urgent Design; documented damage (coords. 18.265152, -66.712952; Active PW). Expected Benefits: Protects

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		documented in Maria's inventory with precise coordinates (wall collapse; Active PW).							urbanization and public security headquarters; Reduces recurring damage.
2026-UTU-PP-07	New	Territorial Planning Plan (POT 2023, Sec. 7.10.6) to receive, manage and assign uses compatible with mitigation (open spaces, green infrastructure, river buffering) to properties acquired under UTU-PP-02 and UTU-PP-05, with permanent use restrictions.	Flooding, Landslides	High	Food, Hydration, Shelter, Safety & Security	Lead: Municipality Support: Secretariat, Federal Programs	Municipal, HMGP, CDBG-MIT	Short	Current Status: In Design. Legal vehicle of the POT 2023 for acquisitions.

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Table 51: Mitigation Strategies - Structural Improvements

New ID	Old ID	Description	Hazard	Priority	Lifeline	Leading Municipal Office	Possible Funding Source	Implementation Term	Current Status and Expected Benefits
2026-UTU-SI-01	SP-1	Structural improvements to PR-111 to reduce landslides, including evaluation of runoff flow improvements; coordinate with DTOP/ACT and verify coverage of active PICA projects. Documented damage (PR-111 km 16.6, Ángeles sector).	Earthquakes, Landslides	High	Transportation	Lead: DTOP Support: ACT, Municipality, FHWA	DTOP, FEMA, FHWA-ER, HMGP	Medium	Current Status: In Design. Check DTOP/PICA Project Coverage (Damage #1242547). Expected Benefits: Maintains connectivity; Reduces landlsides and isolation.
2026-UTU-SI-02	SP-2	Improvements to the storm sewer system of the central area of the town to restore its runoff management capacity; execute in conjunction with UTU-P-01/P-02 and the approved Runoff Plan.	Flooding	Medium	Water Systems, Transportation	Lead: Public Works Support: Planning, DRNA	Municipal, State, HMGP	Medium	Current Status: In design. Articulate with the current Runoff Plan. Expected Benefits: Restores hydraulic capacity of the urban area; Reduces flooding.
2026-UTU-SI-03	SP-3	Construction of the La Capilla Bridge in the Arenas neighborhood and cleaning of the adjacent ravine. Multiple damages on roads in Arenas documented.	Flooding	High	Transportation	Lead: Federal Programs Support: Public Works	Municipal, FEMA HMGP, ACT	Medium	Current Status: In studies and design. Expected Benefits: Restores access to community; Reduces isolation and flooding.
2026-UTU-SI-04	SP-4	Construction of trenches and landslide control works on the PR-603 in the Guaonica	Landslides	Medium	Transportation, Safety & Security	Lead: DTOP Support: Municipality,	Municipal, DTOP, HMGP	Medium	Current Status: Validate with DTOP. Expected Benefits: Restores access to

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		neighborhood, evaluating structural improvements and bioengineering. (Reformulated.)				DRNA			community; Reduces insulation and flooding.
2026-UTU-SI-05	SP-5	Evaluation of structural improvements to the Pancho la Fontaninne highway (Las Palmas neighborhood) or construction of an alternate route. Multiple landslides documented on Camino Bruno Ramos, Las Palmas.	Landslides	Medium	Transportation, Safety & Security	Lead: Municipality Support: DTOP, DRNA, FEMA, HOUSING	Municipal, State, HMGP	Medium	Current Status: Identification of funds. Expected Benefits: Ensures access to Las Palmas; reduces risk of isolation and food safety.
2026-UTU-SI-06	SP-6	Structural improvements on PR-605 interior km 1.9; Documented bridge abutment collapse and scour.	Landslides	Medium	Transportation	Lead: Federal Programs Support: Municipality, FEMA	Municipal, DTOP, ACT, FHWA-ER	Short	Current Status: In Construction. Expected Benefits: Maintains connectivity; Reduces bridge scour.
2026-UTU-SI-07	SP-7	Construction of retention traps or dams on the El Verde creek to reduce flood impacts on the bridge, or improvements to the bridge; prefer nature-based solutions when cost-effective. Documented road collapses. (Reformulated.)	Flooding	Medium	Water Systems, Transportation	Lead: Federal Programs Support: Public Works, HOUSING, FEMA, USDA, DRNA, USACE	Municipal, DRNA, HMGP	Medium	Current Status: Identification of funds. Expected Benefits: Reduces flooding on the bridge; Protect access.
2026-UTU-SI-08	SP-8	Structural evaluation of residences in the San Antonio area (Special Community) to determine vulnerability and retrofit needs in the face of	Tropical Cyclones, Landslides, Flooding	Medium	Food, Hydration, Shelter; Safety & Security	Lead: Federal Programs Support: Municipality, FEMA, HOUSING	Municipal, Federal, State, CDBG-MIT	Medium	Current Status: Identification of funds. Expected Benefits: Identifies housing vulnerability; prioritizes retrofit in LMI community.

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		cyclones and landslides.							
2026-UTU-SI-09	SP-9	Based on the H&H study, implement management of the Viví River channel between the Archilla bridge and La Playita through a cost-effective combination of selective sediment removal, river restoration and NBS; coordinate permits with USACE, DNER, Housing for the execution of a watershed management project. (Strongly reformulated: dredging is no longer a single measure.)	Flooding	High	Water Systems, Transportation	Lead: Federal Programs Support: HOUSING, DRNA, USACE, FEMA, Public Works	CDBG-MIT VIVIENDA, Municipal, DRNA, HMGP, USACE	Medium	Current Status: Design and studies of the Watershed Project. Expected Benefits: Reduces urban flooding of the old town; it protects roads and property.
2026-UTU-SI-10	SP-10	Channel and sediment management program in the Vivi River, Rio Grande de Utuado and tributaries to eliminate obstructions and restore hydraulic capacity, integrating sedimentation control at the basin scale. (Strongly rephrased.)	Flooding	High	Water Systems	Lead: Public Works Support: TURF, USACE, AAA-PRASA	Municipal, CDBG-MIT, DRNA, HMGP, USACE	Long	Current Status: In Design. High Priority; linked Dos Bocas lost 64% of capacity due to sedimentation. Management Project for the Viví River and Rio Grande de Arecibo Watershed. Expected Benefits: Restores channel capacity; Reduces flooding and sedimentation of reservoirs.
2026-UTU-SI-11	SP-11	Improvements and management of the Jardines de Utuado Residential Complex to prevent flooding in the urban area, prioritizing combined solutions (green-gray) over hard channeling;	Flooding	High	Water Systems, Food, Hydration, Shelter	Lead: Federal Programs Support: DRNA, FEMA	State, FEMA, HMGP	Short	Current Status: In Design. Expected Benefits: Restores channel capacity; Reduces flooding and sedimentation of reservoirs.

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		articulate with the Río Viví portfolio. (Reformulated.)							
2026-UTU-SI-12	SP-12	Improvements, cleaning and management of the creek adjacent to the old Dr. Caparrós CDT by relocating the discharge to mitigate flooding in the urban area (Reformulated)	Flooding	High	Safety & Security, Water Systems	Lead: Federal Programs Support: FEMA, USACE, SHPO, DRNA	HMGP, State, Municipal	Short	Current Status: In study and design. Expected Benefits: Protects continuity of medical services; Reduces critical facility flooding.

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Table 52: Mitigation Strategies: Natural Resources Protection

New ID	Old ID	Description	Hazard	Priority	Lifeline	Leading Municipal Office	Possible Funding Source	Implementation Term	Current Status and Expected Benefits
2026-UTU-NR-01	NRP-1	Program for the inspection and protection of areas of high conservation value, beneficial for sustainable tourism and high natural risk not suitable for intensive development. (Coordination with DNER, USFWS, Para La Naturaleza and Protectores de Cuenca.)	Landslides	High	Water Systems, Food, Hydration, Shelter	Lead: OMME Support: DNER, USFWS, Para la Naturaleza	Municipal, DRNA, USFWS, CDBG-MIT	Medium	Current Status: In design. Link with Para La Naturaleza and Protectores de Cuenca (active partners). Expected Benefits: Protects regulatory ecosystems; reduces runoff; tourism co-benefits.
2026-UTU-NR-	NRP-2	Improvements in the places most susceptible to landslides through bioengineering, surface drainage and vegetative stabilization, prioritizing neighborhoods of documented high density (Ángeles, Caguana, Caonillas, Sabana Grande, Roncador, Tetuán, Paso Palma, Viví Abajo and Viví Arriba). (Reformulated.)	Landslides, Earthquakes	High	Transportation, Safety & Security	Lead: Public Works Support: DTOP, DRNA	Municipal, DTOP, HMGP	Medium	Current Status: In design. High Priority; 17 neighborhoods with >25 landslides/km² during María. Expected Benefits: Reduces slippage; protects roads and homes; ecological co-benefits.
2026-UTU-NR-02	NRP-3	Program for the maintenance and cleaning of streams and rivers in critical areas, complementary to channel management (UTU-SP-09 to	Flooding	High	WATER Systems	Lead: Public Works Support: DRNA, NRCS, Watershed Protectors	Municipal, DRNA, NRCS, HMGP	Ongoing execution	Current Status: In design. Articulate with portfolio SP-09 to SP-12. Expected Benefit: Maintains hydraulic capacity; Reduces clogging and

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		SP-12), with ecological criteria and technical partners (Watershed Protectors, NRCS). (Reformulated.)							flooding.
2026-UTU-NR-	NEW	Municipal Watershed Restoration and Management Program (Rio Grande de Arecibo, Río Viví and tributaries): soil stabilization, reforestation, green infrastructure, river restoration (Natural Channel Design) and sedimentation control (Watershed project of the municipality).	Flooding, Landslides	High	Water Systems, Transportation, Safety & Security	Lead: Federal Programs Support: DRNA, USACE, NRCS	CDBG-MIT, HMGP, USDA NRCS, USACE CAP, DRNA	Medium	Current Status: In design. Basin project. It addresses the critical sedimentation of Dos Bocas (64%). Expected Benefits: Reduces runoff, erosion, and sedimentation at the basin scale.
2026-UTU-NR-03	NEW	Soil conservation program on critical farms and slopes: contour planting, vegetative barriers, cover crops, infiltration ditches, drainage management, bioengineering and voluntary agreements with farmers (vetiver/patchouli).	Landslides, Flooding	High	Food, Hydration, Shelter, Safety & Security	Lead: Federal Programs Support: USDA NRC, DRNA, farmers	USDA NRCS EQIP, HMGP, CDBG-MIT, DRNA	Medium	Current Status: In design. Agricultural component of the Basin. Expected Benefits: Reduces erosion and sedimentation; Protects food security and soils.
2026-UTU-NR-	NEW	Municipal green infrastructure program for infiltration, retention and treatment of runoff in urban areas, schools, municipal facilities, parking lots, roadsides and community areas (rain gardens, bioretention,	Flooding	Medium	Transportation, Water Systems, Safety & Security	Lead: Public Works Support: DRNA, EPA, Planning	BRIC, HMGP, CDBG-MIT, EPA SRF, Municipal	Medium	Current Status: In Design. It fits with the infrastructure-first approach of BRIC 2026. Expected Benefits: Reduces urban runoff and flood peaks; Water quality co-benefits.

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		permeable pavement, bioswales).							
2026-UTU-NR-04	NEW	Identify, map and protect critical drinking water infrastructure: Roncador filtration plant, catchment dams, relay tanks, raw water lines, pumping stations and their accesses, through exposure analysis and protection/redundancy measures (coordination with AAA/PRASA).	Flooding, Landslides, Drought	High	Water Systems, Energy, Transportation	Lead: Secretariat Support: AAA/PRASA, DRNA, OMME	CDBG-MIT, HMGP, USDA RD, EPA DWSRF, AAA	Medium	Current Status: In Design. The Roncador Plant gave water to Utuado during Maria for operating by gravity. Expected Benefits: Protects drinking water supply; redundancy in the event of failures.
2026-UTU-NR-05	NEW	Strategic reforestation and riparian restoration program in watersheds, slopes, natural easements, ravine margins and lands with severe erosion, prioritizing native species with deep roots.	Landslides, Flooding	Medium	Water Systems, Safety & Security	Lead: Federal Programs Support: DRNA, USFWS, NRCS, For Nature	CDBG-MIT, HMGP, DRNA, USDA NRCS, USFWS	Medium	Current Status: In Design. Expected Benefits: Stabilizes slopes and margins; reduces erosion; carbon sequestration and habitat.

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Table 53: Mitigation Strategies - Emergency Services

New ID	Old ID	Description	Hazard	Priority	Lifeline	Leading Municipal Office	Possible Funding Source	Implementation Term	Current Status and Expected Benefits
2026-UTU-ES-01	ES-1	Eliminate since the Municipality does not have the resources for the proposed activities. Physical and structural evaluation of public schools that serve as shelters (including Paso Palmas School) to establish a program of improvements; verify repair status of short columns (AEP projects) and expand to community centers used as shelters.	Earthquake, Tropical Cyclones	High	Food, Hydration, Shelter, Safety & Security	Lead: OMME Support: Mayor's Office, AEP, Education	FEMA (FMA, HMGP), AEP, CDBG-DR	Short	Current Status: In Design. High Priority; check for AEP projects (short columns). 100% of communities report need. Expected Benefits: Ensures safe havens; protects the population during events.
2026-UTU-ES-02	NEW	Identify and strengthen critical access routes to shelters, hospitals, CDTs, water plants, substations, distribution centers, and communities with a history of isolation, prioritizing bridges, slopes, drains, and signage.	Flooding, Landslides, Tropical Cyclones	High	Transportation, Health & Medical, Food, Hydration, Shelter, Energy	Lead: OMME Support: DTOP, ACT, Public Works	FHWA PROTECT, ER, HMGP, CDBG-MIT	Medium	Current Status: In Design. Neighborhood isolation is the main concern of emergency management. Expected Benefits: Ensures emergency access; reduces insulation; Protects multiple lifelines.
2026-UTU-ES-03	NEW	Develop a redundant emergency communications system with an inventory of towers, radios, antennas and repeaters, community protocols (amateurs already active) and energy backup for	All Hazards	High	Communications, Energy, Safety & Security	Lead: OMME Support: MEAD/DHS/Amateur Radio	DHS/NMEAD, HMGP, CDBG-MIT	Medium	Current Status: In Design. Incorporate amateur radio network; 37% without internet; The system must not depend on the electricity grid. Expected Benefits: Maintains emergency communications;

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		rural sectors with coverage failures.							Protects response line.
2026-UTU-ES-04	NEW	Update and implement a Municipal Continuity of Operations Plan (COOP) with backup of energy, water, communications, critical files, alternation of facilities, essential personnel and continuity of financial and government services.	All Hazards	High	Safety & Security; Energy, Communications, Government Services	Lead: OMME Support: Finance, Secretariat	DHS/NMEAD, HMGP (planning), CDBG-MIT (planning)	Medium	Current Status: In Design. Integrate with UTU-P-17. Expected Benefits: Ensures continuity of government and essential services in disaster.
2026-UTU-ES-05	NEW	Promote the expansion and widening project of the alternate highway to the PR-111 that gives access to the neighborhoods of Caguana and Roncador, as a road redundancy route in the face of recurrent isolation and to ensure access to the Roncador Filtration Plant and the Caguana substation. (Reclassified from Emergency Services to Structural Project due to its nature as a physical work; originally registered as ES-05.)	Flooding, Landslides, Tropical Cyclones	High	Transportation, Safety & Security, Health & Medical	Lead: Federal Support: ACT, DTOP, FHWA, USDA	FHWA PROTECT/ER, HMGP, CDBG-MIT	Long	Current Status: In Design. Neighborhood isolation is the main concern of emergency management (MRP E3); the alternate route ensures access to Caguana and Roncador (vital water line). Justification for reclassification: structural work in accordance with the FEMA classification rule (the category is defined by the nature of the action).

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Table 54: Mitigation Strategies – Outreach and Awareness

New ID	Old ID	Description	Hazard	Priority	Lifeline	Leading Municipal Office	Possible Funding Source	Implementation Term	Current Status and Expected Benefits
2026-UTU-EA-01	PEA-1	Public outreach, education, and information program on natural hazards and mitigation (including NFIP guidance), with municipal risk management website, AM and FM radio station, interactive maps, and physical media for the 37% of residents without internet. (Modernized.)	All Hazards	High	Communications, Safety & Security	Lead: OMME Support: Mayor's Office, Federal Programs	Municipal, HMGP (planning), CDBG-MIT	Ongoing	Current Status: Identification of funds to implement the proposed mitigation measures. The radio station arises because it is a medium used by the population that does not have access to the internet and currently the local station does not provide services to the municipal public entity. Expected Benefits: Increases risk awareness; promotes safety and preparedness.
2026-UTU-EA-02	PEA-2	Public outreach to residents of NFIP flood areas about annual grants, insurance coverage, and CRS program; link with UTU-P-15. (Evaluate consolidation with UTU-PEA-07, almost identical.) Public outreach to residents of NFIP flood areas about annual grants, insurance coverage, and CRS program; link with UTU-P-15. (Evaluate consolidation with UTU-PEA-07, almost identical.)	Flooding	High	Food, Hydration, Shelter, Communications	Lead: OMME Support: Secretariat	Operational budget	Ongoing	Current Status: In design. CONSOLIDATED — absorbs PEA-07 (decision 2026); Includes floodplain component. Expected Benefits: Increases in NFIP insurance; Reduces uncovered loss.
2026-UTU-EA-03	PEA-3	Develop information and education material on the	All Hazards	High	Communications	Lead: OMME	Municipal, HMGP	Short	Current Status: In Design.

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		mitigation plan and the importance of mitigation to disseminate LHMP 2026.				Support: Federal Programs	(planning)		Adapt materials from Appendix B of the MRP. Expected Benefits: Disseminates the culture of mitigation; supports public participation.
2026-UTU-EA-04	PEA-4	Community development program to organize mitigation committees in the 29 Special Communities (target ≥8 committees); 57.6% of residents collaborate in organizations and 12.6% aspire to leadership. (Focused on neighborhoods.)	All Hazards	High	Safety & Security, Communications	Lead: OMME Support: Faith Bases, Special Communities, CERT	Municipal, HMGP (planning), CDBG-MIT	Medium	Current Status: In development. Implementation has been progressively developed with the 29 Special Communities. Expected Benefits: Strengthens social capital; Improves readiness and recovery.
2026-UTU-EA-05	PEA-5	Training program in resistant self-construction techniques for homeowners (target ≥500), focused on the 29 Special Communities; partners INSEC and Habitat PR. For homes built between 1960-1999 without technical supervision.	Flooding, Earthquake	High	Food, Hydration, Shelter	Lead: Mayor's Office Support: Federal Programs, OMME, INSEC, Habitat PR	Municipal, State, CDBG-MIT	Medium	Current Status: In funds identification. Possible stakeholders INSEC and Habitat PR. Expected Benefits: Improved resilience of self-built housing; Reduces future damage.
2026-UTU-EA-06	PEA-6	Strengthening the guidance program for the reduction of erosion and sedimentation in bodies of water, using as a central argument the loss of 64% of the capacity of the Dos Bocas Reservoir (bathymetry 2021); Watershed Protector	Flooding, Landslides	High	Water Systems	Lead: Secretariat Support: Public Works, OMME, DRNA, NRCS, Basin Protectors	Municipal, DRNA, USDA NRCS	Medium	Current Status: In execution of the MS4 program and orientation of Public Works to the public. Expected Benefits: Reduces erosion and sedimentation; it protects reservoirs and riverbeds.

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		and NRCS partners.							
2026-UTU-EA-07	PEA-7	Differentiated public outreach to NFIP floodplain residents about grants, insurance, and HMGP resources.	Flooding	High	Food, Hydration, Shelter, Communications	Lead: OMME Support: Secretariat	Operational budget	Ongoing	Current Status: Retired. Consolidated in UTU-PEA-02. Rationale (Review Tool): This strategy doubled the scope of PEA-02 (NFIP disclosure); it is consolidated for administrative and reporting efficiency. The differentiated approach to floodplain residents is integrated as a component of UTU-PEA-02. EN: 'This mitigation strategy shall be consolidated into UTU-PEA-02 as it duplicates its scope; the floodplain-resident outreach component is retained within PEA-02.' Expected Benefits: Increased belay in floodplains; Reduces uncovered loss.
2026-UTU-EA-08	PEA-8	Advanced multi-hazard public notification system (including earthquake), incorporating the active amateur radio network and linked to FEMA IPAWS; it must operate without depending on the electricity grid (87.8% report blackouts). (Broadened.)	All Hazards	High	Communications, Safety & Security	Lead: OMME Support: NMEAD, DHS, Amateur Radio	Operational, HMGP, CDBG-MIT	Ongoing	Current Status: In design. Link with energy resilience and the Hydroelectric Cooperative. Expected Benefits: Multi-hazard early warning; saves lives.
2026-UTU-EA-09	PEA-9	Public education on building code compliance and the proper installation and	Tropical Cyclones, Earthquakes	High	Energy, Safety & Security	Lead: OMME Support: Secretariat,	Operational, PREPA	Ongoing	Current Status: In design. Link with energy resilience and the Hydroelectric Cooperative.

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		operation of emergency generators; 87.8% report blackouts and 72.8% would install renewable energy. (Link with community energy.)				PREPA-LUMA			Expected Benefits: Reduces accidents with generators; Promotes resilient energy and codes.
2026-UTU-PEA-9	NEW	Educational program on watersheds, rivers, streams, erosion, sedimentation, drinking water and nature-based mitigation, with meeting/interpretation points, community maps, school workshops and best practice guides (educational component of the Watershed project).	Flooding, Landslides	Medium	Communications, Water Systems	Lead: Federal Programs Support: OMME, PUBLIC WORKS, DRNA, Basin Protectors, Education	CDBG-MIT, HMGP (planning), DRNA	Medium	Current Status: In design. Educational component of the Basin. Expected Benefits: Educates about watershed management; promotes citizen co-responsibility.

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6.5 Participation in NFIP (C2-a)

Covered under the PRPB, the Municipality maintains continuous participation in the National Flood Insurance Program (NFIP) and remains committed to meeting all program requirements to reduce flood risk and protect life and property. Ongoing participation in the NFIP enables residents and businesses to access federally backed flood insurance while promoting sound floodplain management practices. The PRPB, on the municipality's behalf, enforces floodplain management regulations consistent with FEMA requirements, including the adoption and use of Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FIS) for development decisions. Local permitting, inspection, and enforcement activities help ensure that new construction and substantial improvements in Special Flood Hazard Areas comply with applicable elevation and floodproofing standards. The Municipality also supports public awareness and education activities related to flood risk, insurance requirements, and mitigation measures. Continued compliance with the NFIP strengthens eligibility for federal hazard mitigation funding and supports the long-term reduction of flood-related damages.

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7. Plan Maintenance

This chapter outlines the actions required to ensure that the Plan's activities are effectively implemented, kept up to date, and aligned with the mitigation goals and objectives. In some cases, updating the Plan may involve amending proposed activities due to changes in on-site conditions that could increase or decrease the level of risk to which certain areas are exposed.

In accordance with federal requirements, the Local Hazard Mitigation Plan (LHMP) review process must include the following elements:

- A section describing the method and schedule for monitoring, evaluating, and updating the Mitigation Plan within a five-year period.
- A process for integrating the Mitigation Plan's requirements into other local planning mechanisms, such as comprehensive plans or capital improvement plans, when appropriate.
- A discussion of how the community will continue to participate in the Plan's review process.

7.1 Point of Contact

The designated point of contact for the monitoring, revision and update of the Utuado LHMP is:

Table 55: Point of Contact Information

Name	Israel Maldonado
Position	Program Coordinator
Office	Federal Programs
Telephone Number	(939) 497-8990
Email	lmaldonado.utuado@outlook.com

7.2 Continuos Public Participation (D1-a)

The Municipality of Utuado is committed to ensuring ongoing public participation by implementing the following engagement methods:

- Public education and awareness initiatives

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- Surveys
- Community workshops and meetings held throughout the municipality

Accordingly, the municipality commits to fostering public participation and community education. This commitment is reflected in several mitigation strategies described in this Plan. The public is encouraged to provide comments and take part in the LHMP's updates at any time, including requesting a copy of the LHMP—both during its development and throughout its monitoring and maintenance phases. Additionally, each time a progress report is completed for this Plan, a copy will be made available for public review. Progress will also be periodically discussed in public meetings and shared through various social media and communication channels. The municipality will ensure that public participation notices are disseminated throughout the Plan's monitoring and oversight stages.

The municipality will also provide regular presentations to community groups regarding the LHMP's content and the progress of mitigation strategy implementation. These groups may include elected officials, schools, and other community organizations. Furthermore, the municipality will continue to promote civic engagement and community education by offering courses and workshops—such as CERT—focused on preparedness and response to hazardous events, as well as informing residents about components of the NFIP and other relevant programs.

These natural hazard-mitigation efforts must be adapted to the specific vulnerabilities and needs of each community. This approach will help build a more prepared and resilient population. This principle underpins the municipality's commitment to ensuring that the community remains engaged throughout the Plan's update cycle, its effective period, and subsequent processes following the Plan's adoption

7.3 LHMP Oversight (D2-a)

The municipality's review strategy for implementation, monitoring, and evaluation provides a framework that encourages collaboration, information-sharing, and innovation. Through multiple implementation methods, the municipality—acting through its Planning Committee, which is composed of representatives from various municipal agencies and departments—will work with its partners and residents to apply a localized approach to loss reduction while addressing community needs through coordinated efforts. This strategy aims to break the cycle of disasters and strengthen the municipality's ability to withstand future events.

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The Plan will be monitored:

- To maintain accurate information regarding hazards and risks.
- To ensure that mitigation strategies reflect the priorities of participating communities and stakeholders.
- To comply with federal and Puerto Rico government requirements for LHMP review.
- To maintain eligibility for mitigation funding.
- To ensure that the Plan remains aligned with other planning efforts.

To ensure efficient and effective implementation, the municipality will make use of its existing capabilities and infrastructure planning processes. The municipality intends to carry out the mitigation strategies identified as immediate or short – term in the LHMP over the next five (5) years, or for as long as funding and resources allow.

7.4 LHMP Evaluation and Monitoring

The evaluation of the LHMP will be continuous. In addition to the five-year review required by FEMA, the municipality will conduct an annual review of the LHMP, or more frequently if circumstances require it. A meeting of the Planning Committee will be held after each annual review to approve a yearly progress report. Each year, a progress report will be prepared and submitted to the Office of the Mayor, documenting any updates to its information as well as any progress made toward achieving the mitigation goals and objectives. This report will be submitted to the Office of the Mayor and made available to the public.

A preliminary schedule to hold the Planning Committee report is as follows:

Table 56: Preliminary Planning Committee Meeting Schedule

Time Period	Participants	Purpose of the Meeting
Annual Meeting (2027)	Planning Committee (Can be open to the public if deemed necessary)	The Committee members will hold the first annual meeting to identify the funding needed to implement the mitigation measures included in this LHMP, reassess the municipality's priorities regarding natural hazards or risk areas, and develop a strategy for submitting proposals to various state and federal programs. In addition, site visits will be conducted to review at-risk areas, monitor project progress, and establish direct communication with the communities.

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Time Period	Participants	Purpose of the Meeting
Annual Meeting (2028)	Planning Committee (Can be open to the public if deemed necessary)	The Committee will hold the annual meeting during the second year of the LHMP's approval to review the status of mitigation strategy implementation, identify emerging risks, and assess community needs. Site visits to at-risk areas will also be conducted, as needed, to track project progress and maintain direct engagement with the communities.
Annual Meeting (2029)	Planning Committee (Can be open to the public if deemed necessary)	The Committee will meet to confirm the status of mitigation action implementation and determine whether additional funding is required to continue progress.
Annual Meeting (2030)	Planning Committee (Can be open to the public if deemed necessary)	The Committee will hold its final meeting before the next LHMP review/update to verify the implementation status of mitigation actions, which will be documented in the upcoming Plan revision.

7.5 LHMP Update and Revision (D2-c, D3-a)

7.5.1 Revision Following a Major Disaster

Should a future emergency or disaster declaration include the municipality in the five-year term of the LHMP, the Planning Committee—together with stakeholders, community representatives, and nonprofit organizations—will convene a meeting to identify new risk areas, affected communities, opportunities to implement mitigation strategies, and to update the municipality's mitigation priorities. This process will also help capture lessons learned from the event and support the updating of this document. This meeting will replace the annual meeting scheduled for that year.

7.5.2 Five – Year Comprehensive Update

As per federal guidance, this LHMP will be updated five (5) years after its approval and will be submitted to the SHMO and the Federal Emergency Management Agency (FEMA) for the corresponding review and approval. This update will include a comprehensive review of the whole LHMP, including, but not limited to municipal profile, risk assessment and mitigation strategies. Approximately eighteen (18) months

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before the LHMP's expiration date, the Planning Committee and the municipality will begin the review process, paying particular attention to any new requirements and guidance.

7.6 LHMP Integration with other Planning Mechanisms (D3-a)

The following public policies and planning documents were considered in the development of this LHMP:

Commonwealth Level:

- Puerto Rico Land Use Plan (PUT-PR)
- Utuado Territorial Plan (PT)
- Karst Special Planning Area Plan and Regulation
- Joint Regulation for the Evaluation and Issuance of Permits
- Special Flood Hazard Areas Regulation (2021)
- Stormwater System Design, Operation, and Maintenance Regulation
- Utuado Emergency Operations Plan

Following adoption, the LHMP will guide updates to the Territorial Plan, special area plans, and urban expansion plans, and will inform municipal budget priorities. Once FEMA approval is received, a digital copy of the Plan will be submitted to the Puerto Rico Planning Board to support updates to the PUT-PR and other relevant Commonwealth planning documents.

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8. Adoption and Approval (F1-a, F1-b)

8.1 LHMP Adoption

Federal policy establishes LHMPs must include "Documentation that the LHMP has been formally adopted by the governing body of the jurisdiction requesting approval of the Plan. The municipality has one (1) year to adopt the Plan once it receives an Approval Pending Adoption (APA)21.

This LHMP was adopted by the Municipality of Utuado on XXXXXX. A copy of Resolution, titled "To Adopt the 2026 Natural Hazard Mitigation Plan of the Municipality of Utuado and for Other Related Purposes," is included as part of Appendix A.

8.2 LHMP Approval

This LHMP was approved by FEMA and the SHMO on **XXXXX**. A copy of the Approval Letter, titled *"Approval of the Local Hazard Mitigation Plan, Municipality of Utuado,"* is included in **Appendix A**. FEMA's approval of the Plan is valid for a period of **five (5) years**, through **XXXXXX**

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[21] 44 C.F.R. §201.6(c)(5)

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Appendix A: Adoption and Approval

Adoption

To be included in the final approved version

Approval by FEMA

To be included in the final approved version

FEMA APA Letter FEMA

To be included in the final approved version

Review Tool Sheet

To be included in the final approved version

Draft

Appendix B: Planning Committee

Commitment letter

JUNTA DE
PLANIFICACIÓN
GOBIERNO DE PUERTO RICO

Carta de Compromiso sobre el Plan de Mitigación Municipal

El Municipio de Utuado, representado en este acto por su alcalde, Hon. Jorge A. Pérez Heredia, mediante el presente documento denominado carta de compromiso se compromete en conjunto con la Junta de Planificación de Puerto Rico (JPPR) trabajar en la revisión y actualización del plan de mitigación contra peligros naturales municipal (Plan). El mismo tiene el objetivo de identificar actividades y medidas dirigidas a la mitigación de peligros naturales tales como huracanes, inundaciones, sequías, terremotos, deslizamientos, tsunami entre otros que apliquen. El Plan tiene dentro de sus prioridades la reducción de pérdidas de vida y propiedad asociado a los diferentes peligros naturales e identificar medidas para atender las necesidades del municipio y sus residentes de manera planificada y ordenada, promoviendo así el desarrollo sostenido mediante la preservación de la función natural y los beneficios de la conservación de los recursos naturales y la infraestructura.

Observando los planes que se han vencido, y están próximos a vencer, la *Oficina Central de Recuperación, Reconstrucción y Resiliencia* (COR3 por sus siglas en inglés) procedió asignar presupuesto a la JPPR para atender la revisión y actualización de los Planes de Mitigación Contra Peligros Naturales de los municipios. Es importante destacar que los planes de mitigación deberán estar aprobados por la Agencia Federal para el Manejo de Emergencias (FEMA por sus siglas en inglés) para evitar que los municipios pierdan los fondos asignados para la ejecución de los proyectos. Por lo tanto, recae sobre el municipio la responsabilidad de gestionar adecuadamente su plan, ya que la falta de vigencia conllevaría la pérdida de dichos fondos.

La JPPR está facultada para asistir a los municipios, conforme a la Ley Orgánica de la Junta de Planificación de Puerto Rico, Ley Núm. 75 del 24 de junio de 1975, según enmendada, 23 LPRA., sección 62 (k). Asimismo, la JPPR podrá hacer uso de recursos externos para la elaboración del plan de mitigación.

A su vez el Municipio está facultado a realizar acuerdos con cualquier agencia del Gobierno Central para que este desarrolle o lleve a cabo, en beneficio del Municipio, cualquier estudio, trabajo, obra o mejora pública municipal conforme a lo establecido en la ley Código Municipal de Puerto Rico, Ley Núm. 107 del 13 de agosto de 2020, según enmendada.

Es esencial que este plan cumpla con los requisitos del Acta de Mitigación de Desastre, la cual establece que los gobiernos municipales y estatales que hayan adoptado sus planes de mitigación contra peligros naturales serán elegibles para fondos de mitigación pre-desastre (Pre-disaster Mitigation Act) y post desastre a través del Programa de Subvención para la Mitigación de Riesgos (HMGP), el Predisaster Mitigation (PDM) y el Flood Mitigation Assistance Program (FMAP).

Por lo tanto, el municipio reconoce que la JPPR se comprometerá a coordinar junto al municipio la aprobación del Plan; coordinar la evaluación del Plan por parte del COR3 y FEMA; y efectuar la entrega del Plan aprobado por COR3 y FEMA al municipio.

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El Municipio asignará una persona contacto o empleado municipal designado por el alcalde que será el contacto oficial (POC) del municipio para la coordinación, ejecución y la elaboración de la actualización del plan de mitigación. Esta persona trabajará directamente con el personal designado por la Junta de Planificación en este proyecto.

Asimismo, el Municipio agilizará y tramitará la adopción del plan mediante Orden Ejecutiva o a través de la Legislatura Municipal mediante Ordenanza Municipal. También coordinará en conjunto con la JPPR o el personal autorizado, el proceso de participación ciudadana.

Se coordinará por parte del municipio la recopilación de información necesaria que sea requerida, incluyendo:

- Identificación de todos los Riesgos locales – Descripción de los diferentes eventos ocurridos en el Municipio y los impactos que han tenido en la comunidad.
- Identificación de inventario de activos del Municipio, de considerarse el activo como uno crítico favor de identificar el mismo como activo-crítico.
- Información necesaria para complementar la Tabla de análisis de capacidad.
- Identificación e Implantación de las Medidas / actividades de Mitigación: Lista de proyectos y Plan de Acción describiendo cómo los proyectos serán implantados por prioridades, cómo serán administrados, si son costo-beneficiosos.
- Evaluación del Plan Preliminar.
- Evaluación del Borrador del Plan.
- Evaluación del Borrador Final del Plan.
- Implementación del Plan de Mitigación - Monitoreo, Evaluación y Actualización.
- Realizar los esfuerzos educativos y comunicación necesarios a los diferentes sectores de la ciudadanía de este proceso de actualización del plan.
- La JPPR coordinará con el municipio respecto a cualquier otra información que se requiera.

Este compromiso no implica la erogación de fondos públicos por parte del municipio ni de la JPPR. A su vez, podrá ser terminado por la JPPR o por el Municipio, mediante comunicación escrita dirigida al presidente de la JPPR o al alcalde, según corresponda.

Por lo que, de acuerdo con este compromiso, yo, Jorge A. Pérez Heredia lo firmo conforme a los mejores intereses del pueblo de Utuado.

En San Juan, Puerto Rico, hoy 16 de diciembre de 2025.

_____
Alcalde

Planning Committee Appointments

NOTIFICACIÓN DE DESIGNACIÓN
Comité de Planificación del Municipio de UTUADO

Yo, **BOLIVAR BERMUDEZ**, alcalde **INTERINO** del Municipio de **UTUADO**, designo a los siguientes funcionarios y representantes como integrantes del *Comité de Planificación para la actualización del Plan de Mitigación contra Peligros Naturales del Municipio de* ***UTUADO***, con el deber de apoyar, asesorar, coordinar y evaluar los trabajos de revisión, actualización, implementación y monitoreo del Plan mencionado.

Nombre	Puesto y Oficina	Correo electrónico	Teléfono (Ext.)
ARCENIO VELEZ PEREZ	DIRECTOR OMME	POLICIAMUNICIPALUTUADO@GMAIL.COM	787-597-9616
HECTOR CRUZ CRUZ	CORDIANDOR RECONSTRUCION	OMMEUTUADO@YAHOO.COM	939-312-2887
ISRAEL MALDONADO	CORDIANDOR REHABILITACION / MIT	Imaldonado.utuado@outlook.com	939-497-8990
YAHAIRA MAESTRE RUIZ	DIRECTORA FINANZAS	FINANZASUTUADO25@GAMIL.COM	787-486-5919

Funciones principales del Comité:

- Coordinar con los trabajos relacionados con la actualización del Plan de Mitigación.
- Participar de talleres, presentaciones y reuniones sobre la actualización del Plan de Mitigación de Riesgos
- Proporcionar información, y datos sobre la evaluación de los riesgos y vulnerabilidades del municipio, así como las capacidades y los proyectos prioritarios de mitigación.
- Asegurar el cumplimiento con los requisitos estatales y federales para la elegibilidad de fondos de mitigación.
- Ayudar a diseñar y proponer acciones y proyectos de mitigación al municipio para fortalecer la resiliencia y reducir los riesgos de desastres.
- Mantener comunicación con la ciudadanía y promover la participación comunitaria en el proceso de mitigación.
- Apoyar la adopción e implantación del Plan de Mitigación.

Esta designación tendrá vigencia inmediata y se mantendrá en efecto hasta que se notifique lo contrario.

Firmada hoy, 28 ENERO DEL 2026

SR. BOLIVAR BERMUDEZ
Nombre

Firma_____
Alcalde Interino Municipio Utuado

JUNTA DE
PLANIFICACIÓN
GOBIERNO DE PUERTO RICO

FORMULARIO PARA DESIGNAR PERSONA(S) CONTACTO(S)
PLAN DE MITIGACIÓN CONTRA PELIGROS NATURALES

Municipio: Utuado

	Nombre	Teléfono	Correo electrónico
Personal Designado	Hector Crúz Crúz	939-312-2897	omuutuado@yahoo.com
Personal Alterno	Arsenio Vélez Pérez	787-597-5745	policiamunicipalutuado2021@gmail.com
	Israel Maldonado	939-497-8990	imaldonadoutuado@outlook.com

Hon. Jorge A. Pérez Heredia
Nombre (letra de molde)
Alcalde

Firma
Alcalde

Fecha: _____

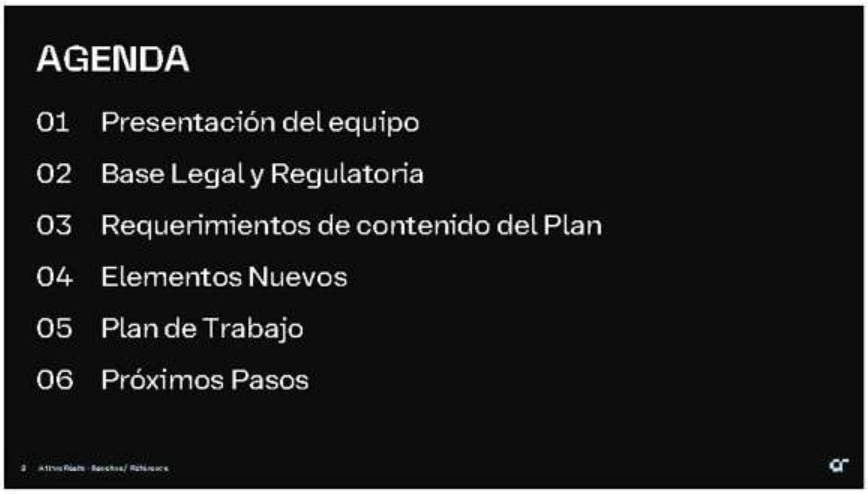
First Planning Committee Meeting

Presentation

02/03/2026

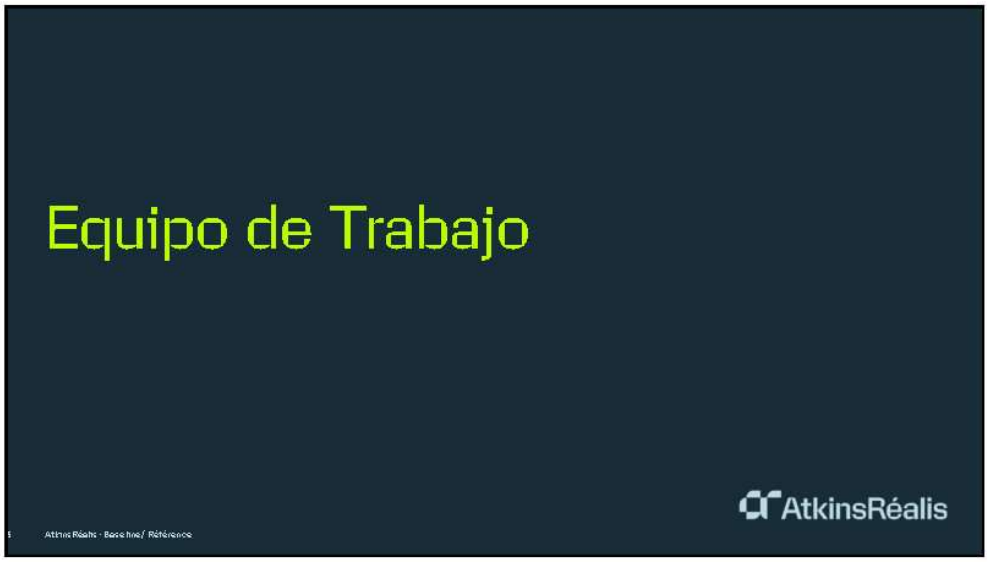


1



2

1


Equipo de Trabajo
AtkinsRéalis

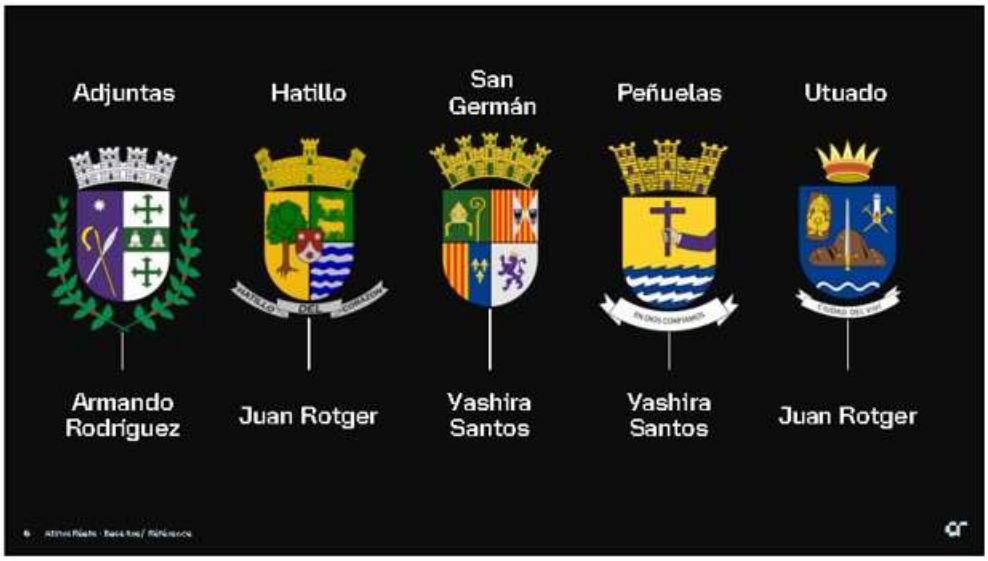
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Equipo de Trabajo
William Pitre, Senior Planner
Ivelisse Gorbea, Senior Planner
Celso Ruiz, Data Analyst
Marsha Caride, Administrative Assistant

4


Equipo de Trabajo
Mario González, Analista de Planificación
Yashira Santos, Analista de Planificación
Leonardo Pérez, Analista de Planificación
Armando Rodríguez, Analista de Planificación
Juan Rotger, Analista de Planificación

5


Adjuntas
Hatillo
San Germán
Peñuelas
Utuado
Armando Rodríguez
Juan Rotger
Yashira Santos
Yashira Santos
Juan Rotger

6

3

Base Regulatoria

7

Base Legal y Regulatoria

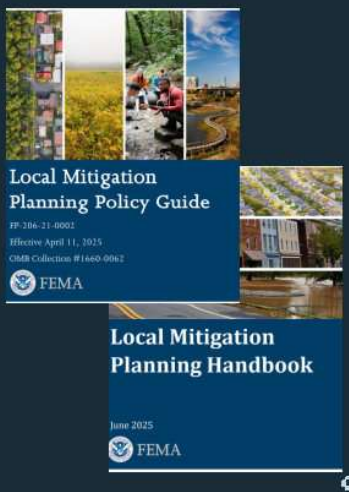
- **Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended**
  - PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288.
  - National Flood Insurance Act of 1968, as amended.
  - National Dam Safety Program Act (Pub. L. 92-367), as amended.
  - Regulation: 44 CFR Part 201 Mitigation Planning.



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Requerimientos del Plan de Mitigación

- Elemento A: Proceso de Planificación
- Elemento B: Identificación de Peligros y Evaluación de riesgos
- Elemento C: Estrategias de Mitigación
- Elemento D: Plan de Seguimiento e Implementación
- Elemento E: Actualización del Plan
- Elemento F: Adopción del Plan
- Elemento G: Peligros Potenciales ante fallos en Represas (opcional)
- Elemento H: Requisitos Estatales Adicionales



9

Elementos nuevos del Plan

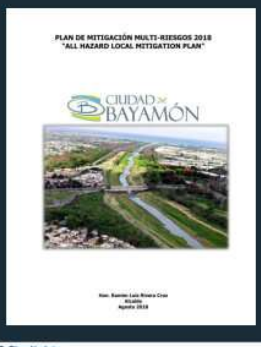
1. **Identificación y evaluación de riesgos**
   - Se clasifica la infraestructura crítica por servicio vital o línea de vida
   - Se analiza su exposición y vulnerabilidad
   - Se prioriza por línea de vida
2. **Evaluación de capacidades**
   - Se evalúa la capacidad local para proteger servicios vitales
   - Se identifican brechas y se proponen acciones
3. **Estrategia de Mitigación**
   - Se incluyen acciones específicas para proteger, estabilizar y restaurar servicios vitales
4. **Participación de Partes Interesadas**
   - Se invita a agencias responsables o representantes de servicios vitales y se documenta su participación
   - Se comunica al público y recopila retroalimentación sobre los servicios vitales



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Elementos nuevos del Plan

- **Actualización del Plan:**
  "Review Tool" especifica los elementos que se deben documentar para reflejar los cambios
  - El Plan describe los cambios en las áreas propensas a peligros (ha incrementado o disminuido la vulnerabilidad o peligro)
  - Deberá reflejar los cambios en prioridades y progreso de los esfuerzos locales de mitigación.



Element E: Plan Update

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))		
E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved?	Click or tap here to enter text.	Choose

11 Attire Risahi - Baseline / Reference

11

Proceso del Plan de Mitigación

Step 1. Organize the Planning Process and Resources	Step 2. Assess Risks	Step 3. Develop a Mitigation Strategy	Step 4. Adopt and Implement the Plan
Task 1. Determine the Planning Area and Resources	Task 4: Conduct a Risk Assessment	Task 5: Review Community Capabilities	Task 7: Review and Adopt the Plan
Task 2: Build the Planning Team		Task 6: Develop a Mitigation Strategy	Task 8: Keep the Plan Current
Task 3: Create an Outreach Strategy			Task 9: Create a Safe and Resilient Community

12 Attire Risahi - Baseline/ Reference

12

Riesgos a Evaluar

13

Peligros a considerar


Terremoto


Modificaciones costeras


Marejada Ciclónica


Fuego Forestal


Deslizamientos


Inundaciones


Calor Extremo


Pandemia/ Epidemia


Tsunami


Ciclones Tropicales


Sequías

14

Represas

Adjuntas

Peñuelas

Utuado

15

¿Qué necesitamos del Municipio?

- Designación del Comité de Planificación
- Apoyo en la actualización de las estrategias de mitigación del plan anterior.
- Incorporación de nuevas estrategias de mitigación.
- Actualizacion de capacidades

16


Evaluación de Capacidades
17 Attms Réalis - Baseline/ Référence

17


Capacidades
Planificación y Reglamentación
Técnica
Financiera
Alcance Comunitario
Desarrollo de Capacidades
18 Attms Réalis - Baseline/ Référence

18

Participación Ciudadana

19

Participación Ciudadana

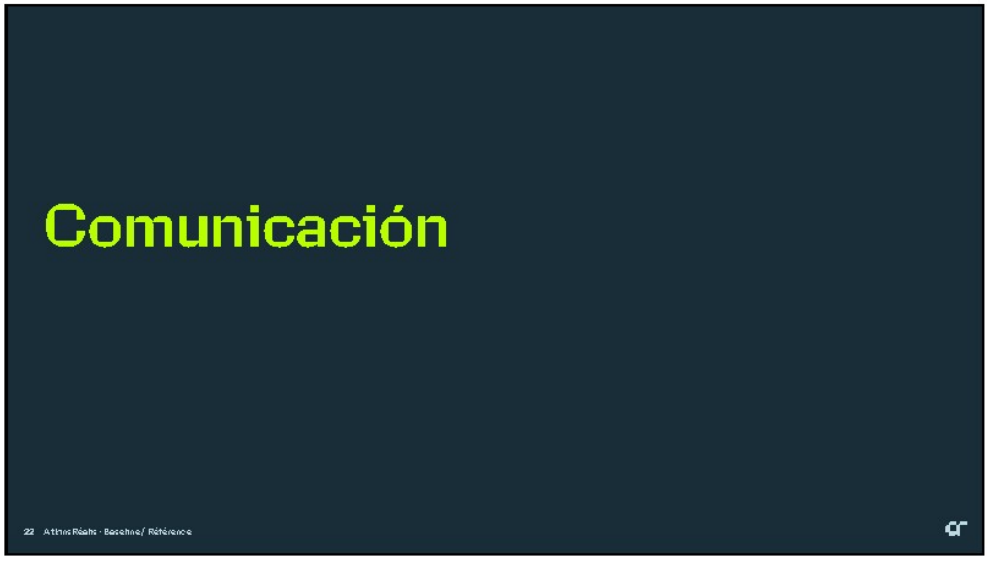
- Dos reuniones de participación ciudadana.
- Notificación sera publicada por Junta de Planificación.
- Publicar 15 días antes de la reunion
- Se otorga 15 días para comentarios
- Para la Segunda reunion se discute el primer borrador.
- El primer borrador sera comentado por el publico, el municipio y la Junta de Planificación



20


Ventana para la primera actividad de participacion ciudadana
2 de marzo al 13 de marzo
Debe informar su fecha de reunion antes del lunes 9 de febrero.
Favor proveer varias fechas para que su analista de Planificación pueda estar.
De no recibir las fechas en o antes del lunes 9, su reunión será calendarizada después de las de otros municipios.

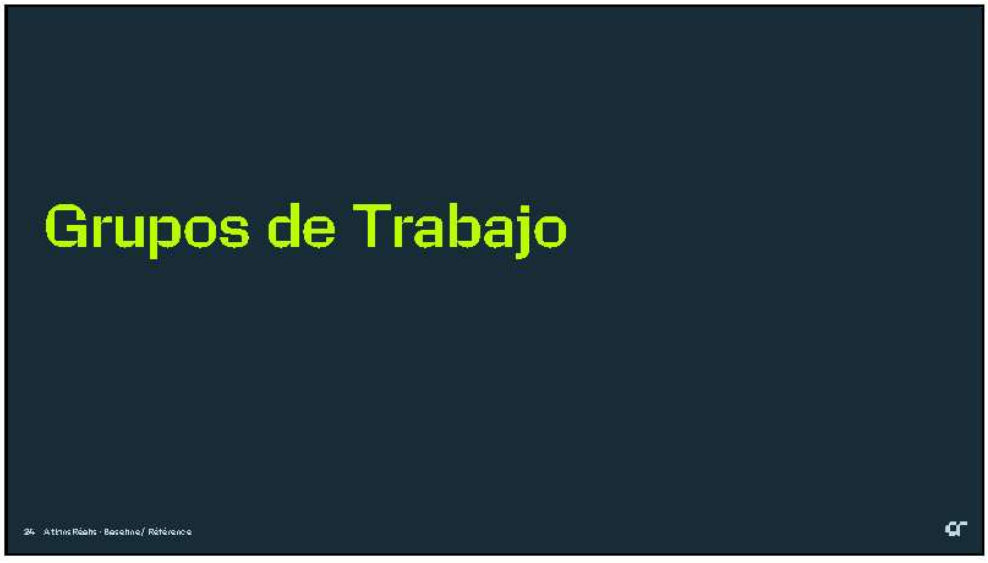
21


Comunicación

22

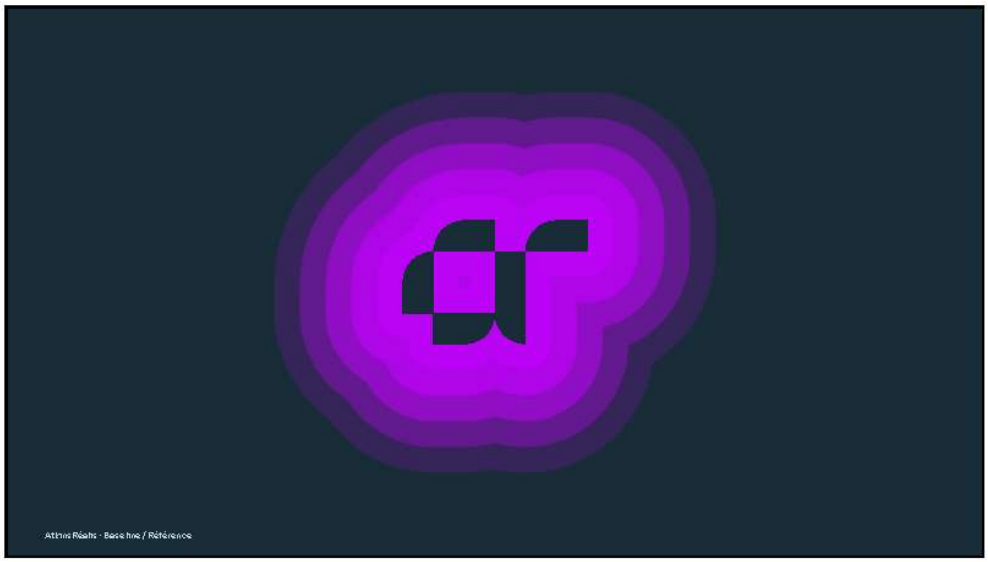

PLANIFICACION
Información de Contacto
Programa
Junta de Planificación
prpb.lhmp@atkinsrealis.com
Plan. Ivette Colón
Junta de Planificación
colon_i@jp.pr.gov
Plan. William Pitre
AtkinsRéalis Caribe
William.Pitre@atkinsrealis.com /+19392051336
Pedimos que el título de todo correo comience únicamente con el nombre del municipio.
Ej.: "San Germán – Tablas de Mitigación Actualizadas"
Solicitamos que en todo correo electrónico relacionado con el programa se copie siempre al correo oficial:
prpb.lhmp@atkinsrealis.com

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Grupos de Trabajo

24

12



25

MINUTA

PROYECTO:	PRPB 25 LHMP Update		
TITULO:	First Committee Meeting		
LUGAR DE LA REUNIÓN:	Centro Gubernamental Minillas	**# REUNIÓN:**	01
FECHA Y HORA:	02/09/2026 – 1:00pm	**MINUTA POR:**	Juan P. Rotger Sánchez

Lista de Asistencia:

NOMBRE	INICIALES	COMPAÑÍA
Arsenio Vélez Pérez	AVP	Municipio de Utuado
Héctor Cruz	HC	Municipio de Utuado
Israel Maldonado	IM	Municipio de Utuado
Juan P. Rotger Sánchez	JPR	AtkinsRéalis

Asuntos Discutidos:

ID	ASUNTOS DISCUTIDOS
AD-1	Aprobación de Minuta Reunión Anterior: ▪ N/A
AD-2	Asunto Relacionado con Alcance de Servicio Contratado y Entregables ▪ N/A
AD-3	Plan de Trabajo Propuesta (Two Weeks Ahead / Four Week Ahead) ▪ N/A
AD-4	Asuntos Nuevos ▪ La reunión dio inicio con una presentación a cargo del planificador William Pitre, de AtkinsRéalis, en la cual se explicó el alcance del proyecto, las actividades a realizar, los requisitos aplicables y el proceso mediante el cual la Junta de Planificación y AtkinsRéalis estarán desarrollando el Plan de Mitigación para los municipios. ▪ Luego, se procedió a la mesa de trabajo con el municipio de Utuado.

NOTA A LOS DESTINATARIOS:
Estas notas de la reunión reflejan la interpretación de AtkinsRéalis sobre la reunión y las acciones previstas que se derivan de la misma. Se asumirá su conformidad en que estas notas constituyen un registro fiel de lo discutido, a menos que se reciban comentarios adversos por escrito dentro de los cinco (5) días posteriores a su recepción.

PLANIFICACIÓN AtkinsRéalis 1

ID	ASUNTOS DISCUTIDOS
	▪ J. Rotger se presentó y ofreció un resumen de su rol dentro del programa, así como su experiencia previa. Posteriormente, cada uno de los integrantes del municipio se presentó. ▪ J. Rotger solicitó a los integrantes que designaran un Punto de Contacto (POC) principal para facilitar una comunicación más efectiva. Se estableció que IM sería el POC. ▪ Se procedió a preguntar cuán familiarizados estaban o si habían trabajado directamente con el *Local Hazard Mitigation Plan* (LHMP) anterior, con el fin de identificar el estatus de los proyectos incluidos en dicho plan. ▪ El equipo indicó que no había tenido la oportunidad de trabajar con el plan anterior. ▪ De manera breve, J. Rotger repasó la lista de acciones del plan anterior para que los participantes se familiarizaran con su contenido y, al discutirla, pudieran recordar el estatus de alguno de los proyectos. ▪ Acciones discutidas: ▪ El municipio cuenta con un proyecto que atiende mejoras estructurales en la PR-11. ▪ Mediante limpiezas periódicas atienden el sistema de alcantarillado pluvial. No obstante, sostendrán una reunión este mes para desarrollar, implementar y hacer cumplir un programa que mitigue el impacto de escombros en le sistema de alcantarillado del casco urbano. ▪ Anualmente proveen mantenimiento y limpieza en quebradas y ríos en áreas críticas. ▪ Tienen encaminado un estudio para el diseño de la elevación de la muralla de la Urb. Cabrera y el refuerzo la sede de la comandancia. ▪ Desean incluir las áreas como parte del mantenimiento de las líneas eléctricas. ▪ Indicaron que la Autoridad de Carreteras y Transportación realizó una evaluación a todos los puentes del municipio y estiman que al menos el 80% presenta deficiencias. ▪ Anualmente actualizan el Plan de Emergencia. ▪ Para evitar daños repetitivos por eventos de inundación en infraestructura crítica y asegurar el acceso a las comunidades cercanas a la Universidad de Puerto Rico (UPR) de Utuado, se encuentra en construcción un puente provisional. No obstante, el municipio aspira a atender esta situación mediante la construcción de un puente elevado permanente. ▪ Está en proceso un estudio para diseño que atender las inundaciones en la Urb. Pérez Matos y el centro de la ciudad, causadas por el río Viví. ▪ Está en proceso un estudio de diseño para atender las inundaciones en la Urb. Pérez Matos y en el centro de la ciudad, causadas por el río Viví. ▪ No existe una oficina de planificación que recopile de manera sistemática los datos sobre daños a las estructuras municipales ni que mantenga un inventario integral que permita establecer un programa de mantenimiento eficaz. ▪ Durante este mes llevarán a cabo una reunión comunitaria sobre la evaluación de estructuras, con el propósito de generar un inventario que identifique cuáles fueron construidas bajo el código de construcción vigente. ▪ Desean atender las inundaciones en el área del Residencial San José mediante la ampliación de la muralla existente.

NOTA A LOS DESTINATARIOS:
Estas notas de la reunión reflejan la interpretación de AtkinsRéalis sobre la reunión y las acciones previstas que se derivan de la misma. Se asumirá su conformidad en que estas notas constituyen un registro fiel de lo discutido, a menos que se reciban comentarios adversos por escrito dentro de los cinco (5) días posteriores a su recepción.

ID	ASUNTOS DISCUTIDOS
	▪ No cuentan con un sistema de monitoreo y seguimiento para la operación municipal que permita capacitar a los empleados y al personal de seguridad sobre prácticas adecuadas para el manejo de escorrentías, particularmente en el mantenimiento de la infraestructura de alcantarillado y en las actividades operacionales diarias. ▪ Luego de revisar la lista, J. Rotger preguntó y presentó una tabla para identificar proyectos que no estuvieran incluidos en el LHMP anterior y que el municipio considerara importantes para añadir. Estos proyectos serán discutidos durante la reunión de revisión del plan con el resto del comité. ▪ Como parte del esfuerzo por motivar a los presentes a reflexionar sobre proyectos de mitigación prioritarios para su municipio, se implementó una dinámica denominada "Planning Poker", donde J. Rotger les hizo la pregunta que, si pudiesen recibir fondos ilimitados para hacer un sólo proyecto de mitigación, cuál sería y por qué. ▪ Dos (2) de los representantes indicaron que reemplazarían y/o ampliarían la muralla en la San José, Cabrera, La Playita y Pérez Matos. El tercer representante compartió que desea que todos en su municipio cuenten con viviendas resilientes y seguras. ▪ Posteriormente, se les realizó una segunda pregunta a los integrantes del municipio. Se les indicó que, si nuevamente contaran con fondos ilimitados, además del proyecto antes mencionado, cuál sería el otro proyecto de mitigación que atenderían. ▪ Un representante indicó que desarrollaría un proyecto de mitigación y monitoreo de deslizamientos para garantizar carreteras transitables en todo momento y evitar interrupciones en la cadena de suministros. Otro mencionó el control de escorrentías e inundaciones en la Ave. Ribas Dominichi, en el casco urbano y San José. ▪ El tercer representante señaló el control de precipitación en la zona como prioridad. ▪ J. Rotger procedió a compartir una lista con peligros naturales identificados y solicitó que los clasificaran del uno (1) al tres (3), siendo tres (3) el de mayor impacto según su criterio. ▪ Indicaron con tres (3) el colapso de la represa e inundaciones, con uno (1) el terremoto. ▪ Concluida la dinámica, J. Rotger recalcó que para enviar o solicitar información el correo electrónico del proyecto es prpb.lhmp@atkinsrealis.com.
AD-5	Discusión de Acciones por Tomar ▪ Tabla Inferior
AD-6	Coordinación Próxima Reunión ▪ TBD

Acciones Por Tomar:

NOTA A LOS DESTINATARIOS:
Estas notas de la reunión reflejan la interpretación de AtkinsRéalis sobre la reunión y las acciones previstas que se derivan de la misma. Se asumirá su conformidad en que estas notas constituyen un registro fiel de lo discutido, a menos que se reciban comentarios adversos por escrito dentro de los cinco (5) días posteriores a su recepción.

ID	ACCIONES POR TOMAR	FECHA LÍMITE	ENTIDAD RESPONSABLE
AT-1	Confirmación de fecha, hora y lugar para reunión comunitaria.	02/03/2026	Municipio de Utuado
AT-2	Envío de logo al municipio.	02/03/2026	Municipio de Utuado

Acuerdos/Aclaraciones:

ID	DESCRIPCIÓN
AC-1	N/A

Anejos:

ID	DESCRIPCIÓN ANEJO	NÚMERO DE PÁGINAS
AN-1	N/A	N/A

PRÓXIMA REUNIÓN:	TBD		
MEDIO DE DISTRIBUCIÓN:	Email		
FECHA DISTRIBUCIÓN:	02/04/2026	ARCHIVO DE REFERENCIA:	First Planning Committee Meeting

NOTA A LOS DESTINATARIOS:
Estas notas de la reunión reflejan la interpretación de AtkinsRéalis sobre la reunión y las acciones previstas que se derivan de la misma. Se asumirá su conformidad en que estas notas constituyen un registro fiel de lo discutido, a menos que se reciban comentarios adversos por escrito dentro de los cinco (5) días posteriores a su recepción.

Second Planning Committee Meeting

Presentation

To be included in the final draft version

Documentation

To be included in the final draft version

Draft

Appendix C: Public Participation and Outreach

First Public Meeting

Notification



Presentation





TRASFONDO

Ley de Mitigación de Desastres de 2000 (DMA2K)

Requiere un plan de mitigación aprobado y adoptado para recibir financiamiento federal a través de:

- ❑ Programa de subvenciones para mitigación de peligros
- ❑ mitigación previa al desastre, y
- ❑ asistencia para mitigar inundaciones.

(d) ***Local governments.*** The key responsibilities of local governments are to:

(1) Prepare and adopt a jurisdiction-wide natural hazard mitigation plan as a condition of receiving project grant funds under the HMGP, in accordance with § 201.6.

(2) At a minimum, review and update the local mitigation plan every 5 years from date of plan approval of the previous plan in order to continue program eligibility.

Regulation: 44 CFR Part 201 Mitigation Planning.

JUNTA DE PLANIFICACIÓN

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

CONCEPTOS IMPORTANTES

Peligros naturales	Eventos o sucesos naturales que amenazan vidas, bienes materiales, infraestructura, el ambiente y otros activos. Tienden a ocurrir repetidamente en las mismas zonas geográficas. Ej. Terremotos, deslizamientos de tierra, hundimientos, inundaciones, tsunamis, huracanes, erosión, incendios, etc.
Mitigación de riesgos	Esfuerzo o acciones para reducir la pérdida de vida y propiedad reduciendo el impacto de los peligros naturales.
Plan de mitigación contra peligros naturales	Documento donde se evalúan la vulnerabilidad del municipio ante los peligros naturales y se identifican acciones para minimizar las pérdidas de vida y propiedad ante un evento futuro.

JUNTA DE PLANIFICACIÓN

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

Ciclo para el manejo de emergencias



PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

Proceso de Planificación para la Mitigación

1. Coordinación con Municipio
2. Evaluación de riesgos
3. Evaluación de capacidad
4. Estrategias de mitigación
5. Mantenimiento del plan
6. Documentación del plan



PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

Coordinación con Municipio

- Carta de compromiso
- Designar el Comité de Planificación de Mitigación de Peligros del municipio.
- Reunión inicial ("kick off meeting").
- La participación pública y divulgación a las principales partes interesadas.
- La recopilación y el análisis de datos.
- Preparación y presentación del plan.

Junta de Planificación

Planes de Mitigación contra Peligros Naturales
Planificar para proteger

Evaluación de Riesgos


Terremoto


Erosión costera/ modificaciones costeras


Marejada Ciclónica


Deslizamientos


Inundaciones


Calor Extremo


Tsunami


Ciclones Tropicales


Sequías


Fuego Forestal


Pandemia/ Epidemia

Junta de Planificación

Planes de Mitigación contra Peligros Naturales
Planificar para proteger

Evaluación de capacidad

- Mide la capacidad para implementar el plan de mitigación de peligros.
- El propósito es establecer la capacidad municipal para la planificación, determinación de la capacidad financiera, la asistencia técnica y la necesidad de adiestramiento.
- Las capacidades evaluadas son las siguientes:



Junta de Planificación

Planes de Mitigación contra Peligros Naturales
Planificar para proteger

Resultado de Evaluación



Junta de Planificación

Estrategias de Mitigación

- Describir las metas y objetivos específicos para minimizar el impacto en el municipio.
- Identificar acciones de mitigación específicas y proyectos.
- Estas pueden incluir:
  - **Prevención**- actividades tales como planificación usos terrenos, regulaciones, mantenimientos, etc.
  - **Protección de propiedades**- mejoras de diseños, relocalización, adquisición, etc.
  - **Proyectos de estructura**- ej. Diques, muros de contención, alcantarillado pluvial, etc.
  - **Servicios de emergencia**- alertas, sistemas de advertencias, manejo y planes de desalojo, ejercicios de respuesta a emergencias, etc.
  - **Educación y concientización pública.**

JUNTA DE PLANIFICACIÓN

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

Mantenimiento y documentación del Plan

- **Monitoreo:** Identificar frecuencia para verificar el progreso de las acciones en el plan.
- **Evaluación:** Determinar si el plan sigue siendo viable, si las acciones aún tienen sentido, etc.
- **Actualización:** Si se determina que algo debe cambiarse en el proceso de evaluación, identificar persona a cargo (comité de planificación) para la actualización cada 5 años.
- **Adopción del Plan por el municipio:** ordenanza de la legislatura municipal u orden ejecutiva del alcalde.
- **Revisión, certificación y aprobación de FEMA.**

JUNTA DE PLANIFICACIÓN

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
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Proyecto actualización de los Planes de Mitigación

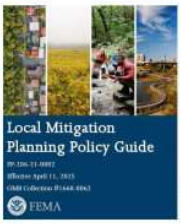


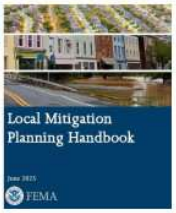
JUNTA DE PLANIFICACIÓN

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

Alcance del trabajo

1. Revisar y actualizar los planes de mitigación contra peligros naturales de acuerdo con las nuevas guías y regulaciones.
2. Coordinar las actividades y trabajos en conjunto con el municipio y la Junta de Planificación.
3. Promover la participación ciudadana.
   - Reuniones de planificación con la comunidad
   - Página cibernética JP (www.jp.pr.gov)





plandemitigación@jp.pr.gov

JUNTA DE PLANIFICACIÓN

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger


ACTIVIDADES DEL PROYECTO
1ra Reunión de planificación con la comunidad
2da Reunión de planificación con la comunidad
Revisión del Plan por FEMA/ Aprobación APA
Aprobación final del Plan por FEMA
1ra Reunión Inicial (Comité)
Plan Borrador + Reunión con el Comité
Borrador Final
Adopción del Plan (Municipio)
• Orientar sobre el proceso del plan de mitigación.
• Insumos de la comunidad sobre riesgos.
• Orientar sobre el borrador del plan de mitigación.
• Incorporar comentarios de los ciudadanos al Plan.
• plandemitigacion@jp.pr.gov
JUNTA DE PLANIFICACIÓN
PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger


ENCUESTA DE LA COMUNIDAD
JUNTA DE PLANIFICACIÓN
PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

Comment Forms

BOLETA DE COMENTARIOS COMUNITARIOS

Plan de Mitigación contra Peligros Naturales Utuado
Municipio

Referencia relativa del lugar: _____

Comentario relacionado a temas de mitigación de peligros naturales:
(Describa inquietudes, riesgos identificados, sugerencias o situaciones que afecten su comunidad)

Tenemos Centro Comunal pero nuestro refugio más cercano era la Esc. Judith A. Vivas pero ya no es refugio y el campo Esc. María L. Gómez la preocupación es que tenemos personas adultas mayores.

¿Cómo se afectó?
Cerca del residencial tenemos una Quebrada que no esta canalizada y pezlicamiento.

Fecha: _____

BOLETA DE COMENTARIOS COMUNITARIOS

Plan de Mitigación contra Peligros Naturales Utuado
Municipio

Referencia relativa del lugar: _____

Comentario relacionado a temas de mitigación de peligros naturales:
(Describa inquietudes, riesgos identificados, sugerencias o situaciones que afecten su comunidad)

El mayor riesgo es por las inundaciones provocadas por el río.
* Se agrava por una industria de fango de arena que ha tapado desagües. Modifica el río: lo estrecha lo reducen ... etc.

¿Cómo se afectó?
En 3 ocasiones el río llegó e inundó la casa familiar donde vivo

Fecha: 11 III 2026

COMENTARIOS DE LA COMUNIDAD

Plan de Mitigación contra Peligros Naturales Ufuculo
Municipio

Nombre (Opcional): _____

Barrio: _

Sector: _

Carreter

Referen

Comentario relacionado a temas de mitigación de peligros naturales:
(Describa inquietudes, riesgos identificados, sugerencias o situaciones que afecten su comunidad)

3 urbanizaciones del pueblo en zona inundable, muchos lugares con peligro de derrumbes, peligro con la crecida de ríos y arroyuelos

¿Cómo se afectó?

Fecha: _____

BOLETA DE COMENTARIOS COMUNITARIOS

Comentario relacionado a temas de mitigación de peligros naturales:
(Describa inquietudes, riesgos identificados, sugerencias o situaciones que afecten su comunidad)

Llevamos años con problema del alcantarillado, ya que hay varios arroyos que no se cortan. Están tan grandes y a los que cruzan la carretera.

¿Cómo se afectó?

Cada vez que llueve se inunda la carretera, ya que el alcantarillado están tapados; por las hojas y ~~[illegible]~~

Fecha: 12-03-26

BOLETA DE COMENTARIOS COMUNITARIOS

Plan de Mitigación contra Peligros Naturales Utuado
Municipio

Referencia relativa del lugar: _____

Comentario relacionado a temas de mitigación de peligros naturales:
(Describa inquietudes, riesgos identificados, sugerencias o situaciones que afecten su comunidad)

Tenemos Centro Comunal pero nuestro refugio más cercano era la Esc. Judith A Vives pero ya no es refugio y tampoco Esc. Maria L. Gomez la preocupación es que tenemos personas de adultas mayores.

¿Cómo se afectó?

Cerca del Residencial tenemos una Quebrada que no esta canalizada y Pezlicamiento.

Fecha: _____

BOLETA DE COMENTARIOS COMUNITARIOS

Plan de Mitigación contra Peligros Naturales Utuado
Municipio

Carretera y Kilómetro: _____

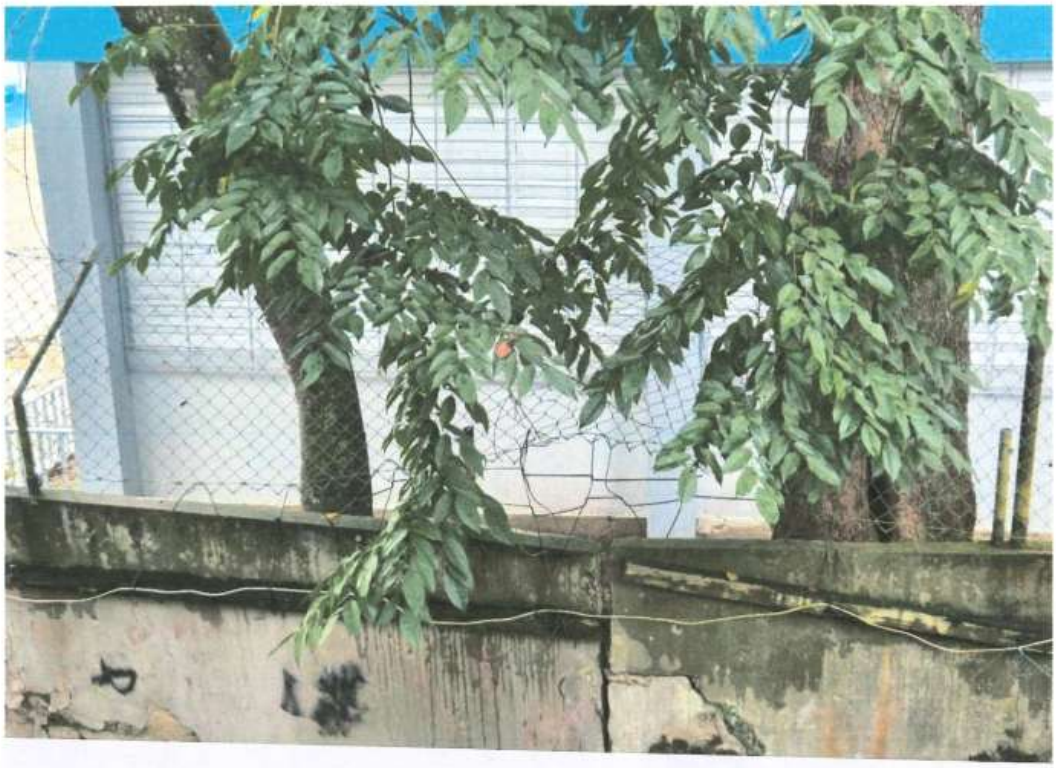
Referencia relativa del lugar: Area de deslizamientos

Comentario relacionado a temas de mitigación de peligros naturales:
(Describa inquietudes, riesgos identificados, sugerencias o situaciones que afecten su comunidad)

¿Cómo se afectó?

Deslizamientos, Seguias

Fecha: _____



BOLETA DE COMENTARIOS COMUNITARIOS

Plan de Mitigación contra Peligros N...

Nombr

Barrio:

Sector:

Carrete... y Kilometro:

Referencia relativa del lugar: Probable deslizamiento de arboles en la Escuela Francisco Lam

Comentario relacionado a temas de mitigación de peligros naturales:
(Describa inquietudes, riesgos identificados, sugerencias o situaciones que afecten su comunidad)

Desde los años 90 se dejaron crecer arboles en el area del rio de nuestra propiedad y luego del huracan Maria este se ha convertido en un peligro latente. Hay la ocasión un evento de deslizamiento podria afectar nuestra propiedad pero puede causar daños a la escuela y causar perdida de vida y enseres.

¿Cómo se afectó?

Fecha: 3/15/2024



Attendance sheets

JUNTA DE PLANIFICACIÓN
GOBIERNO DE PUERTO RICO

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

HOJA DE ASISTENCIA

Asunto: 1era Reunión de Planificación con la Comunidad- Municipio de Utuado — Fecha: 12 de marzo de 2026

Lugar: Legislatura Municipal, 8 Calle Dr. Betances, Utuado P.R. — Hora: 6:00 PM

Nombre completo (en letra de molde)
José M. Montes
Frederick Coll
Edir Ramírez
Sonia E. Cruz
Diana de la Paz
Celines Beauchamp Rodriguez
Maria Montalvo
Arsenio Vélez Rios
*Elliot Sosa
Maria E. Rivera

JUNTA DE PLANIFICACIÓN
GOBIERNO DE PUERTO RICO

PLANES DE MITIGACIÓN CONTRA PELIGROS NATURALES
Planificar para proteger

HOJA DE ASISTENCIA

Asunto: 1era Reunión de Planificación con la Comunidad- Municipio de Utuado — Fecha: 12 de marzo de 2026

Lugar: Legislatura Municipal, 8 Calle Dr. Betances, Utuado P.R. — Hora: 6:00 PM

Nombre completo (en letra de molde)
Maribel Hernandez
Thalia C. Vélez
Malvaina Maldonado
Manuel A. Garcés
Yanaira Maestre
Javier Schettini Morales
José L. Gonzalez
Israel L. Morell
Alan J. Gonzalez Cancel
Jorge Ubaldo Hernandez

JUNTA DE PLANIFICACIÓN
GOBIERNO DE PUERTO RICO

PLANES DE MITIGACIÓN
CONTRA PELIGROS NATURALES
Planificar para proteger

HOJA DE ASISTENCIA

Asunto: 1era Reunión de Planificación con la Comunidad- Municipio de Utuado
Fecha: 12 de marzo de 2026
Lugar: Legislatura Municipal, 8 Calle Dr. Betances, Utuado P.R.
Hora: 6:00 PM

Nombre completo (en letra de molde)				
Ivette Colón Melendez				
Pablo Collazo Cortés				
Luis Lamboy Torres				

Dra

Photographic records





Draft


SALON
DR. ANTONIO CAPELLA
REVISIÓN Y ACTUALIZACIÓN DEL
PLAN DE MITIGACIÓN CONTRA
PELIGROS NATURALES


SALON
DR. ANTONIO CAPELLA

Second Community Meeting

Notification

To be included in Final Draft

Presentation

To be included in Final Draft

Attendance Sheet

To be included in Final Draft

Photographic Record

To be included in Final Draft

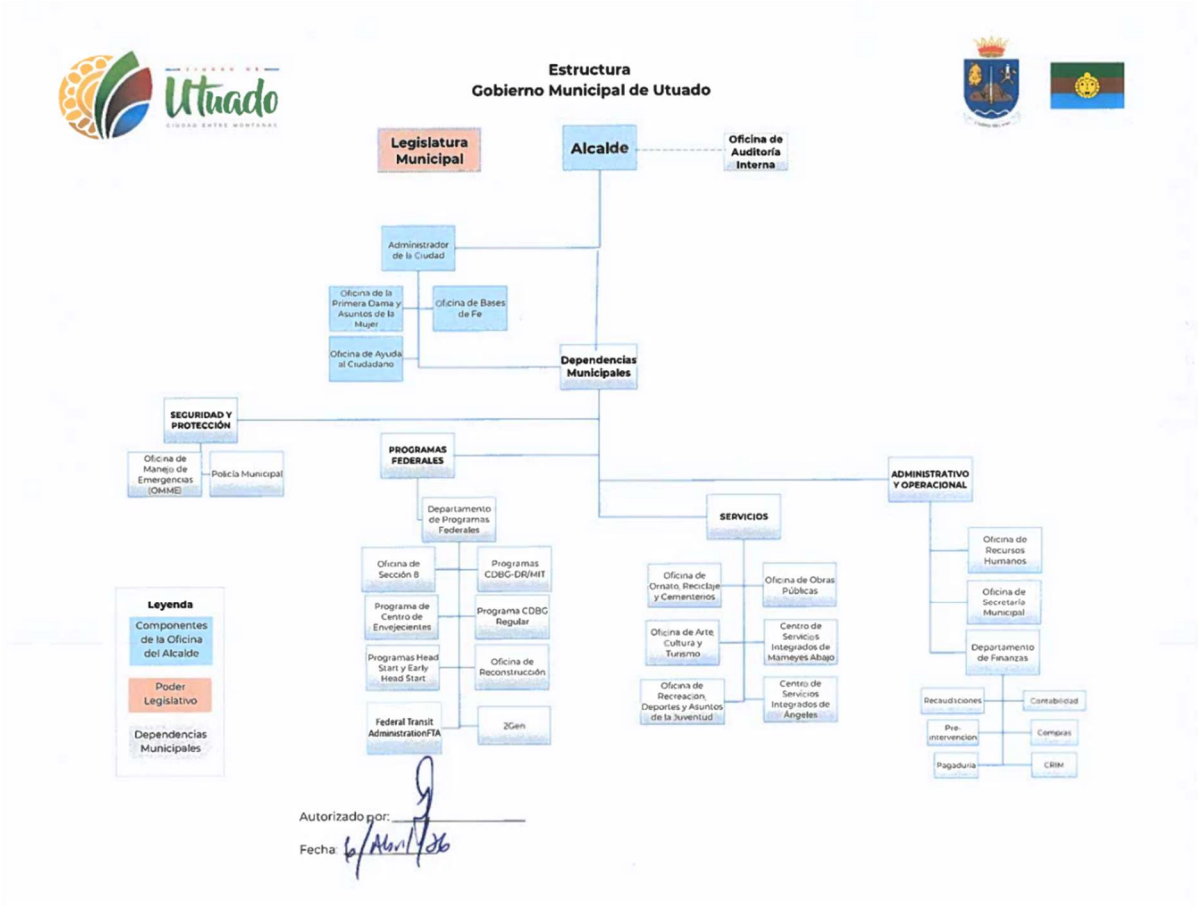
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Appendix D: Stakeholder Involvement

To be included in the final draft version

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Appendix E: Organization Chart



Appendix F: List of Critical Infrastructures by Lifeline

The following table offers a list of Critical Infrastructures in Utuado according to the Puerto Rico Planning Board.

Table 57: Critical Infrastructures by Lifeline

Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
(Est. de Bomba) Alturas de Utuado	18.26444	-66.6912	Lifeline: Water Systems	Water Supply	PRASA
(Est. de Bomba) Calle Progreso	18.26647	-66.699	Lifeline: Water Systems	Water Supply	PRASA
(Est. de Bomba) Colegio Regional	18.25777	-66.7225	Lifeline: Water Systems	Water Supply	PRASA
(Est. de Bomba) La Playita	18.26661	-66.708	Lifeline: Water Systems	Water Supply	PRASA
(Est. de Bomba) Perez Matos	18.26654	-66.7029	Lifeline: Water Systems	Water Supply	PRASA
(Est. de Bomba) San Jose	18.28351	-66.7025	Lifeline: Water Systems	Water Supply	PRASA
(Est. de Bomba) Santa Clara	18.27207	-66.7101	Lifeline: Water Systems	Water Supply	PRASA
(Est. de Bomba) Urbanizacion Cabrera	18.26645	-66.7101	Lifeline: Water Systems	Water Supply	PRASA

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
(Est. de Bomba) Utuado Nueva Salto Abajo	18.28315	-66.7056	Lifeline: Water Systems	Water Supply	PRASA
(Generador) Alturas de Utuado	18.26438	-66.6912	Lifeline: Water Systems	Water Supply	AAA
(Generador) Calle Progreso	18.26656	-66.6989	Lifeline: Water Systems	Water Supply	AAA
(Generador) PAS Utuado Nueva	18.30594	-66.6853	Lifeline: Water Systems	Water Supply	AAA
(Generador) PAS Vega Alta	18.41776	-66.3384	Lifeline: Water Systems	Water Supply	AAA
(Generador) San Jose	18.28355	-66.7024	Lifeline: Water Systems	Water Supply	AAA
Archilla St Km. 0.01	18.26698	-66.6974	Lifeline: Transportation	Transportation Systems	Puente
Cancha Bo. Ángeles	18.28528	-66.7994	Lifeline: Food, Hydration and Shelter	Food Supply	Centro de Acopio
Cancha de Baloncesto	18.27799	-66.8177	Lifeline: Food, Hydration and Shelter	Food Supply	Centro de Acopio
Casa Alcaldía	18.26502	-66.6998	Lifeline: Safety and Security	Government Service	Gobierno

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
Centro Comunal Caguana	18.29307	-66.7353	Lifeline: Food, Hydration and Shelter	Food Supply	Centro de Acopio
Centro Comunal Fernando Luis Garcia	18.26864	-66.6988	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Centro Comunal Res. Jardines de Utuado	18.27003	-66.7013	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Centro de Acopio	18.28347	-66.666	Lifeline: Food, Hydration and Shelter	Food Supply	Centro de Acopio
Centro de Acopio Municipal	18.26577	-66.7212	Lifeline: Food, Hydration and Shelter	Food Supply	Centro de Acopio
Centro de Envejecientes Recreativo Mis años de Dorados	18.26528	-66.6962	Other Facilities	Recreational Facilities	Centros Comunales
Centro de Gobierno Bo. Caguana	18.28244	-66.7578	Lifeline: Safety and Security	Government Service	Gobierno
Centro de Gobierno Estatal	18.26795	-66.7126	Lifeline: Safety and Security	Government Service	Gobierno

Draft

Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
Centro de Gobierno Municipal Bo. Ángeles	18.28518	-66.7999	Lifeline: Safety and Security	Government Service	Manejo de Emergencias
Centro de maquinaria municipal	18.25208	-66.6794	Lifeline: Safety and Security	Government Service	Gobierno
Centro Judicial	18.26928	-66.697	Lifeline: Safety and Security	Law Enforcement	Gobierno
Ciudad Dorada Madre Dios	18.22216	-66.6737	Other Facilities	Recreational Facilities	Centros Comunales
Comandancia de la Policía Region Utuado	18.26711	-66.712	Lifeline: Safety and Security	Law Enforcement	Cuartel de la Policía Estatal
Community Assets de pelota	18.28979	-66.8026	Other Facilities	Recreational Facilities	Community Asset
Cuartel de la Policía Estatal	18.29934	-66.5964	Lifeline: Safety and Security	Law Enforcement	Estaciones De Policía
Cuartel de la Policía Estatal	18.28826	-66.8023	Lifeline: Safety and Security	Law Enforcement	Estaciones De Policía

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
Cuartel de la Policía Municipal	18.26495	-66.6993	Lifeline: Safety and Security	Law Enforcement	Estaciones De Policía
Depto. de Justicia (Fiscalía) / USDA Rural Development	18.26747	-66.6959	Lifeline: Safety and Security	law enforcement	Gobierno
EBAS Calle Progreso	18.26644	-66.6988	Lifeline: Water Systems	Water Supply	Sanitary System
EBAS Perez Matos	18.26663	-66.7029	Lifeline: Water Systems	Water Supply	Sanitary System
Esc. Antonio Reyes Padilla	18.26707	-66.7256	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Esc. Antonio Tulla Torres	18.29859	-66.602	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Esc. Bernardo González	18.27555	-66.7114	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Esc. Carmen Aponte	18.29467	-66.7395	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Esc. Elemental Bo. Ángeles	18.29231	-66.8036	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Esc. Francisco Jordán	18.28348	-66.7516	Lifeline: Food, Hydration and Shelter	Shelters	Refugio

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
Esc. José Vizcarrondo	18.28419	-66.8033	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Esc. Segunda Unidad	18.22097	-66.6735	Lifeline: Food, Hydration and Shelter	Shelters	Refugio
Estación de Bombas AAA	18.27936	-66.7324	Lifeline: Water Systems	Water Supply	Potable Water Systems
Estación de Bombas AAA	18.27201	-66.8148	Lifeline: Water Systems	Water Supply	Potable Water Systems
Estación de Bombas AAA Agua Potable	18.2398	-66.6789	Lifeline: Water Systems	Water Supply	Potable Water Systems
Estación de Bombas AAA de Aguas Sanitarias (EBAS) Alturas de Utuado	18.26435	-66.6911	Lifeline: Water Systems	Water Supply	Sanitary System
Estación de Bombas AAA Salto Abajo	18.28324	-66.7056	Lifeline: Water Systems	Water Supply	Potable Water Systems
Estacion de Bombeo de Agua Potable	18.23233	-66.678	Lifeline: Water Systems	Water Supply	Potable Water Systems

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
Estación de Bomberos	18.2904	-66.8032	Lifeline: Safety and Security	Fire Station Facilities	Estaciones De Bomberos
Estación de Bomberos	18.2686	-66.702	Lifeline: Safety and Security	Fire Station Facilities	Estaciones De Bomberos
Estacion de Filtros AAA Santa Isabel	18.24615	-66.8108	Lifeline: Water Systems	Water Supply	Potable Water Systems
Estadio Ramón Cabaña	18.27522	-66.7082	Lifeline: Food, Hydration and Shelter	food supply	Centro de Acopio
Guardia Nacional	18.26881	-66.7121	Lifeline: Safety and Security	Law Enforcement	Estaciones De Policía
Hospital Metropolitano	18.26778	-66.7013	Lifeline: Health and Medical	Medical Care	Hospital
IPA 19	18.26574	-66.6988	Lifeline: Health and Medical	Medical Care	CDT
Oficina de Manejo de Emergencias (OMME)	18.26845	-66.7011	Lifeline: Safety and Security	Government Service	Manejo de Emergencias
Palma Street	18.26649	-66.7035	Lifeline: Transportation	Transportation Systems	Puente
Planta de Filtros Saban Grande	18.28192	-66.6713	Lifeline: Water Systems	Water Supply	Potable Water Systems
Planta de Filtros Utuado	18.24398	-66.6704	Lifeline: Water Systems	Water Supply	Potable Water Systems

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
Planta de Tratamiento Utuado	18.30557	-66.6847	Lifeline: Water Systems	Water Supply	Sanitary System
Power Plant Caonillas	18.29618	-66.6432	Lifeline: Energy	Energy Generation And Distribution	AEE, LUMA
PR 10	18.25631	-66.7256	Lifeline: Transportation	Transportation Systems	Puente
PR 10 Km. 38.7	18.23809	-66.7205	Lifeline: Transportation	Transportation Systems	Puente
PR 10 Km. 39.1	18.24303	-66.7231	Lifeline: Transportation	Transportation Systems	Puente
PR 10 Km. 39.6	18.24653	-66.7234	Lifeline: Transportation	Transportation Systems	Puente
PR 10 Km. 47.1	18.30068	-66.7053	Lifeline: Transportation	Transportation Systems	Puente
PR 111	18.29854	-66.7825	Lifeline: Transportation	Transportation Systems	Puente
PR 111	18.29724	-66.8225	Lifeline: Transportation	Transportation Systems	Puente
PR 111	18.29491	-66.825	Lifeline: Transportation	Transportation Systems	Puente
PR 111	18.2591	-66.6852	Lifeline: Transportation	Transportation Systems	Puente
PR 111	18.2589	-66.6852	Lifeline: Transportation	Transportation Systems	Puente
PR 111	18.25274	-66.6789	Lifeline: Transportation	Transportation Systems	Puente
PR 111 Km. 47.1	18.2894	-66.791	Lifeline: Transportation	Transportation Systems	Puente
PR 111 Km. 60.8	18.2674	-66.7082	Lifeline: Transportation	Transportation Systems	Puente
PR 111 Km. 62.2	18.26817	-66.696	Lifeline: Transportation	Transportation Systems	Puente
PR 111 Km. 64.2	18.25639	-66.6828	Lifeline: Transportation	Transportation Systems	Puente
PR 111 Km. 66.1	18.24624	-66.6713	Lifeline: Transportation	Transportation Systems	Puente
PR 111R Km. 2.1	18.26039	-66.6918	Lifeline: Transportation	Transportation Systems	Puente
PR 111R Km. 2.2	18.25933	-66.6907	Lifeline: Transportation	Transportation Systems	Puente

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
PR 123	18.32399	-66.6739	Lifeline: Transportation	Transportation Systems	Puente
PR 123	18.2594	-66.7217	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 48.1	18.22921	-66.7176	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 48.2	18.22984	-66.7172	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 52	18.25131	-66.722	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 55.6	18.26653	-66.7087	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 56.2	18.27558	-66.713	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 56.3	18.27504	-66.7109	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 59.3	18.29767	-66.7071	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 59.35	18.29564	-66.7067	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 59.7	18.30255	-66.7111	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 60.0	18.3239	-66.6739	Lifeline: Transportation	Transportation Systems	Puente
PR 123 Km. 62.5	18.3	-66.6755	Lifeline: Transportation	Transportation Systems	Puente
PR 140	18.27681	-66.6562	Lifeline: Transportation	Transportation Systems	Puente
PR 140	18.2603	-66.6627	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 14.4	18.21694	-66.6426	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 15	18.22339	-66.642	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 27.1	18.27451	-66.6576	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 35.5	18.29141	-66.6147	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 40.3	18.30122	-66.5818	Lifeline: Transportation	Transportation Systems	Puente

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
PR 140 Km. 43.1	18.29849	-66.5878	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 43.35	18.31404	-66.5832	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 43.90	18.31763	-66.5828	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 44.0	18.31787	-66.5826	Lifeline: Transportation	Transportation Systems	Puente
PR 140 Km. 44.4	18.32044	-66.5845	Lifeline: Transportation	Transportation Systems	Puente
PR 146 Km. 7.6	18.325	-66.6124	Lifeline: Transportation	Transportation Systems	Puente
PR 603	18.2599	-66.7223	Lifeline: Transportation	Transportation Systems	Puente
PR 603	18.2598	-66.7222	Lifeline: Transportation	Transportation Systems	Puente
PR 603 Km. 1.2	18.25387	-66.7353	Lifeline: Transportation	Transportation Systems	Puente
PR 603 Km. 1.6	18.25345	-66.7327	Lifeline: Transportation	Transportation Systems	Puente
PR 605	18.18016	-66.6639	Lifeline: Transportation	Transportation Systems	Puente
PR 605 Km. 5.8	18.21266	-66.6733	Lifeline: Transportation	Transportation Systems	Puente
PR 611 Km. 0.01	18.26615	-66.7005	Lifeline: Transportation	Transportation Systems	Puente
PR 612 Km. 0.10	18.28112	-66.6439	Lifeline: Transportation	Transportation Systems	Puente
PR 612 Km. 3.0	18.30128	-66.6448	Lifeline: Transportation	Transportation Systems	Puente
PR 612 Km. 3.7	18.30194	-66.6439	Lifeline: Transportation	Transportation Systems	Puente
PR 613 Km. 10.60	18.2804	-66.5973	Lifeline: Transportation	Transportation Systems	Puente
PR 984 Km. 5.15	18.31219	-66.6855	Lifeline: Transportation	Transportation Systems	Puente
PR-10	18.25079	-66.7236	Lifeline: Transportation	Transportation Systems	Puente

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Facility Name	Y Coordinate	X Coordinate	Lifeline	Category	Sub-Category
Represa Caonillas	18.2763	-66.6571	Lifeline: Water Systems	Water Supply	Potable Water Systems
Represa Rio Camuy	18.29496	-66.8251	Lifeline: Water Systems	Water Supply	Potable Water Systems
Rural Local Road	18.30604	-66.6964	Lifeline: Transportation	Transportation Systems	Puente
Rural Local Road	18.30111	-66.6983	Lifeline: Transportation	Transportation Systems	Puente
Subestación Eléctrica Utuado	18.26875	-66.6975	Lifeline: Energy	Energy Generation And Distribution	AEE, LUMA
Terminal Carros Públicos (Centro de recuperación de FEMA)	18.26616	-66.6974	Lifeline: Transportation	Transportation Systems	Transporte Público
TKPR El Faro	18.28144	-66.6986	Lifeline: Water Systems	Water Supply	Potable Water Systems
TKPR Salto El Buey	18.2847	-66.691	Lifeline: Water Systems	Water Supply	Potable Water Systems

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Appendix G: DSS-WISE Simulation Methodology for Puerto Rico Hazard Mitigation Plan Update

AtkinsRéalis

DSS-WISE Simulation Methodology for Puerto Rico Hazard Mitigation Plan Update

Overview

This document describes the methodology applied to run dam breach scenarios for the 14 dams requested in Puerto Rico in support of the hazard mitigation plan updates.

Scope

Fourteen (14) dams were identified for evaluation. PTS partners had existing 2D dam breach simulation results for four (4) dams within the La Plata watershed that were leveraged for the study. The remaining ten (10) dams were modelled using DSS-WISE.

Methodology

The National Center for Computational Hydroscience and Engineering (NCCHE) developed the (Decision Support System for Water Infrastructure Security (DSS-WISE) tool with funding from FEMA for the purpose of evaluating the consequences of floods relating to dams and levees.

For hazard mitigation planning, it is advised to account for the maximum event. Thus, this inundation mapping exercise will simulate a complete dam failure event assuming failure at top of dam elevations.

Hydraulic Model Outputs

Hydraulic model outputs from dam breach simulations were employed when available. The dams along the La Plata watershed included La Plata Dam, Comerio I Dam, Comerio II Dam, and Carite Dam. These dams followed the same stream

DSS-WISE Inputs

The best available data is captured in the National Inventory of Dams, captured by the United States Army Corps of Engineers (USACE). Table 1 describes how the DSS-WISE inputs are estimated.

Table 1. DSS-WISE Inputs and Assumptions

DSS-WISE Parameters	Inputs
Reservoir Name	NID field for NID ID
Reservoir Point	Identified around NID field for Latitude and Longitude
Normal Pool Elevation (ft NAVD88)	Normal Depth = {NID field for Normal Storage} / {NID field for Surface Area} Normal Pool Elevation = {estimated Ground Elevation} + {Normal Depth}
Normal Pool Volume (ac-ft)	NID field for Normal Storage

- Dam crest elevation used is reasonable.
- DSS-WISE inputs align with the calculated inputs.
- Breach hydrograph, if provided, is reasonable and aligns with the calculation spreadsheet.
- Reservoir volume fills to 100% and drains throughout the simulation.
- Simulation results are complete and reasonable.

GIS Processing

The finalized inundation extents were used to identify impacted points of infrastructure. A visual inspection also evaluated to include structures with a point location that may be outside the inundation area but its associated structure or accessibility would be impacted by a dam breach event.

The impacted points of infrastructure are summarized by the intersecting municipality.

Points

All points of critical infrastructure are provided in the results shapefile. Points are identified by dam breach inundation zone they fall within with a "Y" or "N" in the respective dam's name field. These dams are summarized in the "Dams_List" field that concatenates the dams that may inundate the point of critical infrastructure.

Lines

The lines of critical infrastructure are clipped to the dam inundation extents. These dams responsible for inundation the lines are summarized in the "Dams_List" field that concatenates the dams that may inundate the point of critical infrastructure. For the Primary and Secondary Roads features, duplicate roadways are summarized with alternate names provided for the stretch.

Polygons

Polygons are only provided where they intersect a dam inundation extent. Polygons are identified by dam breach inundation zone they fall within with a "Y" or "N" in the respective dam's name field. These dams are summarized in the "Dams_List" field that concatenates the dams that may inundate the point of critical infrastructure.

Where polygons intersect multiply municipalities, they are duplicated such that they are present for each municipality.

Data Sources

Data was leveraged from numerous federal sources, such as the FEMA Resilience Analysis and Planning Tool (RAPT) and the Federal Geographic Data Committee (FGDC) National Geographic Data Asset (NGDA). These datasets are described in Table #.

Dataset	Description	Source
Critical Infrastructure	Points of critical infrastructure, provided by the Caribe team's contacts.	Junta de Planificación de Puerto Rico (2026)
Municipalities	Polygon boundaries of municipalities, provided by the Caribe team's contacts.	Junta de Planificación de Puerto Rico (2026)

DSS-WISE Parameters	Inputs
Maximum Pool Elevation (ft NAVD88)	Maximum Pool Elevation = {estimated Ground Elevation} + {NID field for Dam Height}
Maximum Pool Volume (ac-ft)	NID field for Maximum Storage
Failure Pool Elevation (ft NAVD88)	Same value as Maximum Pool Elevation
Failure Pool Volume (ft NAVD88)	Same value as Maximum Pool Volume
Dam Name	NID field for Dam Name
Dam Crest Line	Drawn following aerial or terrain imagery around NID field for Latitude and Longitude
Crest Elevation (ft NAVD88)	Same value as Maximum Pool Elevation
Hydraulic Height (ft)	NID field for Dam Height
NID ID	NID field for NID ID
Structures Type	NID field for Primary Dam Type
Breach Center Point	Located at a reasonable point, likely along the middle of the crest line
Breach Type	"Reservoir", or "Hydrograph" if Reservoir Breach Type does not fully drain reservoir.
Breach Outflow Hydrograph	If "Hydrograph" Breach Type is selected, use inputs from NRCS TR60 Breach Peak with TR66 Breach Hydrograph worksheet.
Failure Type	"Sudden & Complete Failure"
Domain Buffer Distance (miles)	20 miles (and extended if needed)
Cell Size (ft)	15 ft
Project Name	NID field for NID ID and Dam Name (e.g., "PR#######_Dam_Name")
Scenario Name	Default name
Scenario Description	Default description

Dam Crest Elevation Selection

The dam crest was selected by using the Elevation Profile tool in DSS-WISE Beta 4.0 version to identify the lowest point along the dam crest line.

Where dams were removed from the terrain, the dam crest elevation was selected from the fragments still in the terrain. Where the DSS-WISE simulation failed to match the filled reservoir volume at 100%, the simulation was iterated to identify the elevation to the nearest half-foot to match the filled reservoir volume corresponding to the maximum storage volume indicated in the National Inventory of Dams. Simulations were also performed using a dam crest elevation adding the ground elevation with the dam height.

Hydrograph Breach Simulation

For dams that were unable to fully drain under the reservoir breach scenarios on DSS-WISE, the NRCS TR60/TR66 Breach Hydrograph Worksheet was employed to generate the breach hydrograph for DSS-WISE. Inputs were derived from accessible information online, the NID, or the report from a previous DSS-WISE simulation.

Simulation Quality Checks

The DSS-WISE simulations were independently checked for quality, where the reviewer checked for the following items:

Dataset	Description	Source
USA Structures (Puerto Rico)	Polygon boundaries of building footprints for structures larger than 450 square feet, generated from a collaboration of FEMA, Oak Ridge National Laboratory, and the U.S. Geological Survey	FEMA (2025)
RAPT Colleges and Universities	Point locations of post-secondary education facilities, as defined by the Integrated Post Secondary Education System from the National Center for Education Statistics in the U.S. Department of Education for the 2019-2020 school year, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Hospitals	Point locations of hospital facilities acquired from various state departments or federal sources, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Local Law Enforcement Locations	Point locations of law enforcement agencies as defined by the U.S. Department of Justice – Bureau of Justice Statistics for their Census of State and Local Law Enforcement Agencies, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Public Schools	Point locations of public elementary and secondary education facilities as defined by the Common Core of Data from the National Center for Education Statistics in the U.S. Department of Education for the 2022-2023 school year, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Wastewater	Point locations of wastewater treatment plants compiled from the U.S. Environmental Protection Agency Facility Registry Service and Integrated Compliance Information System, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Nursing Homes	Point locations of facilities that house elderly adults, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Power Plants	Point locations of operable electric generating plants by energy source as defined by the Energy Information Administration, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Prison Boundaries	Polygon boundaries of where the incarcerated population is located with fence lines or building footprints for federal (excluding military) to local government jurisdictions, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Public Health Departments	Point locations of public health department locations downloaded in 2024, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Dialysis Centers	Point locations of dialysis centers identified by Rx Open downloaded in 2023, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)

Garzas Dam (PR00006)

The Garzas Dam runs in series upstream of Adjuntas Dam and Dos Bocas Dam. Since the terrain is steep, these dams are modelled independently. The normal and maximum storage volumes were identical, so the maximum pool elevation was also leveraged for the normal pool elevation.

Adjuntas Dam (PR00007)

The Adjuntas Dam runs in series between Garzas Dam and Dos Bocas Dam. Since the terrain is steep, these dams are modelled independently. The Adjuntas Dam crest elevation was unable to be identified from the terrain, and the sum of the ground elevation and dam height did was unable to acceptably fill the reservoir volume to match the NID data. Thus, the simulation was iterated to find the nearest elevation (to the half-foot) that would fill the reservoir.

Pellejas Dam (PR00008)

The Adjuntas Dam runs in series upstream of Dos Bocas Dam. Since the terrain is steep, these dams are modelled independently. The Pellejas Dam crest elevation was unable to be identified from the terrain, and the sum of the ground elevation and dam height did was unable to acceptably fill the reservoir volume to match the NID data. Thus, the simulation was iterated to find the nearest elevation (to the half-foot) that would fill the reservoir.

Dos Bocas Dam (PR0009)

The Dos Bocas Dam was modelled using the methods described in this report.

Vivi Dam (PR00010)

The Vivi Dam runs in series upstream of Dos Bocas Dam. Since the terrain is steep, these dams are modelled independently. The Pellejas Dam crest was elevation unable to be identified from the terrain, so the dam crest elevation was estimated by adding the dam height to the ground elevation.

Caonillas Dam (PR00011)

The Caonillas Dam was modelled using the methods described in this report.

La Plata Dam (PR00017)

The La Plata Dam was modelled in series with Carite Dam, Comerio I Dam, and Comerio II Dam and is the most significant dam in this series. This dam breach scenario was modelled as a probable maximum flood event by Freese and Nichols, Inc. in October 2024 as part of the February 2024 Puerto Rico Dam Safety Under Extreme Rainfall Final Assessment Report by ARC.

The associated model includes the hydrologic (probable maximum flood event) for the full basin from Carite down, but only the La Plata dam is breached in this model. Thus, points of critical infrastructure upstream of the La Plata Dam may be attributed to the La Plata Dam.

Comerio II Dam (PR00018)

The Comerio II Dam was modelled as a probable maximum flood event by Freese and Nichols, Inc. in October 2024 as part of the February 2024 Puerto Rico Dam Safety Under Extreme Rainfall Final Assessment Report by ARC. The model terminates with ponding in the La Plata Dam.

Dataset	Description	Source
RAPT Pharmacies	Point locations of pharmacies identified by Rx Open downloaded in 2023, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
RAPT Transmission Lines	Lines of electric power transmission lines, collected for the Homeland Infrastructure Foundation-Level Data	FEMA (2025)
NGDA Medical Emergency Response Structures	Point locations of hospitals, medical centers, ambulance services, fire stations, and EMS stations from the U.S. Geological Survey	FGDC (2025)
NGDA Law Enforcement Structures	Point locations of police and prison landmarks from the U.S. Geological Survey	FGDC (2025)
NGDA Recreation Structures	Point locations of campgrounds, trailheads, and visitor information centers from the U.S. Geological Survey	FGDC (2026)
NGDA Landmarks and Government Buildings	Point locations of cemeteries, post offices, city/town halls, and courthouses from the U.S. Geological Survey	FGDC (2025)
NTAD Runways	Polygon boundaries of runways identified from the Federal Aviation Administration	USDOT (2026)
NTAD Aviation Facilities	Point locations of airport locations identified from the Federal Aviation Administration	USDOT (2026)
TIGER/Lines Primary and Secondary Roads (Puerto Rico)	Lines indicating roads part of main artery systems, including interstate highways, U.S. highways, state highways, and county highways.	U.S. Census Bureau (2026)

Results

Results for dam inundation breaches are summarized by HUC10 watershed level. The modeling inputs for the dam breach events modeled on DSS-WISE are also summarized in the DSS-WISE simulation reports.

Guajataca Dam (PR00001)

Guajataca Dam was unable to fully drain under the reservoir breach scenarios on DSS-WISE. The NRCS TR60/TR66 Breach Hydrograph Worksheet was employed to generate the breach hydrograph for DSS-WISE. USACE included a figure of the maximum cross-section of the dam with values to input in the Breach Hydrograph Worksheet, such as the crest width, downstream stability berm width, upstream slope, and downstream slope. The remaining TR60/TR66 inputs were derived from the NID or the report from a previous DSS-WISE simulation.

Guayo Dam (PR00005)

The Guayo Dam was modelled using the methods described in this report.

Comerio I Dam (PR00019)

Comerio I Dam is a very small, run-of-river style dam. Model results are not provided for this dam breach since the inundation results captured by the dams upstream and downstream of Comerio I Dam will capture the hazard of a dam breach.

Cidra Dam (PR00020)

The Cidra Dam crest elevation was unable to be identified from the terrain, and the sum of the ground elevation and dam height did was unable to acceptably fill the reservoir volume to match the NID data. Thus, the simulation was iterated to find the nearest elevation (to the half-foot) that would fill the reservoir.

Carite Dam (PR00021)

The Carite Dam was modelled as a sunny day failure event by Freese and Nichols, Inc. in October 2024 as part of the February 2024 Puerto Rico Dam Safety Under Extreme Rainfall Final Assessment Report by ARC. The model terminates with ponding in the La Plata Dam.

Patillas Dam (PR00023)

The Patillas Dam was modelled using the methods described in this report.

Discussion

Of the 25 municipalities of focus, the dam breaches impacted the following municipalities: Adjuntas, Aguas Buenas, Añasco, Arecibo, Arroyo, Barranquitas, Cataño, Comerío, Dorado, Isabela, Las Marías, Patillas, and Utuado.

The 12 municipalities not impacted by the dam breaches include: Aguada, Ceiba, Hatillo, Jayuya, Peñuelas, Rincón, Salinas, San Germán, Santa Isabel, Vega Alta, Vieques, and Yabucoa.

Recommendations

It is recommended to visually evaluate the identified critical infrastructure impacted, based on local knowledge. There may be schools identified through multiple datasets (Inf_Critica_Final provided by the PRPB LHMP, Schools idenfied by the FGDC NGDA, and Public Schools identified by the FEMA RAPT datasets). All datasets are provided in case one includes details not provided by another dataset. Additional investigation should be employed to determine if the additional data is applicable.

Check the dam breach results are reasonable for the dam's location. The La Plata Dam model extends upstream of the La Plata Dam due to the PMF breach results form the Carite Dam, so those reports should be adjusted accordingly.

If these files are converted to shapefiles, the field names may be truncated to accommodate the shapefile 10-character limit.

SQL Queries

SQL queries are provided below to best understand how to identify different points of relevance.

Definition Query

To remove extraneous point features that are not associated with an existing dam inundation extent using the following definition query:

Dams_List IS NOT NULL

By Municipality

To identify the mileage of roads impacted by municipality, the "municipio" field can be leveraged for querying. For example, the following steps will identify the road names, mileage, and associated dam breaches that impact a road:

1. "Select By Attribute":
    a. Selection Type: "New selection"
    b. Where: "municipio = 'Aguas Buenas' "

By Dam Breach

To identify features impacted by specific dams, the dam can be queried depending on the type of feature, as described below:

1. For discrete point and polygon features: "Select By Attribute":
    a. Selection Type: "New selection"
    b. Where: "Adjuntas_Dam = 'Y'"
2. For line features: "Select By Attribute:"
    a. Selection Type: "New selection"
    b. Where: "Dams_List LIKE '%Adjuntas_Dam%' ESCAPE '\'" (this selects where the Dams_List field contains the text "Adjuntas_Dam")

Visual Inspection Additions

To identify features that were identified through visual inspection, use the following selection steps:

1. "Select By Attribute":
    a. Selection Type: "New selection"
    b. Where: "Dams_List IS NOT NULL"
2. "Select By Location":
    a. Selection Type: "Select subset from the current selection
    b. Invert Spatial Relationship
    c. Relationship: Intersect

d. Selecting Features: merged floodplain shapefile

This step can be modified by first setting a definition query to the "Select By Attribute" query and then selecting by location with a new selection.

QUALITY CONTROL TRACKING STAMP (3-STEP)		
QC DOCUMENT:		
QC REVIEW ACTIVITY		
1. READY FOR REVIEW	ORIG:	Juan P. Rotger
	Date	10/14/2026
2. QC REVIEW	REV:	
(Red = correction)	Date:	
3. CHANGES MADE AND VERIFIED	ORIG:	
√ (Blue check next to comment = accept) √ (Yellow highlight over red comment = change made to address comment)	Date:	
ORIG = Originator, REV = Independent Reviewer		
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