DEPARTMENT OF HOUSING

CDBG-MIT

COVERED PROJECTS NARRATIVE

SOUTH REGION WATER SUPPLY SYSTEM IMPROVEMENT (BAUTA)

V.1

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1 South Region Water Supply System Improvement

Project information

Subrecipient Type:	Puerto Rico State Agency
Subrecipient Name:	PR AQUEDUCT AND SEWER AUTHORITY (PRASA)
Project Name:	South Region Water Supply System Improvement (Bauta)
Project Number:	4339-0046 (FEMA-Issued Project #)
Project Address/ Location:	Toa Vaca River, Villalba 00766 Bauta River, Orocovis 00720
Eligible Activity:	Section 105(a)(2) – Public Facilities and Improvements
National Objective:	Low-to-Moderate Income Area Benefit (LMA) (24 C.F.R. § 570.483 (b)(1)) HUD alternative national objective for Covered Project as defined at 84 FR 45838, section V.A.2.h.
Point(s) of Contact:	Joel Lugo Rosa, PE

2 Covered Project Requirements

Projects must follow and meet the requirements for Covered Projects as described in detail in the Covered Projects Section of the CDBG-MIT Action Plan.

3 Covered Project Analysis & Description

Project Description and Eligibility

1.1 Project Scope

The proposed South Region Water Supply System Improvement Project (**Project**) is a water infrastructure project that directly mitigates the impacts of drought in the southern region of Puerto Rico. This Project has been approved for funding through the Federal Emergency Management Agency (**FEMA**) Hazard Mitigation Grant Program (**HMGP**), for which CDBG-MIT funds will provide the non-federal match share through the global match strategy. Through the Global Match methodology,[1] project costs will be funded 100% by CDBG-MIT funds.

The proposed South Region Water Supply System Improvement Project includes the construction of a tunnel between the Bauta River and Toa Vaca watershed basin, the expansion of the Toa Vaca water treatment plant, and the installation of water distribution pipelines. It will transfer water from the Bauta River to the hydrographic basin of Toa Vaca River by constructing a tunnel.

Construction of the proposed project is expected to have a positive impact on the population of the south coast of Puerto Rico. It would result in long-term benefits on the environment and will support the restoration of the south coast aquifer, impacting the direct beneficiaries of the Toa Vaca Water Treatment Plant and surrounding residents.

The Project's objective is to increase the safe yield of the Toa Vaca Reservoir from 16 million gallons per day (**MGD**) up to 29.9 MGD, ensuring the supply of water for the southern region of Puerto Rico. This Project also includes the expansion of the Toa Vaca Water Treatment Plant to increase the capacity from 7.5 MGD up to 20.5 MGD, including new transmission pipelines.

Once the improvement is completed, the operation of the existing water supply wells will be discontinued, allowing the 13.02 MGD of water currently extracted by the wells to be used for aquifer restoration.

[1] Global Match is a cost share method for the Non-Federal cost share portion of twenty-five percent (25%) required for eligible hazard mitigation measures under the HMGP that contributes not more than seventy-five percent (75%) of the total eligible project costs as per Section 404 of the Stafford Act. When using Global Match, the Non-Federal cost share does not need to be twenty-five percent (25%) for each individual project, rather the Non-Federal cost share for all the Applicants' submitted projects combined must equal twenty-five percent (25%) for the overall portfolio.

1.2 Project Location

Activities will be carried out at the following GIS points:

1. Toa Vaca Water Treatment Plant
Latitude: 18.097721
Longitude: -66.485835

2. Tunnel Intake
Latitude: 18.234678
Longitude: -66.462092

3. Tunnel Output
Latitude: 18.1321
Longitude: -66.4442

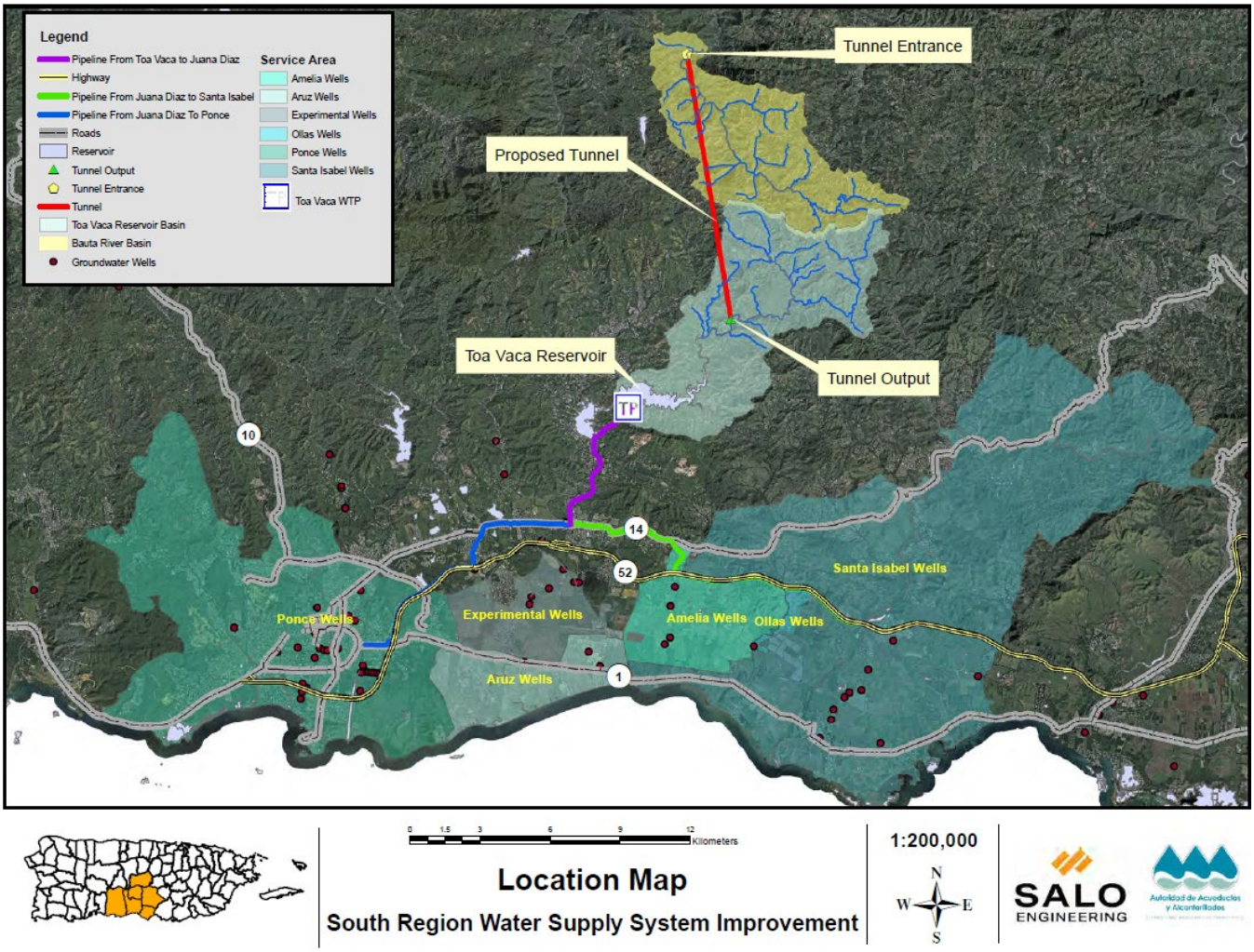

Figure 1: Project Location Aerial View

I. HUD Eligible Activity

Construction of the Project is an eligible activity under Section 105(a)(2) - Public Facilities and improvements of Title I of the HCDA, 42 U.S.C.A. § 5305.

II. Project Cost and Estimated Timeframe

The South Region Water Supply System Improvement is an infrastructure project with a total estimated project cost of $257,406,750.22. This includes activities planned in two-phases according to FEMA HMGP requirements. The project cost breakdown prepared by the applicant entity can be found in **Table 1**.

Table 1: Preliminary Project Cost Breakdown

PHASE 1	Cost %	Cost
Procurement for Engineering Service	0.03%	$ 62,691.60
Schematic Engineerig Design.	1.25%	$ 2,606,670.50
Field Studies and Surveying	1.00%	$ 2,089,719.95
Preliminary Engineering Design	1.67%	$ 3,491,593.99
Permits	3.00%	$ 6,269,159.84
Design & Construction Documents	5.44%	$ 11,373,741.84
Land Acquisition	0.25%	$ 522,429.99
Phase 1 subtotal		$ 26,416,007.70
PHASE 2		
Bidding and Project Award	0.05%	$ 104,486.00
Construction	100.00%	$ 208,971,994.80
Designer Services During Construction	1.49%	$ 3,106,782.18
Construction Management & Inspection Services	3.00%	$ 6,269,159.84
PRASA General Administrative Work	1.00%	$ 2,089,719.95
Phase 2 subtotal		$ 220,542,142.77
Contingencies	5.00%	$ 10,448,599.74
Total Project Cost		**$ 257,406,750.22**

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SALO ENGINEERING

As a part of the planning activities performed by **PRASA** for the development of the proposed project, a preliminary project schedule was prepared including the expected timeframes for the completion of project development and construction phases. This preliminary schedule contemplates a timeframe of approximately 3.5 years (44 months) for the project's implementation. The proposed project schedule is expected to be modified as the project's development advances, and design and environmental review activities are completed.

III. Area of Impact

The transfer of water from the Bauta River to the Toa Vaca Reservoir will increase the safe yield of the Toa Vaca Reservoir and reduce the amount of periods and days under the 25% of the reservoir's capacity. This will result in a safer and more reliable source of potable water for the southern region of Puerto Rico, while contributing to the storage

and restoration of the south coast aquifer by stopping well extraction. This source can be used in case of an emergency or during the period when the storage capacity of the Toa Vaca Reservoir reaches 25% of its capacity.

Area of impact considers the beneficiaries of the proposed 20.5 MGD Toa Vaca Water Plant as well as surrounding residents. The estimated population that will be served by the Water Treatment Plant is 69,184 plus the existing 26,395 people that are currently served by the 7.5 MGD Toa Vaca Water Treatment Plant for a total of 95,579 estimated beneficiaries.

Table 2 presents the classification of the customers served by this facility in terms of residential, commercial, and industrial.

Table 2: Summary of Clientele Served (by Type) within the Project Service Area

Service Area	Population	Clients	Categories		
			Residential	Industrial	Comercial
Amelia	4386	1528	1462	1	66
Experimental	7720	2390	1488	2	38
Aruz	6679	2141	1486	1	42
Ollas	1591	585	1476	0	52
Santa Isabel	34415	12469	1497	0	31
Ponce	14393	5452	5104	5	343
Toa Vaca	26395	9327	8921	5	401

Consistency with Mitigation Needs Assessment

Based on an extensive analysis of hazards, risks, and lifeline assets in Puerto Rico, PRDOH has determined that critical lifelines are those on which other lifelines depend. These include sectors within Energy, Transportation, Communications, Food, Water, and Shelter. This project falls within the water and wastewater sector of the Food, Water, and Shelter lifeline.

The scope of this project mitigates the impact of a drought hazard in an area assessed by PRDOH as at risk. Drought is most prevalent in the south-central and central regions of the Island and extends along the southern coast and into the central and north-central portions of the Island (See **Figure 2**).

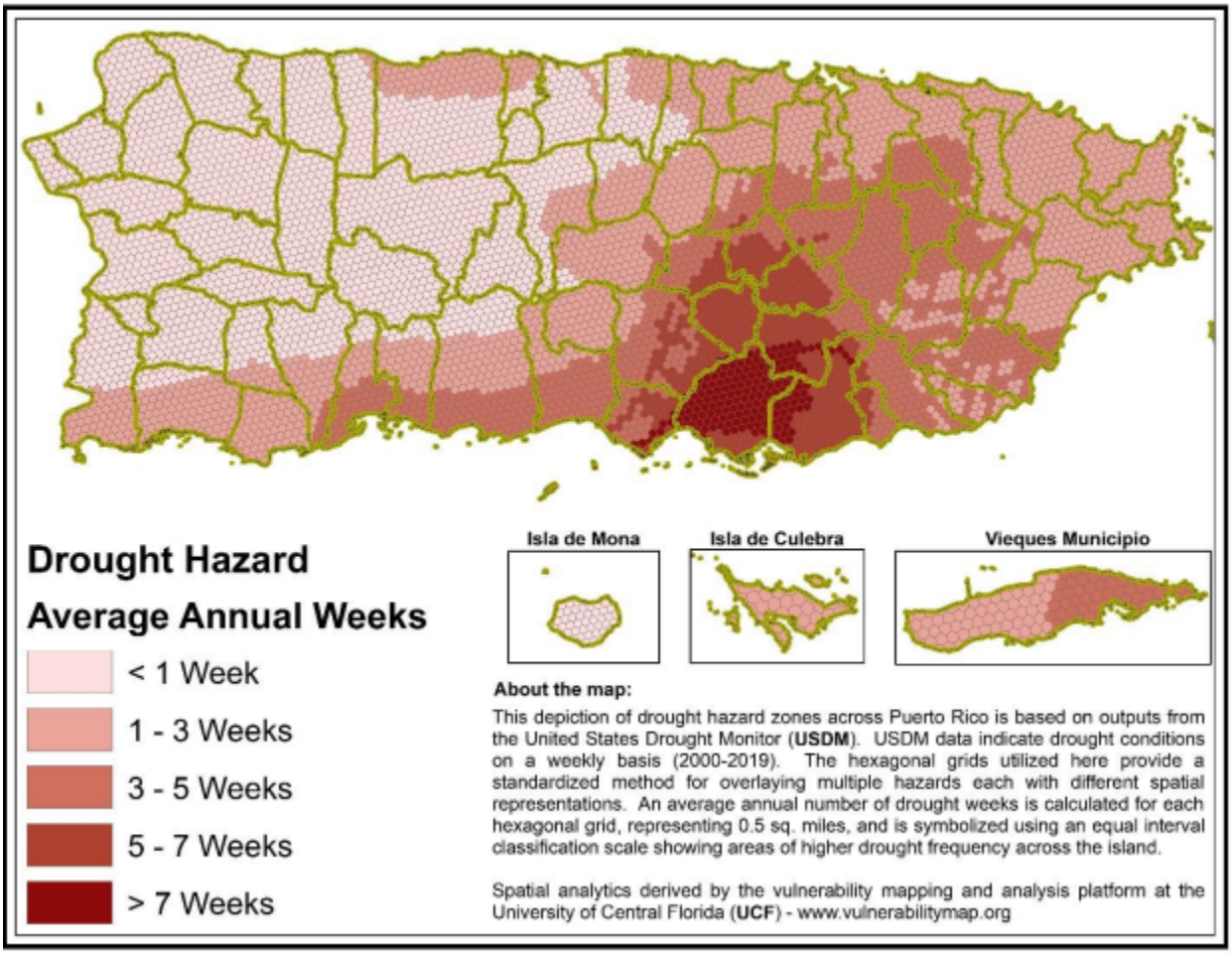

Figure 2: Map Illustrating the Drought Hazard Zones

In the municipalities benefiting from this project, drought appears in the top 5 risks according to the PRDOH Risk Assessment. In Coamo and Santa Isabel, drought is the 4th highest risk, and in Juana Díaz and Ponce it is the 5th highest risk.[2]

[2] Information accessed through the PRDOH website, in English and Spanish, at https://cdbg-dr.pr.gov/iframes/PRhazardandrisksIFRM and https://cdbg-dr.pr.gov/iframes/PRpeligrosyriesgosIFRM.

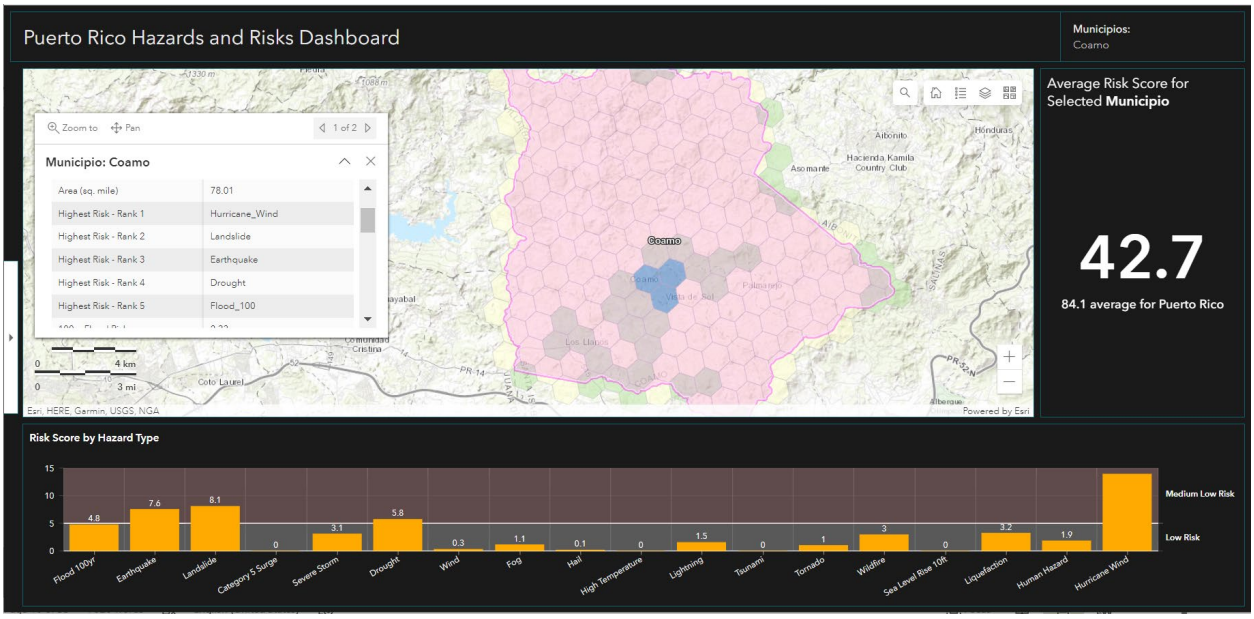

Figure 3: Municipality of Coamo Average Risk Score

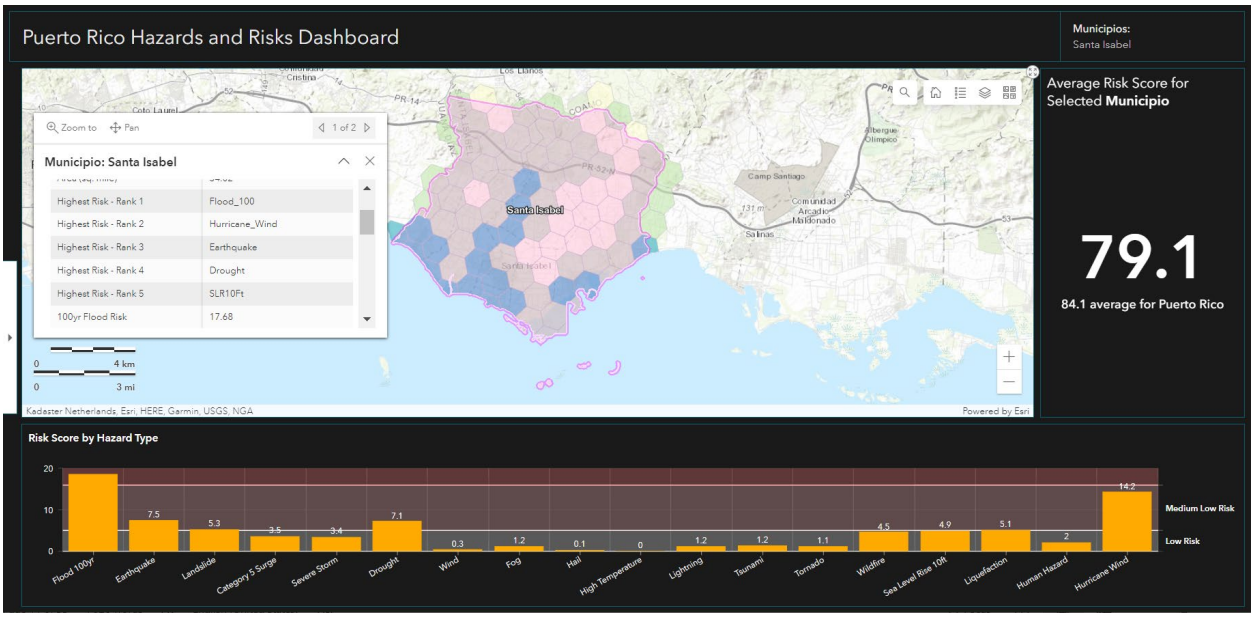

Figure 4: Municipality of Santa Isabel Average Risk Score

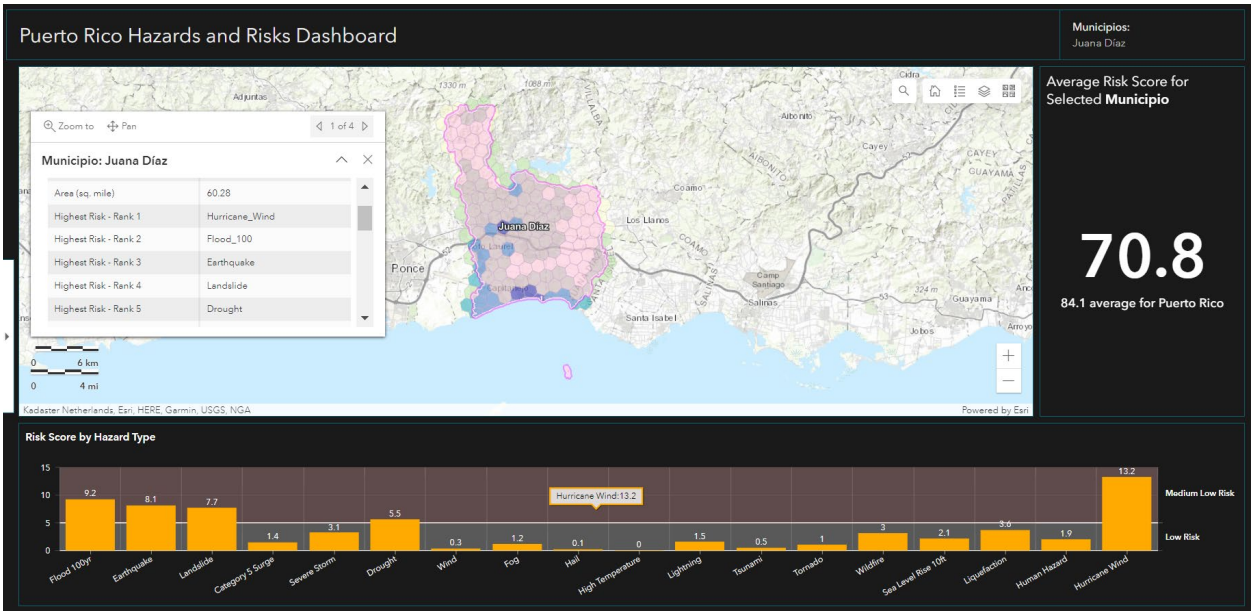

Figure 5: Municipality of Juana Díaz Average Risk Score

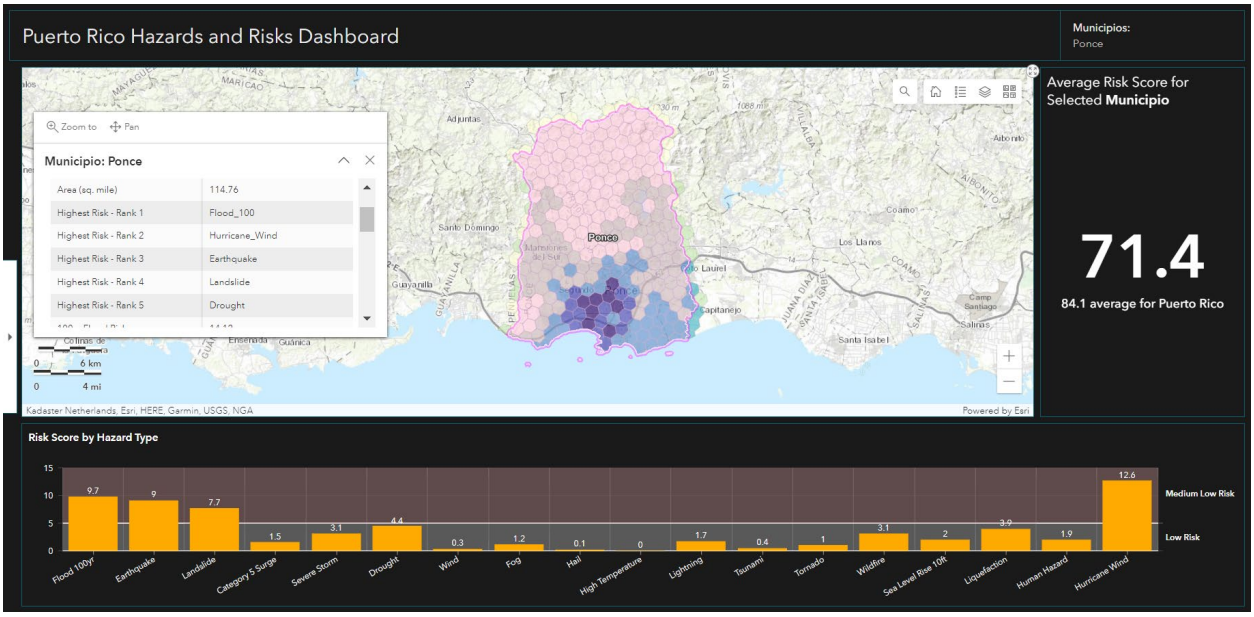

Figure 6: Municipality of Ponce Average Risk Score

Additionally, as stated in the Risk Based Mitigation Needs Assessment section of the PRDOH CDBG-MIT Action Plan, a precipitation deficiency can be compounded by a reduction in reservoir storage capacity, generally as a result of sedimentation within the reservoir. Water yield from the reservoirs is highly dependent on their storage capacity.

Recurring droughts and sedimentation-induced reductions in reservoir storage represent an aggravating challenge to potable water supply in Puerto Rico.

Compliance with National Objective for Covered Projects

The following Area of Benefit (**AOB**) determination is preliminary in nature and is based on the current status of project design, Benefit-Cost Analysis (**BCA**), and other studies. The AOB determined may change upon completion of the design and other studies.

The project service area includes residents in Coamo, Santa Isabel, Juana Díaz, and Ponce municipalities with an area of 387 square kilometers (km2). These municipalities demonstrate a primarily LMI population with a combined 81%. This indicates that the AOB, including the direct 95,579 estimated beneficiaries, is predominantly LMI, meeting HUD's LMI national objective.

Table 3: Summary of LMI Persons within the Project Service Area

Total Persons	Total LMI Persons	Area of Benefit LMI Percentage
247,403	199,780	81%

Figure 7: Project Service Area

Table 4: Adjusted Census Tracts within the Project Service Area

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
1	Census Tract 9535, Municipality of Santa Isabel, Puerto Rico	4,364.00	3,655.00	0.84	Santa Isabel
2	Census Tract 9537, Municipality of Santa Isabel, Puerto Rico	2,306.00	1,866.00	0.81	Santa Isabel
3	Census Tract 9538, Municipality of Santa Isabel, Puerto Rico	5,107.00	4,202.00	0.82	Santa Isabel
4	Census Tract 9536, Municipality of Santa Isabel, Puerto Rico	5,671.00	4,002.00	0.71	Santa Isabel
5	Census Tract 9533, Municipality of Santa Isabel, Puerto Rico	4,328.00	3,100.00	0.72	Santa Isabel
6	Census Tract 703, Municipality of Ponce, Puerto Rico	2,586.00	2,530.00	0.98	Ponce
7	Census Tract 724, Municipality of Ponce, Puerto Rico	5,924.00	4,551.00	0.77	Ponce
8	Census Tract 730.02, Municipality of Ponce, Puerto Rico	4,749.00	4,101.00	0.86	Ponce

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
9	Census Tract 710, Municipality of Ponce, Puerto Rico	1,431.00	1,314.00	0.92	Ponce
10	Census Tract 727.04, Municipality of Ponce, Puerto Rico	3,078.00	2,781.00	0.90	Ponce
11	Census Tract 725, Municipality of Ponce, Puerto Rico	6,305.00	4,497.00	0.71	Ponce
12	Census Tract 730.06, Municipality of Ponce, Puerto Rico	2,986.00	2,660.00	0.89	Ponce
13	Census Tract 702.02, Municipality of Ponce, Puerto Rico	1,323.00	1,197.00	0.90	Ponce
14	Census Tract 726, Municipality of Ponce, Puerto Rico	2,952.00	2,697.00	0.91	Ponce
15	Census Tract 701, Municipality of Ponce, Puerto Rico	4,896.00	3,970.00	0.81	Ponce
16	Census Tract 730.01, Municipality of Ponce, Puerto Rico	2,779.00	2,295.00	0.83	Ponce
17	Census Tract 723, Municipality of Ponce, Puerto Rico	1,340.00	1,303.00	0.97	Ponce
18	Census Tract 727.03, Municipality of Ponce, Puerto Rico	5,067.00	3,646.00	0.72	Ponce

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
19	Census Tract 730.03, Municipality of Ponce, Puerto Rico	2,085.00	1,872.00	0.90	Ponce
20	Census Tract 729, Municipality of Ponce, Puerto Rico	5,998.00	3,849.00	0.64	Ponce
21	Census Tract 730.08, Municipality of Ponce, Puerto Rico	0.00	0.00	0.00	Ponce
22	Census Tract 715, Municipality of Ponce, Puerto Rico	3,253.00	2,803.00	0.86	Ponce
23	Census Tract 704, Municipality of Ponce, Puerto Rico	2,418.00	2,309.00	0.95	Ponce
24	Census Tract 705.02, Municipality of Ponce, Puerto Rico	3,817.00	3,004.00	0.79	Ponce
25	Census Tract 705.03, Municipality of Ponce, Puerto Rico	3,924.00	2,293.00	0.58	Ponce
26	Census Tract 705.13, Municipality of Ponce, Puerto Rico	2,517.00	2,171.00	0.86	Ponce
27	Census Tract 705.14, Municipality of Ponce, Puerto Rico	2,811.00	2,229.00	0.79	Ponce
28	Census Tract 705.22, Municipality of Ponce, Puerto Rico	2,861.00	2,266.00	0.79	Ponce

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
29	Census Tract 708, Municipality of Ponce, Puerto Rico	1,349.00	1,301.00	0.96	Ponce
30	Census Tract 709, Municipality of Ponce, Puerto Rico	1,943.00	1,888.00	0.97	Ponce
31	Census Tract 712, Municipality of Ponce, Puerto Rico	2,262.00	1,779.00	0.79	Ponce
32	Census Tract 730.05, Municipality of Ponce, Puerto Rico	2,791.00	1,851.00	0.66	Ponce
33	Census Tract 718, Municipality of Ponce, Puerto Rico	1,793.00	1,600.00	0.89	Ponce
34	Census Tract 719, Municipality of Ponce, Puerto Rico	5,032.00	4,717.00	0.94	Ponce
35	Census Tract 720, Municipality of Ponce, Puerto Rico	2,029.00	1,331.00	0.66	Ponce
36	Census Tract 722.01, Municipality of Ponce, Puerto Rico	3,597.00	3,059.00	0.85	Ponce
37	Census Tract 721.01, Municipality of Ponce, Puerto Rico	1,604.00	1,534.00	0.96	Ponce
38	Census Tract 721.02, Municipality of Ponce, Puerto Rico	4,462.00	3,379.00	0.76	Ponce

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
39	Census Tract 722.02, Municipality of Ponce, Puerto Rico	4,483.00	3,185.00	0.71	Ponce
40	Census Tract 727.01, Municipality of Ponce, Puerto Rico	3,000.00	2,586.00	0.86	Ponce
41	Census Tract 730.04, Municipality of Ponce, Puerto Rico	3,708.00	3,027.00	0.82	Ponce
42	Census Tract 702.01, Municipality of Ponce, Puerto Rico	2,687.00	2,459.00	0.92	Ponce
43	Census Tract 730.10, Municipality of Ponce, Puerto Rico	3,883.00	2,579.00	0.66	Ponce
44	Census Tract 730.09, Municipality of Ponce, Puerto Rico	5,045.00	4,822.00	0.96	Ponce
45	Census Tract 716.01, Municipality of Ponce, Puerto Rico	2,425.00	1,951.00	0.80	Ponce
46	Census Tract 716.02, Municipality of Ponce, Puerto Rico	3,172.00	3,126.00	0.99	Ponce
47	Census Tract 713, Municipality of Ponce, Puerto Rico	3,664.00	3,464.00	0.95	Ponce
48	Census Tract 717, Municipality of Ponce, Puerto Rico	1,482.00	1,176.00	0.79	Ponce

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
49	Census Tract 714.01, Municipality of Ponce, Puerto Rico	2,233.00	1,755.00	0.79	Ponce
50	Census Tract 714.02, Municipality of Ponce, Puerto Rico	3,825.00	2,978.00	0.78	Ponce
51	Census Tract 7104, Municipality of Juana Díaz, Puerto Rico	2,100.00	1,981.00	0.94	Juana Díaz
52	Census Tract 7109.02, Municipality of Juana Díaz, Puerto Rico	5,657.00	4,127.00	0.73	Juana Díaz
53	Census Tract 7107, Municipality of Juana Díaz, Puerto Rico	1,931.00	1,646.00	0.85	Juana Díaz
54	Census Tract 7108, Municipality of Juana Díaz, Puerto Rico	6,013.00	4,852.00	0.81	Juana Díaz
55	Census Tract 7105, Municipality of Juana Díaz, Puerto Rico	1,238.00	1,110.00	0.90	Juana Díaz
56	Census Tract 7102, Municipality of Juana Díaz, Puerto Rico	4,757.00	3,899.00	0.82	Juana Díaz
57	Census Tract 7110.02, Municipality of Juana Díaz, Puerto Rico	3,854.00	3,285.00	0.85	Juana Díaz
58	Census Tract 7101.02, Municipality of Juana Díaz, Puerto Rico	5,718.00	4,457.00	0.78	Juana Díaz

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
59	Census Tract 7103.02, Municipality of Juana Díaz, Puerto Rico	3,989.00	2,494.00	0.63	Juana Díaz
60	Census Tract 7106, Municipality of Juana Díaz, Puerto Rico	2,050.00	1,634.00	0.80	Juana Díaz
61	Census Tract 7109.01, Municipality of Juana Díaz, Puerto Rico	4,522.00	4,021.00	0.89	Juana Díaz
62	Census Tract 7103.01, Municipality of Juana Díaz, Puerto Rico	4,172.00	2,887.00	0.69	Juana Díaz
63	Census Tract 9543, Municipality of Coamo, Puerto Rico	1,902.00	1,802.00	0.95	Coamo
64	Census Tract 9544, Municipality of Coamo, Puerto Rico	1,751.00	1,522.00	0.87	Coamo
65	Census Tract 9546, Municipality of Coamo, Puerto Rico	5,121.00	3,723.00	0.73	Coamo
66	Census Tract 9545, Municipality of Coamo, Puerto Rico	7,759.00	6,414.00	0.83	Coamo
67	Census Tract 9547, Municipality of Coamo, Puerto Rico	7,220.00	5,036.00	0.70	Coamo
68	Census Tract 9539, Municipality of Coamo, Puerto Rico	2,860.00	2,459.00	0.86	Coamo

#	Census Tracts	Total Persons	Total LMI Persons	LMI %	Municipality
69	Census Tract 9542, Municipality of Coamo, Puerto Rico	5,944.00	4,978.00	0.84	Coamo
70	Census Tract 9540, Municipality of Coamo, Puerto Rico	3,444.00	2,923.00	0.85	Coamo
71	Census Tract 9541, Municipality of Coamo, Puerto Rico	2,056.00	1,820.00	0.89	Coamo

Long-term efficacy and sustainability of the project

The nature of this project, once completed, will require periodic inspection, which will be conducted at a frequency to be determined after full project design. This project will alter river flows during high flows in the vicinity of the intake. However, it will guarantee minimum environmental flows while minimizing environmental impacts during the life of the project.

The design of the Bauta River intake will consider all the environmental needs that the river requires since the project consists of a tunnel. Therefore, the environmental impact is minimal once in operation. No electromechanical equipment is considered as water flow will work by gravity and the intake will be designed to work with minimal human intervention.

Once the project is implemented, the Toa Vaca Lake will continue transmitting water surface elevations as well as measure raw water delivery to the Water Filtration Plants. Since the project will provide a Safe Yield, part of the monitoring process will be to consider the water availability in the southern region in the development plans. During droughts, measurements and documentation will be prepared to determine the efficiency of the project as intended.

The useful life of the improved facility is estimated at 50 years. At present, Operations & Maintenance (**O&M**) for the improvement has been estimated on an annual basis at $1,000,000. **PRASA** will develop an O&M Plan for the proposed infrastructure in

accordance with best industry practices. Typically, **PRASA's** O&M Manual includes the following:

1. A general description of the facility, including Principal Design Criteria, Water Characteristics, Operations and Controls of Unit Operation, Distribution System, Valves, Piping & Fittings, Flow Meters, Pressure Main, Tunnel System, Normal Operation, Process Controls and Pump Maintenance & Operations.

2. A Monitoring Plan that includes Operational Monitoring, Operational Parameters, General Monitoring Requirements for Tunnel Operation, Compliance Monitoring, Analytical Methods, Loading Rate Calculations and Monitoring Quality Assurance.

3. Preventative Maintenance for General Plant Appearance, Equipment Maintenance and Scheduling, Supplies and Spare Parts.

4. Records and Reporting for Plans and Specifications, Daily Operating Log, Operation, Sampling and Testing Log and Maintenance Records.

The estimated yearly O&M expenses will be provided from PRASA's Operational Revenues, generated from service billings. Annually, as a part of the regular budgetary process, PRASA reassess its financial needs to comply with its operating requirements for the following year and determine if rate adjustments and other measures are required to endure proper compliance of its O&M activities.

The O&M budget estimate is incorporated in the BCA analysis provided in the next section. Development and maintenance of the project O&M Plan will be monitored by PRDOH in coordination with the Central Office for Recovery, Reconstruction and Resiliency (**COR3**), in accordance with HUD requirements and industry standards.

Changing environmental conditions such as climate-sensitive events, more frequent and severe weather events, and localized hazardous events, will be addressed by incorporating risk assessment activities into the project O&M Plan. Risk assessment for changing climatic conditions will allow:

- Identification of the Risks related to changing environment. For example, change in the frequency of occurrence of natural hazards.
- Assessment of Consequences. Assess the consequences of the natural hazard events resulting in disaster.

- Assess the probability. Establish the probability of a specific event occurring.
- Risk Characterization. Ranking of risk according to the severity and potential consequences.

The O&M Plan will be amended and updated according to the results of the risk assessment.

Demonstration of Benefit to Most Impacted and Distressed Area[3]

I. BCA Methodology

In accordance with the PRDOH BCA Guidelines, the South Region Water Supply System Improvement Project BCA has been prepared using the FEMA BCA methodology and the latest version of the Toolkit Calculator v6.0.0. PRDOH has confirmed with PRASA that no other Federal agency has rejected a BCA for this Covered Project, including any BCA for an earlier version of the current proposed Covered Project. Additionally, this project has been analyzed and approved by FEMA.

FEMA has a well-established BCA method and software tools to assess the cost-effectiveness of hazard mitigation projects for the various FEMA mitigation grant programs. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. §5121 *et seq.*, requires FEMA hazard mitigation projects to be proven cost-effective using the BCA approach defined in Section 3 of PRDOH BCA Guidelines. Using the FEMA method, a project is considered to be cost-effective when the Benefit-to-Cost Ratio (**BCR**) is 1.0 or greater, indicating the benefits of a prospective hazard mitigation or resilience project are sufficient to justify the costs:

$$BCR = \frac{Benefits}{Costs} \geq 1.0$$

Additionally, in accordance with OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, FEMA BCAs are prepared on a net present value basis, meaning the present value of the benefits gained over the life of the project is compared to the total project costs to establish the BCR. Because most project benefits accumulate over time, project benefits can be calculated on an average annual basis

[3] See 84 FR 35838, section II. C. Most Impacted and Distressed Areas. The entire Island of Puerto Rico is considered most impacted and distressed area.

("annualized") and then multiplied by a Present Value Coefficient (**PVC**) using the formula shown below to determine the present value of the annualized benefits.

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

Where: *r* is the discount rate (7.00% per OMB Guidance) and *T* is the useful life of the project (typically 25-50 years for most public building and infrastructure projects). Refer to Appendix D: Project Useful Life Summary of the FEMA BCA Reference Guide (June 2009) for a summary of FEMA project useful life values for flood, hurricane wind, and seismic mitigation measures.

II. Factors Considered in the BCA

The BCA has been prepared using historic damages. The following section summarizes the assumptions, data source, and methodology applied to conduct the BCA for the mitigation project. Applying the FEMA's methodology to calculate the BCR based on the drought risk recurrence intervals, the project BCR is estimated at **2.35**.

The service areas considered for this project include the municipalities of Coamo, Santa Isabel, Juana Díaz, and Ponce with an area of 387 square kilometers (km2) and a proposed estimated population of 69,184 people.

History of Hazards/Damages include the following:

During the last two (2) decades, Puerto Rico has been confronting a series of Abnormal Dry to Extreme Drought periods, being the south and southeast coast of the Island the more affected. The National Drought Mitigation Center (**NDMC**) from the University of Nebraska, in collaboration with the U.S. Department of Agriculture (**USDA**) and the National Oceanic and Atmospheric Administration (**NOAA**) keep statistics on the levels of potential drought recorded in the United States, including Puerto Rico. The data are grouped into the following categories: D0- Abnormally Dry, D1-Moderate Drought, D2-Severe Drought, D3-Extreme Drought, and D4- Exceptional Drought.[4] There have been important events that have negatively impacted agriculture and have required drastic measures such as water rationing and the introduction of emergency measures such as the distribution of drinking water to affected communities. According to data provided

[4] U.S. Drought Monitor, Drought Classification. Accessed at: https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

by FEMA, there have been two (2) emergency situations for which federal assistance was needed. The two (2) drought events are:[5]

- May 26, 1964: Presidential Disaster Declaration Number 170 due to extreme drought conditions.
- August 29, 1974: Presidential Emergency Declaration Number 3002 due to drought impacts.

In addition to these events, Puerto Rico has experienced three (3) important drought periods that have affected the south coast of Puerto Rico.

- **Drought 1994:** According to the data, Puerto Rico began experiencing a 35% decrease in normal rainfall since August 1993. The decrease of rainfall fluctuated but became more severe during the period from April to July 1994, when 56% of normal rain was registered. This drought impacted about 55% of Puerto Rico's extension and water rationing measures had to be implemented in 29 municipalities. Water rationing began on April 5, 1994 and ended in September 1994. This drought had a negative impact on Puerto Rico's economy, particularly on agriculture, with an estimated gross income loss of $93.9 million.

- **Drought 2015:** This drought started on March 2015 when PRASA issued its first warning on the need for implementation of water-saving measures due to decreasing levels in water reservoirs. In May, the U.S. Drought Monitor classified 12 municipalities under Moderate Drought and 40 municipalities were declared as Abnormally Dry. This caused a negative impact on agriculture, rivers, basins, and wells.

- **Drought 2019:** An Abnormally Dry period began affecting Puerto Rico on June 5, 2018, reaching a Moderate Drought level on December 10, 2019, and ending on January 28, 2020. During this period, the south coast aquifer, which is the source of domestic water for the Municipality of Salinas, was adversely affected.

For the purpose of the BCA, the following events were considered:

- **Extreme Drought**: An Extreme Drought affected the south coast of Puerto Rico starting on August 11, 2015, peaking on August 18, 2015 and ending on February 16, 2016. This caused a negative impact on agriculture, rivers, basins, and groundwater wells. During the last 20 years, one (1) event of this magnitude had happened, suggesting a 20-year recurrence interval with a period of 189 days. This event was input on the BCA as a 20-year recurrence interval event with 189 days affecting the

[5] Puerto Rico Hazard Mitigation Plan 2016

population served by the south coast aquifer. **Figure 8** shows the peak of the drought period.

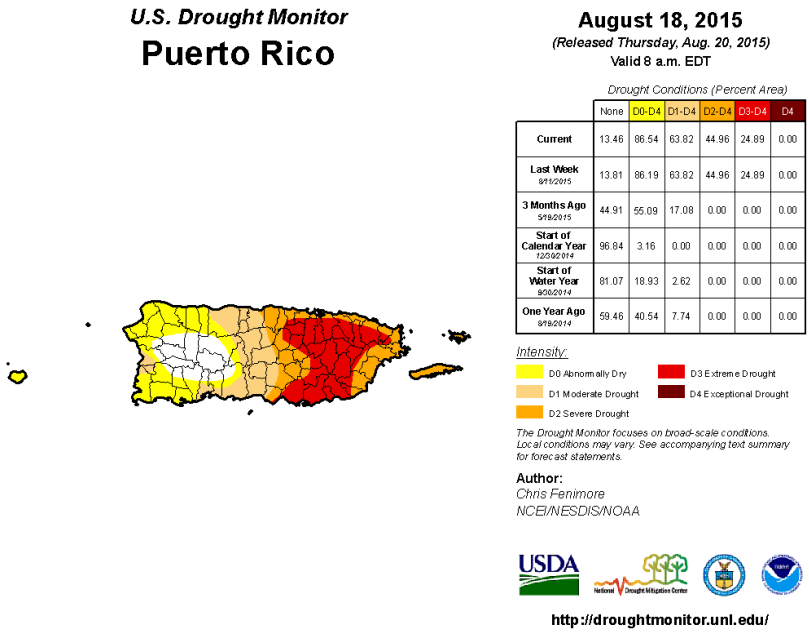

Figure 8: Peak of Extreme Drought (Period8/11/2015-2/16/2016)

- **Severe Drought:** A Severe Drought affected the Southern coast of Puerto Rico on July 2, 2019, peaking on August 27, 2019 and ending on September 24, 2019. During this period, the south coast aquifer was adversely affected. During the last 20 years, two (2) events of this magnitude happened in the following periods: from July 2, 2019 to September 24, 2019, and from June 9, 2020 to July 28, 2020, suggesting a 10-year recurrence interval with an average period of 67 days. These events were input on the BCA as a 10-year recurrence interval event with 67 days, affecting the population served by the south coast aquifer. **Figure 9** shows the peak of the two (2) drought periods.

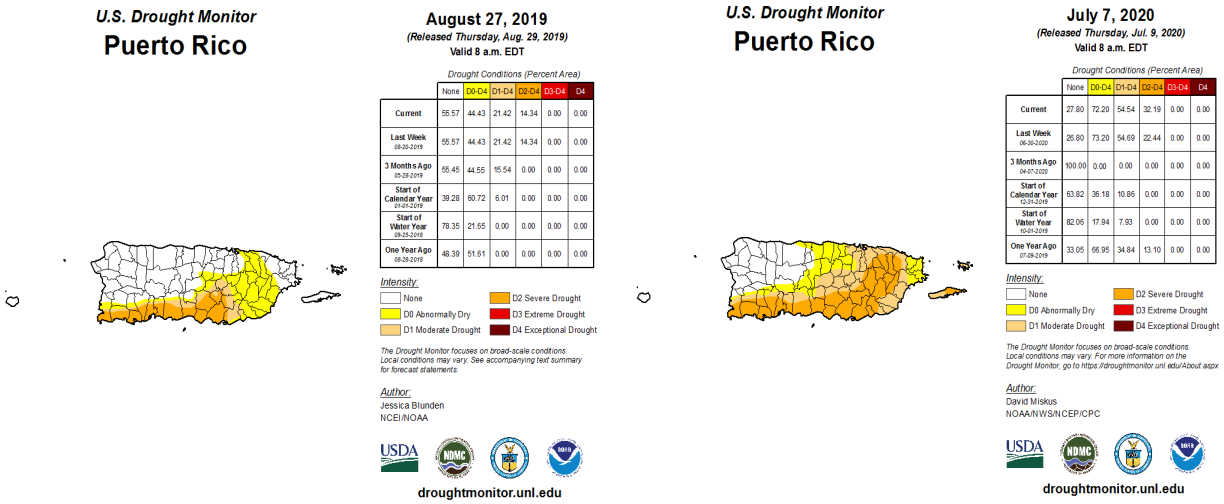

Figure 9: Peak of Severe Drought (Period 7/2/2019-9/24/2019 and 6/9/2020-7/28/2020)

- **Moderate Drought:** A Moderate Drought impacted the southern coast of Puerto Rico on August 1, 2017, peaking on August 22, 2017 and ending on August 29, 2017. During this period, the south coast aquifer was adversely affected. During the last 20 years, four (4) events of this magnitude occurred (March 15, 2005-April 12, 2005; February 20, 2007-April 3, 2007; July 8, 20014-August 19, 2014; and August 1, 2017-August 29, 2017), suggesting a 5-year recurrence interval with an average period of 35 days. These events were input on the BCA as a 5-year recurrence interval event

with 35 days, affecting the population served by the south coast aquifer. **Figure 10** shows the peak of the four (4) drought periods.

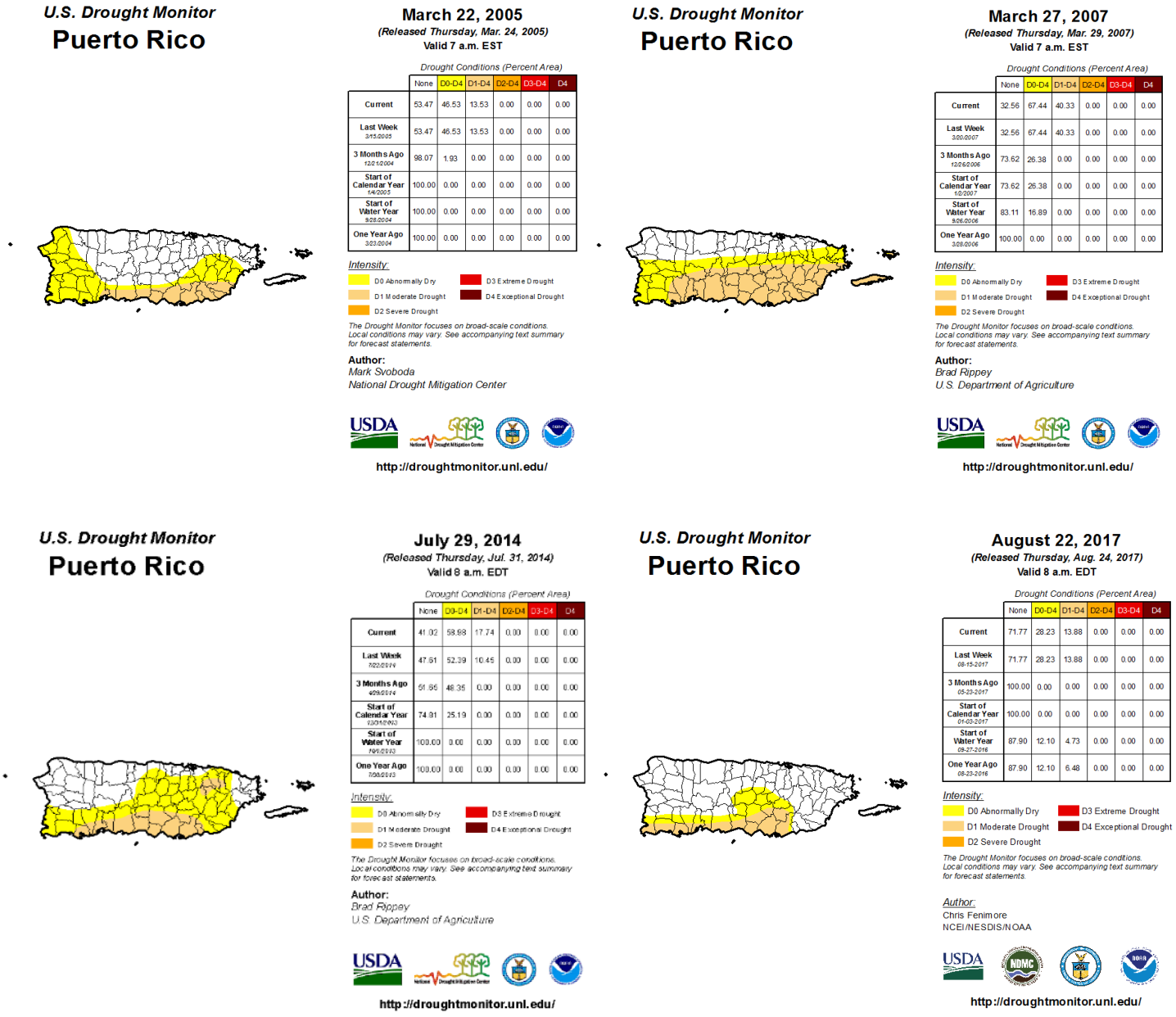

Figure 10: Peak of Moderate Drought (Periods 3/15/2005-4/12/2005, 2/20/2007-4/3/2007, 7/8/2014-8/19/2014 and 8/1/2017-8/22/2017)

Groundwater levels in the aquifer have declined in the last years due to the imbalance caused by limited surface recharge and high rates of water extraction. The high withdrawals rate and reduced recharge have lowered the aquifer's water table below sea level, allowing seawater contamination (saline intrusion) from the Caribbean Sea. Saline intrusion has caused an increased in total dissolved solids (**TDS**) in PRASA's groundwater wells near, or more than the U.S. Environmental Protection Agency (**EPA**) recommended maximum drinking water level of 500 mg/L. During the 2019 drought, thirty (30) of the forty-one (41) wells operated by PRASA in the Coamo and Ponce Operational Areas have reported TDS concentration levels over the 500 mg/L maximum drinking water contamination level.

Rising sea levels also pose a problem for the aquifer, as it encourages saline intrusion. Sea levels have been rising in Puerto Rico and the elevation rate has accelerated since 2002.

As mentioned above, the drought periods and sea level rise have caused increases in groundwater TDS concentration over 500 mg/L, which is the EPA recommended maximum drinking water contamination level. It has resulted in a loss of use of groundwater well supply.

For periods of drought, PRASA created and implemented an Operational Plan to supply potable water to areas that are normally served by groundwater wells. The Plan considered operational adjustments including pressure reduction and intermittent rationing for service areas where raw water comes from the Toa Vaca and Cerrillos reservoirs in order to supply potable water to areas currently being served by the groundwater wells. The Operational Plan considered a 10% reduction of the total demand for the services area from Toa Vaca and Cerrillo Reservoir, affecting a population of more than 200,000 people. With the water transfer from the reservoir, well extraction was stopped in some well service areas. In the remaining service areas, the extraction was reduced to an average of 33% to handle the drought and to manage and control the aquifer crisis, even though 75% of the groundwater wells were over the maximum drinking water contamination level.

Is important to highlight that the groundwater extracted from the PRASA's wells had a TDS concentration above 500 mg/L in 30 of the wells at the time of the drought. This high concentration of TDS can be toxic for human consumption as established by EPA. Extraction from wells with TDS levels above 500 mg/L was supposed to be completely stopped.

For BCA purposes, a 33% (4.43 MGD) reduction of the total demand of 13.02 MGD was used.

III. Additional Benefits

Consistent with the PRDOH BCA Guidelines and HUD guidance, additional benefits such as enhancing a community's economic development potential, improving public health, or expanding recreational opportunities have been assessed to consider the positive impacts on traditionally marginalized or disadvantaged populations. Such benefits are not accounted for in FEMA's BCR methodology,[6] but are addressed in the narrative here.

The South Region Water Supply System Improvement project will substantially improve water utility service for a predominantly LMI region with a socioeconomic make-up that demonstrates the presence of socially vulnerable populations as well as protected classes. The benefits of improved water service and implementation of drought-resistant measures translate into reduced health risks for these residents due to improved water quality and a higher likelihood of water security during the next drought. Economically, these improvements will result in the creation of both temporary and full-time jobs to construct and operate the facilities. Improved water utilities also translate into improved property values and local growth opportunities.

IV. Community Characteristics

Additional community impact can be considered in the demographics of the residents benefiting from this project. Social vulnerability describes an area's capacity to prepare for, respond to, and rebound from disaster events[7], and has a long conceptual and theoretical history in social science and disaster fields. Socially vulnerable populations have fewer resources to prepare for disasters, are often bear the brunt of disaster impacts, and take the longest to recover.

As shown in **Figure 11**, the four (4) municipalities with improved service and mitigated effects in times of drought have medium-low to high concentrations of socially vulnerable population. See the Risk Analysis section of the CDBG-MIT Action, as amended, for additional information on the Social Vulnerability Index (SoVI).

[6] FEMA allows use of the following social benefits for flood resilience projects only that directly protect residential housing units: (1)$2,443/person for mental stress and anxiety treatment, and (2) $8,736/person for lost worker productivity. Neither apply here.
[7] Cutter, Susan L., Emrich, Christopher T. Moral Hazard, Social Catastrophe: The Changing Face of Vulnerability along the Hurricane Coasts. The ANNALS of the American Academy of Political and Social Science. March 1, 2006.

Ponce has a high concentration of SoVI populations in the south-central area of the municipality and medium-low to medium concentration in the rest of the municipality. Juana Díaz has a low to a medium-low concentration of SoVI populations in the south-central area with a medium concentration in the middle and northern areas of the municipality. Santa Isabel has a medium to medium-low concentration of SoVI populations. Coamo has a predominantly medium-low concentration of SoVI.

Improved water infrastructure for the residents of these municipalities is presumed to serve SoVI populations proportional to the regional characteristics assessed at the municipal level.

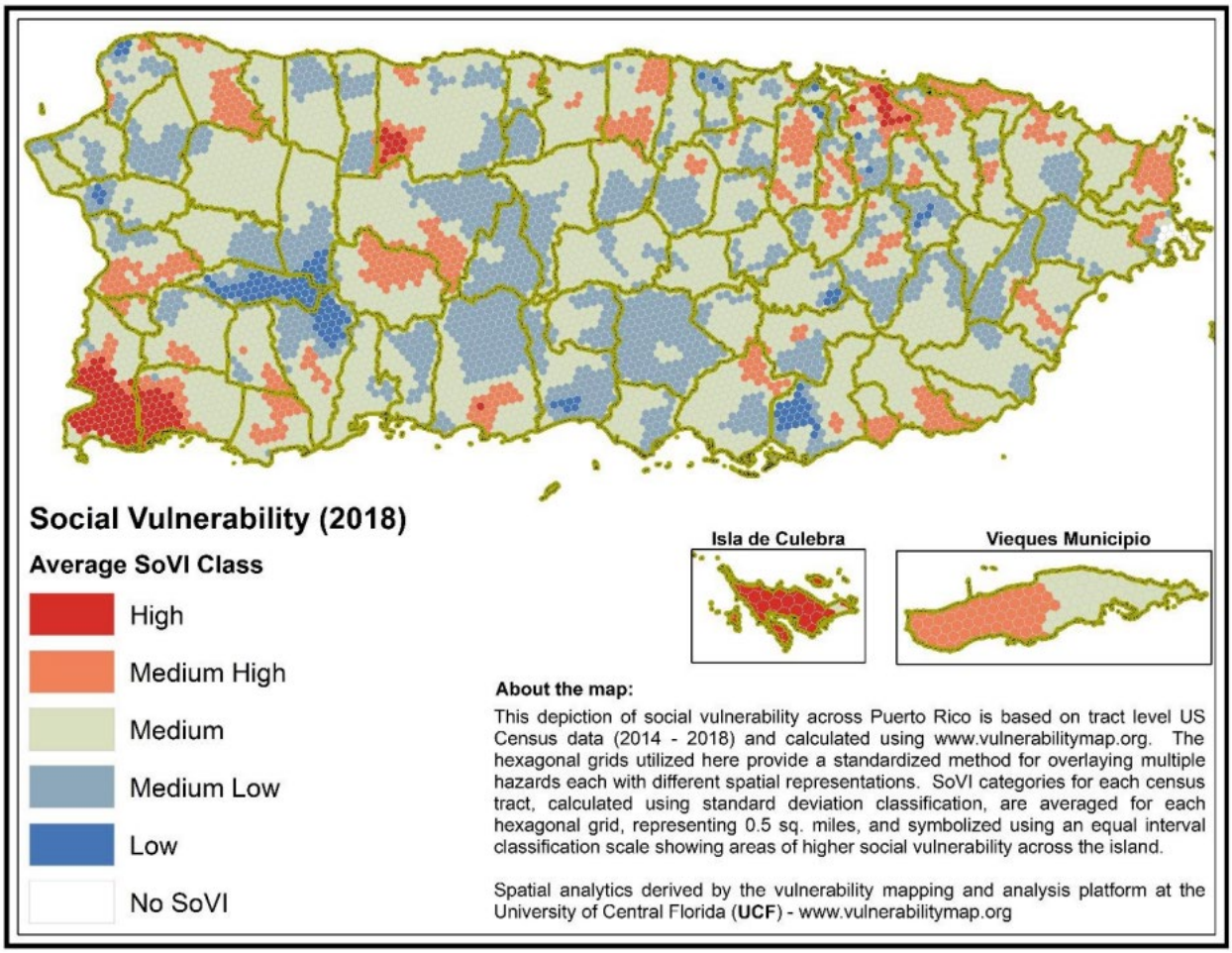

Figure 11: Social Vulnerability Area Map

Another important consideration of the community impacts the project will have on the area pertain to protected classes as defined in the Civil Rights Act of 1964 (CRA) and subsequent federal laws.

The social vulnerability index implemented in Puerto Rico's CDBG-MIT Risk Assessment includes at least ten (10) protected classes' indicators, including: race, sex, familial status, and a certain measure of disability. However, several protected classes, identified in the Fair Housing Act, are not included in the social vulnerability index. Recognizing the importance of identifying these populations and building programs that do not disadvantage them, requires additional analysis beyond that provided by the social vulnerability index. To the extent possible, additional analytical steps were taken to ensure that these protected classes are identified and monitored throughout the CDBG-MIT process.

In the Project's beneficiary municipalities, identifying and accounting for persons of differential ability is considered an important facet of disaster mitigation activities. To this end, data on disability and "difficulty" from the United States Census[8] was assessed to identify the location in which differently abled populations are residing. The Census has evolved in its understanding (and measurement) of disabilities. Beginning with the ACS 2008, the Census moved from the strict use of the term "disability" to the broader and inclusive term of "difficulty".[9] Census defines several disabilities/difficulties as follows.

Hearing Difficulty	"deaf or … [had] serious difficulty hearing."
Vision Difficulty	"blind or … [had] serious difficulty seeing even when wearing glasses."
Cognitive Difficulty	"serious difficulty concentrating, remembering, or making decisions."
Ambulatory Difficulty	"serious difficulty walking or climbing stairs."
Self-care Difficulty	"difficulty dressing or bathing."
Independent Living Difficulty	"doing errands alone such as visiting a doctor's office or shopping."

[8] ACS2015-2019, 5-Year census product, table S1810.
[9] American Community Survey and Puerto Rico Community Survey. *2019 Subject Definitions*. Accessed at: https://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2019_ACSSubjectDefinitions.pdf

As shown in the Table 5, each of the benefiting municipalities demonstrate the presence of these populations.

Table 5: Summary of Socially Vulnerable Persons Living within the Project Area of Benefit

Municipality	Total Population (2019)	Hearing difficulty	Vision difficulty	Cognitive difficulty	Ambulatory difficulty	Self-care difficulty	Independent living difficulty
Coamo	38,857	1567 (4.03%)	6030 (15.52%)	3096 (7.97%)	2837 (7.3%)	1083 (2.79%)	3477 (8.95%)
Juana Díaz	45,976	1766 (3.84%)	3240 (7.05%)	4770 (10.37%)	5951 (12.94%)	1603 (3.49%)	5634 (12.25%)
Ponce	137,042	5204 (3.8%)	6158 (4.49%)	13817 (10.08%)	22549 (16.45%)	10742 (7.84%)	18510 (13.51%)
Santa Isabel	21,757	807 (3.71%)	2955 (13.58%)	1158 (5.32%)	1344 (6.18%)	438 (2.01%)	1515 (6.96%)

Gender, or specifically being a woman, is an important factor of social vulnerability to disasters. Patriarchal structures and power imbalances tend to reduce women's status in society, their access to resources, opportunities, and power, and subsequently lead to higher female vulnerability to adverse hazards and disaster outcomes.[10] Age, another key characteristic influencing social vulnerability, is normally recognized at the two (2) extremes of the age continuum—children and older adults are more vulnerable than others.[11] Both age cohorts (young and old) need special care, are often more susceptible to harm, and may have mobility constraints, all of which influence the ability

[10] Trieb, Carolin-Anna. *Vulnerability to Natural Hazards: A Gender Perspective in Disasters*, Management Center Innsbruck. Accesed at:
http://www.ibgeographypods.org/uploads/7/6/2/2/7622863/university_dissertation_ib_dp_geography.pdf
[11] Rodriguez, Donner & Trainor. *Handbook of Disaster Research. 2018.*

to get out of harm's way.[12,13] For this assessment, a focus on aging populations is required by Fair Housing regulations. Similarly, families with large numbers of dependents or single-parent households may be more vulnerable because of the need to rely on paid caregivers. Like sex and age, identifying areas based on familial status, or those with children in the home, is of particular interest here to address Fair Housing regulations. Each of these three (3) indicators of socially vulnerable areas are mapped and discussed here.

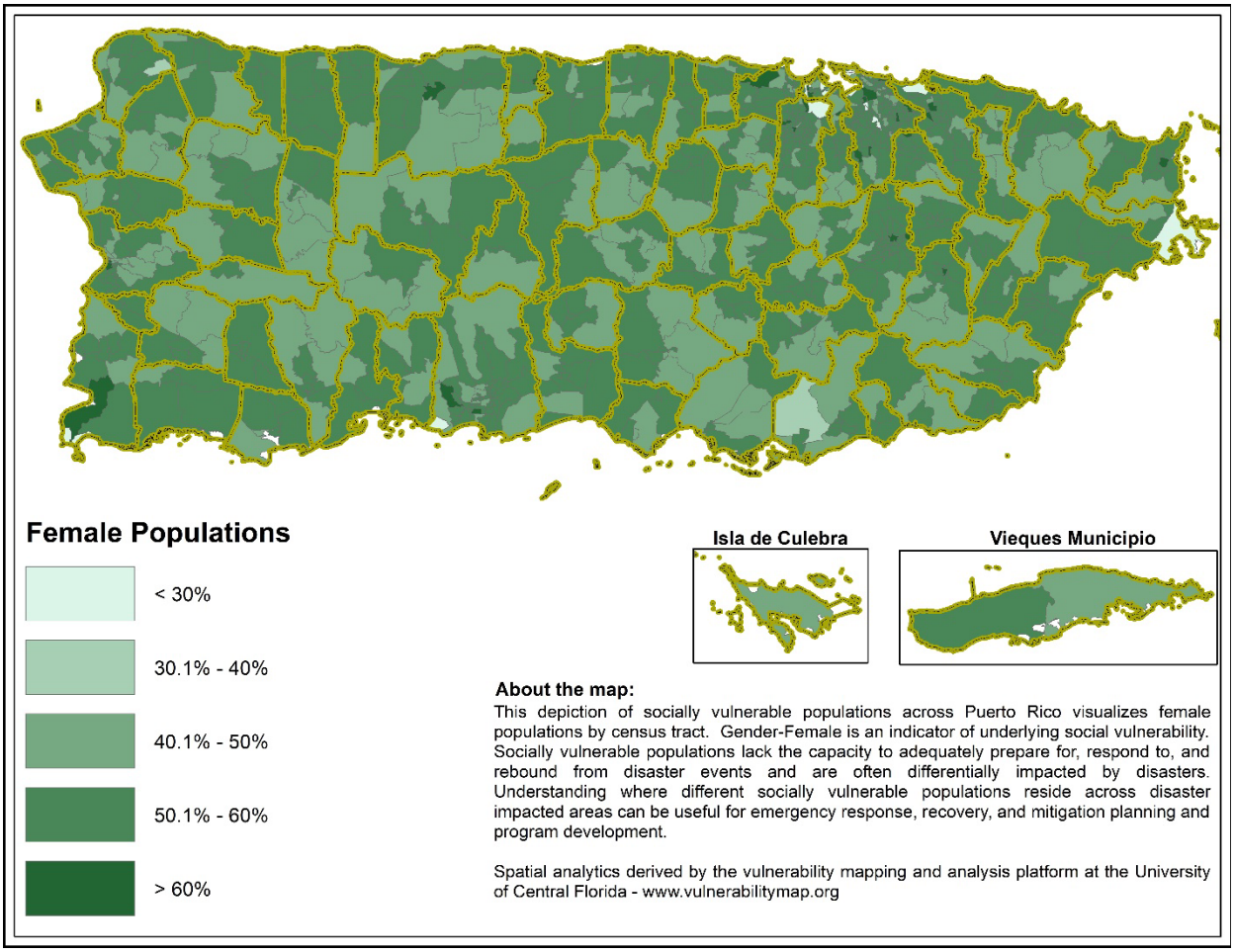

Figure 12: Female Population Area Map

[12] Anderson, William A. *Bringing children into focus on the social science disaster research agenda*, International Journal of Mass Emergencies and Disasters. Accessed at: http://ijmed.org/articles/376/download/
[13] Smith, Susan M. *Disaster planning and response: considering the needs of the frail elderly*, International Journal of Emergency Management. Accessed at: https://www.researchgate.net/publication/244924906_Disaster_planning_and_response_Considering_the_needs_of_the_frail_elderly

All four (4) benefiting municipalities demonstrate a strong presence of female residents with census areas predominantly indicating a 50.1% to 60% concentration of female residents.

Regarding age, the four (4) municipalities benefiting from the project did not demonstrate a high concentration of residents over 65 years. However, they do show a strong concentration of households with children under 18 as shown in **Figure 13**.

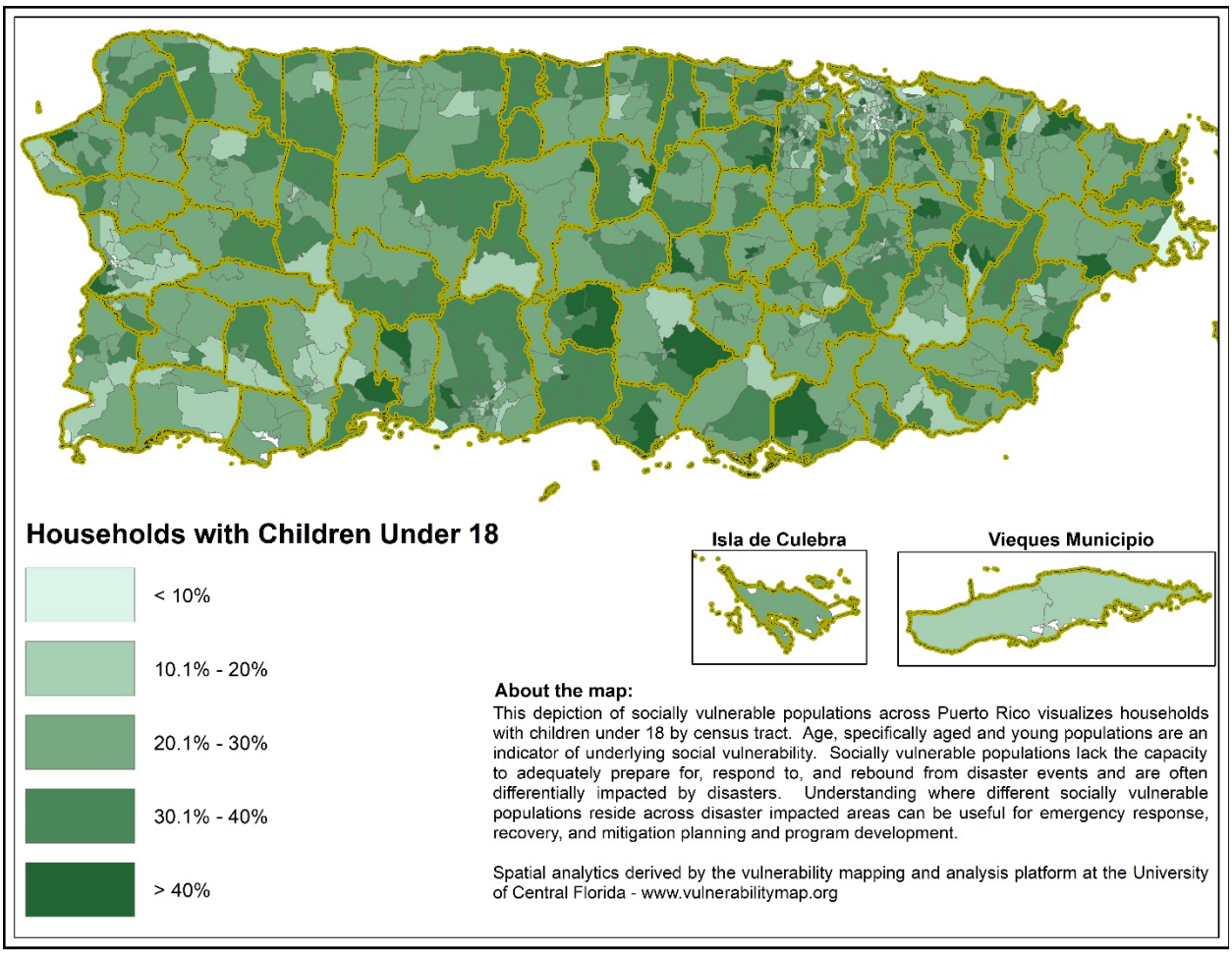

Figure 13: Area Map of Households with Children (under 18 years of age)

Racial concentrations are also demonstrated in the AOB, especially in Santa Isabel and Coamo, as shown in **Figure 14**.

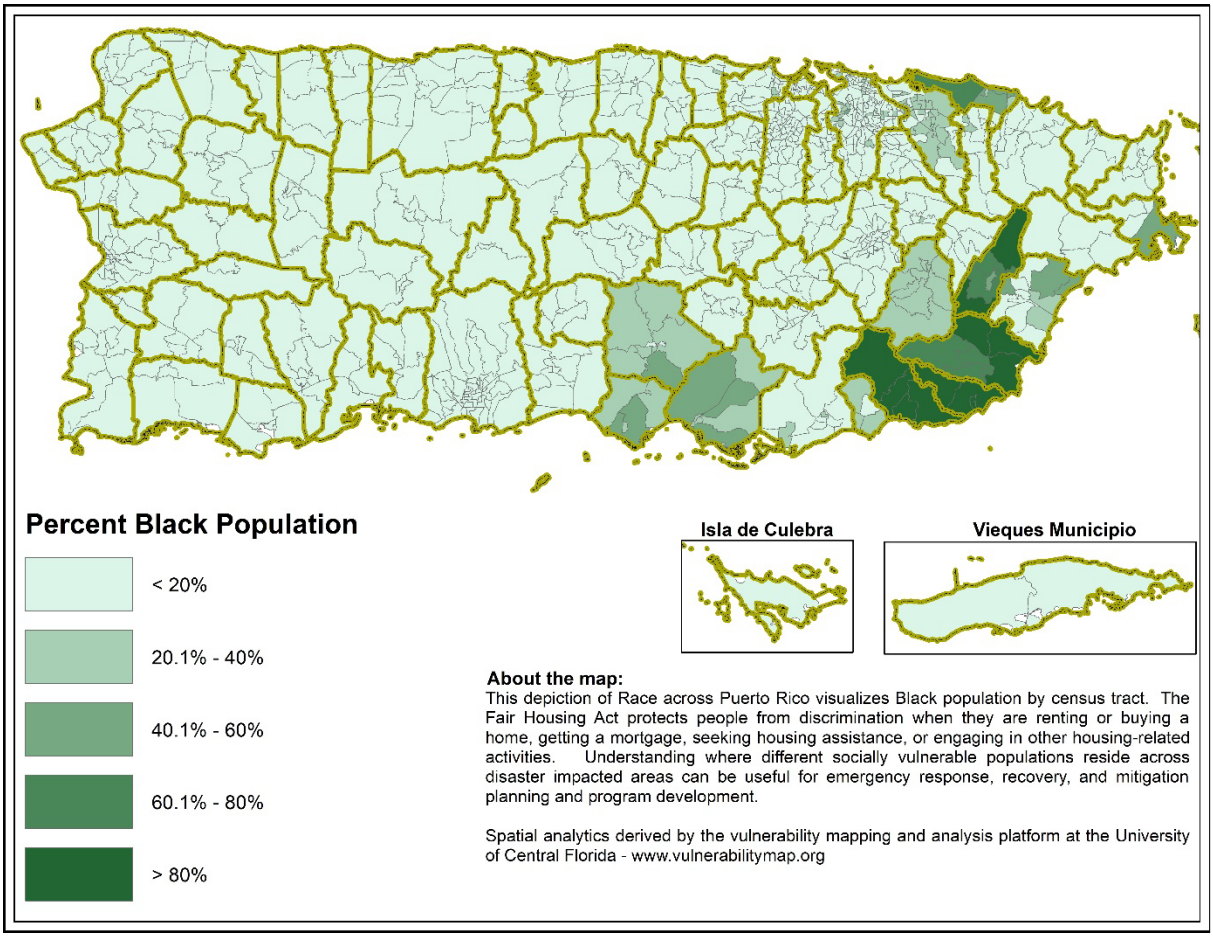

Figure 14: Area Map showing the Location of Black Populations

The Migration Policy Institute identified thirteen (13) different Caribbean countries in a Caribbean Migration Study aimed at understanding Black Caribbean immigration to the United States.[14] These countries include Cuba, Dominican Republic, Haiti, Jamaica, Bahamas, Barbados, Trinidad & Tobago, and Countries in the British West Indies, the U.S. Virgin Islands, and other West Indian Countries such as Grenada, St. Lucia, Antigua-Barbuda, St. Vincent, Dominica, and St. Kitts-Nevis. In Puerto Rico, the largest populations of Black Caribbean's have ancestral links to the Dominican Republic.

An evaluation of Afro Caribbean Ancestry in the benefited area demonstrates the following:

[14] Thomas, Kevin J.A. *A demographic Profile of Black Caribbean Immigrants in the United States*, Migration Policy Institute. April 2012. Accessed at: https://www.migrationpolicy.org/pubs/CBI-CaribbeanMigration.pdf.

Table 6: Summary of Estimated Persons with Afro-Caribbean Ancestry Living within the Project Area of Benefit

Municipality	Total Population	Total Hispanic Afro Caribbean	Total Dominicans	Total Cubans
Coamo	38,906	193	55	138
Juana Díaz	46,152	133	112	21
Ponce	139,671	1,079	750	329
Santa Isabel	21,757	14	14	-

Similar to the SoVI analysis, improved water infrastructure for the residents of these municipalities is presumed to serve protected class populations proportional to the regional characteristics assessed at the municipal level.

Furthermore, there is a strong concentration of impoverished residents in the municipalities that stand to benefit from the project. As shown in **Figure 15**, Ponce has a blend of poverty levels with the highest concentration of poverty (80% or greater) down in the southwest corner of the municipality.

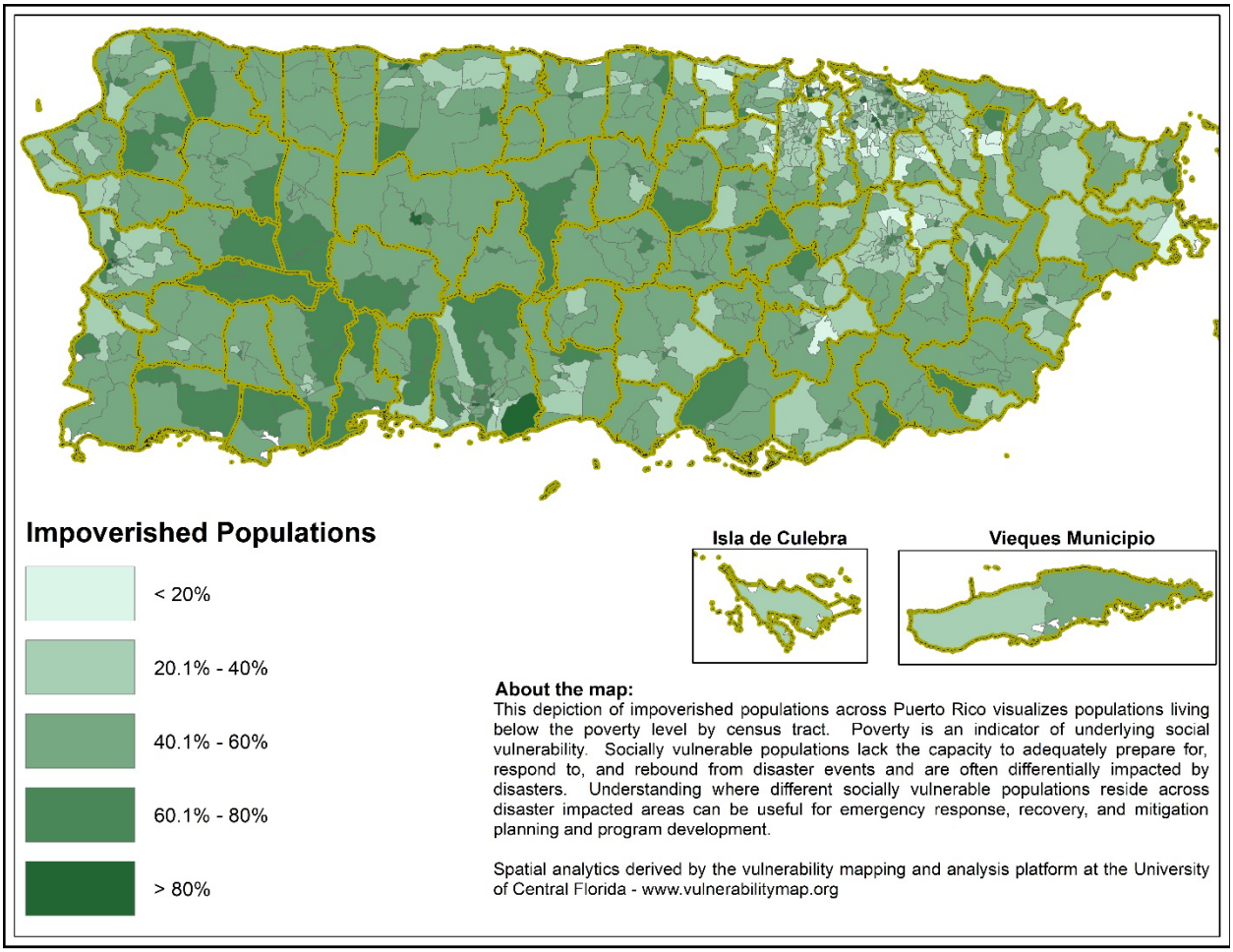

Figure 15: Area Map showing Impoverished Populations

Consistency with Other Mitigation Activities

The proposed project will in no way increase the risk of loss of life or property. Furthermore, the proposed project will benefit the population of the southern coastal region while minimizing water extraction from the south coast aquifer and allowing it to recharge. It was confirmed to be aligned with the 2016 Hazard Mitigation Plan that has been approved by FEMA. This Plan was the approved plan at the time of the project's application submission to FEMA. PRDOH confirmed the project is still in alignment with the goals included in the approved 2021 Hazard Mitigation Plan.

The proposed South Region Water Supply System Improvement Project is consistent with Goal 1 of the Puerto Rico 2016 State Hazard Mitigation Plan: Develop a more resilient Puerto Rico to disasters, reducing vulnerability to future natural hazard events. It is consistent with objective 1.1: Strengthen PRASA's capacity to mitigate natural and unnatural hazards; and specifically with Action 1.1.5: Identify, evaluate, and assess the hazard vulnerability of state critical facilities, emphasizing on the dangers of floods, hurricanes, landslides, and earthquakes, in order to identify mitigation alternatives (e.g. Improvements or relocation of structures) to reduce or eliminate vulnerabilities.

According to the plan, it is particularly necessary to promote the importance of maintaining updated vulnerability analysis of the critical infrastructure, such as the Puerto Rico Electric Power Authority, the Puerto Rico Aqueduct and Sewer Authority, the Department of Transportation and Public Works, and the Telecommunications Regulatory Board. Distribute the analysis results with agencies related to planning and mitigation processes and identify measures to mitigate the vulnerability of the critical infrastructure. This action is priority No. 22 in the state plan. Another action included in the plan which this project is aligned with is Action 1.1.6: Identify specific restoration or relocation projects of state critical facilities that can be developed prior to the occurrence of the disaster with funding sources such as Federal Highway and FEMA-Pre Disaster Mitigation (PDM) matched with local funds, or those that can be activated after a disaster with funds from FEMA HMGP. This action is priority No. 23 in the State Plan.

END OF NARRATIVE