

Managing the Urban Environment of San Juan, Puerto Rico

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Abstract

This article, *Managing the Urban Environment of San Juan, Puerto Rico*, is the twelfth in a series of books that focus on the practice of Urban Environmental Management (UEM) in developing countries, which both face more immediate, critical problems than the developed world and have fewer resources to deal with them in a comprehensive manner. Previous studies have proposed environmental plans for Mysore, India, Lagos, Nigeria, Manila, the Philippines, Lima, Peru, Santo Domingo, the Dominican Republic, Jakarta, Indonesia, Istanbul, Turkey, Bangkok, Thailand, Casablanca, Morocco, Rio de Janeiro, Brazil, and Dhaka, Bangladesh (Edelman, 2025). In the wake of the HABITAT III Conference In Quito, Ecuador in 2016, these studies contribute directly to understanding the urban environmental challenges inherent in achieving the objectives of the conference's final document, *The Quito Declaration on Sustainable Cities and Human Settlements for all* (HABITAT, 2016). This article's objective, then, is to enable graduate students to study the issues faced by San Juan as it attempts to develop an environmental plan using published data sources. The sectors covered are poverty alleviation, industry, energy, transport, water, wastewater/solid waste and finance. San Juan has implemented a comprehensive suite of environmental policies, noted here, aimed at addressing climate change, enhancing sustainability, and protecting its natural ecosystems. Some of these are locally initiated and, others are the result of the city taking advantage of its Commonwealth status to access Federal programs.

Keywords

Urban Environment, Environmental Problems of Developing Countries, Sustainable Development

1. Introduction

This study summarizes the report of a graduate-level workshop that took place at

the School of Planning, College of Design, Architecture, Art and Planning, University of Cincinnati, USA from August through December 2025. The objective of the workshop was to prepare students to work overseas in data-poor environments as professional consulting planners. Several lectures were given to set the framework of the mixed class of twelve domestic and international students to operate in seven collaborative sector-level working groups or teams preparing a 5-year plan for metropolitan San Juan, Puerto Rico utilizing a real-world database and a limited, but realistic budget.

This project formed most of the classwork, culminating in the completion of a professional quality planning document, abstracted here, which is composed of seven chapters, which are Poverty Alleviation, Industry, Transportation, Energy, Water Management, Solid Waste and Sewage, and Finance prepared by the students, as well as an Introduction and a Conclusion written by me.

2. The History and Importance of San Juan, Puerto Rico

In Puerto Rico, population clusters tend to be found along the coast of the island, and the largest of these by far is found in and around San Juan. An exception to this is a sizeable population located in the interior of the island immediately south of the capital around Caguas, but most of the interior, particularly in the western half of the island, is dominated by the Cordillera Central mountains, where population density is low (See [Exhibit 1](#)).



Exhibit 1. Location Map of Puerto Rico (world atlas).

The city of San Juan is the capital of the Commonwealth of Puerto Rico, an unincorporated territory of the United States. It is located on the northeastern coast of the island of Puerto Rico and was founded by Spanish colonists in 1521,

who called it *Ciudad de Puerto Rico* (“Rich Port City”). Puerto Rico’s capital is the second oldest European-established capital city in the Americas, after Santo Domingo, in the Dominican Republic, and was claimed for Spain by Christopher Columbus on his second voyage to the Americas in 1493. It became an American possession in 1898 after the Spanish-American War (CIA, 2025).

San Juan is many faceted. While widespread poverty exists, its widest beach fronts the Isla Verde resort strip, known for its bars, nightclubs and casinos. Cobblestoned Old San Juan features colorful Spanish colonial buildings and 16th-century landmarks including La Fortaleza, the oldest executive mansion in continuous use in the Americas, and El Morro, both of which are massive fortresses with sweeping ocean views, as well as the Paseo de la Princesa bayside promenade.



Exhibit 2. Puerto Rico (Pinterest).

Moreover, San Juan is Puerto Rico’s most important seaport and is the largest in the Caribbean (See **Exhibit 2**). It is also the island’s manufacturing, financial, cultural, and tourism center. The population of Puerto Rico is 3,019,450, with 93.6% of the population, urban. While San Juan municipality has 395,326 inhabitants, the population of the Metropolitan Statistical Area, including San Juan and the municipalities of Bayamón, Guaynabo, Cataño, Canóvanas, Caguas, Toa Alta, Toa Baja, Carolina and Trujillo Alto, is 2,350,126. Thus, about 76% of the population of Puerto Rico now lives and works in this area. (Ibid.)

3. Economy

The San Juan-Caguas area is the largest of the island’s seven metropolitan areas (**Exhibit 3** and **Exhibit 4**), representing roughly 75 percent of the island’s economy, which is classified as a high-income economy by the World Bank, and as the most competitive economy in Latin America by the World Economic Forum. The main drivers of Puerto Rico’s economy are manufacturing, which primarily includes pharmaceuticals, textiles, petrochemicals, and electronics; followed by the

service industry, notably finance, insurance, real estate, and tourism. The geography of Puerto Rico and its political status are both determining factors of its economic prosperity, primarily due to its relatively small size as an island; its lack of natural resources used to produce raw materials, and, consequently, its dependence on imports; as well as its relationship with the United States federal government, which controls its foreign policies while exerting trading restrictions, particularly in its shipping industry (Ibid.).



Exhibit 3. Old San Juan.

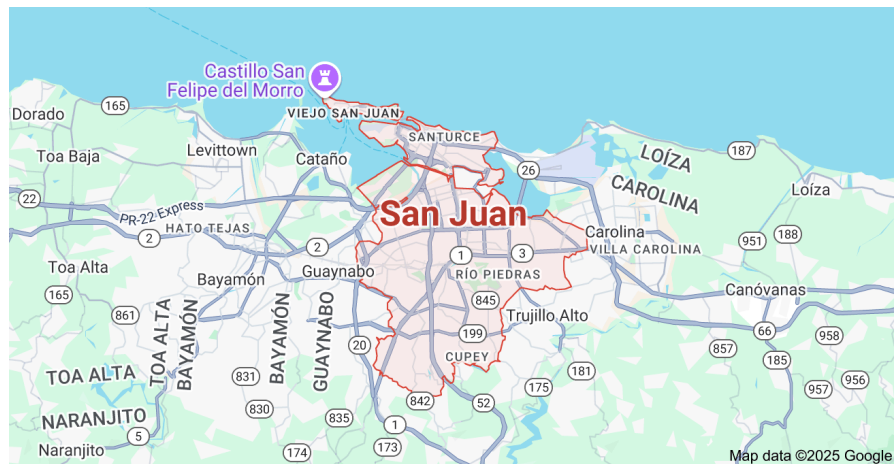


Exhibit 4. Map of San Juan (Google).

In comparison to the different states of the United States, Puerto Rico is poorer than Mississippi, the poorest state of the United States, with 45% of its population living below the poverty line (Quintero, 2013). However, when compared to Latin America, Puerto Rico has the highest GDP per capita in the region.

4. Territorial and Federal Government

San Juan is the territorial capital of the Commonwealth of Puerto Rico, and it is

home to the executive, legislative and judicial branches of the Puerto Rican government. San Juan is also the seat of the Puerto Rico Senatorial District I, which is represented by two Senators. The United States District Court for the District of Puerto Rico is located in Hato Rey. There are two additional federal offices in the San Juan metropolitan area: the Jose V. Toledo U.S. Post Office and Courthouse in Old San Juan, and the GSA Federal Center in Guaynabo. The Federal Bureau of Investigation (FBI), along with other federal organisms, has also had regional offices at the Federico Degetau Federal Building in Hato Rey.

5. San Juan Today

Today, San Juan is known as *La Ciudad Amurallada* (the walled city) and is one of the biggest and best natural harbors in the Caribbean and is the second oldest European-founded city in the Americas after Santo Domingo, which was officially founded on August 5, 1498 (Topuertorico.org, 2025). The metropolitan area, also known as San Juan, now has 3 distinct areas: Old San Juan, the Beach & Resort area, and other outlying communities, the most important of which are Río Piedras, Hato Rey, Puerta de Tierra, and Santurce. In the 20th century the city expanded beyond its walled confines, known as Old San Juan, to incorporate suburban Miramar, Santurce, Condado, Hato Rey and Río Piedras (founded in 1714) (Ibid.)

6. Poverty Alleviation

Poverty in San Juan, Puerto Rico remains one of the most challenging socioeconomic issues facing the municipality. As a U.S. territory with a unique political status, Puerto Rico can participate in many federal anti-poverty programs, but it can only do so under modified frameworks that tend to limit greatly benefit levels, accessibility, and program responsiveness (Center on Budget and Policy Priorities). San Juan itself is the island's largest and most economically central municipality, and because of that, it is the center of government, commerce, transportation, tourism, and services in Puerto Rico. But despite this, the area exhibits some of the highest poverty concentrations on the island due to persistent socioeconomic inequalities, aging infrastructure, and limited upward mobility for residents. These issues can be traced back to a combination of historical structural constraints, economic instability, labor market challenges, and repeated natural disasters that burden Puerto Rico as a whole, intensifying existing vulnerabilities and contributing to cyclical hardship in San Juan (Rodríguez-Díaz, 2018).

This section of the report assesses the current state of poverty in San Juan, examining legal frameworks shaping current alleviation services and evaluating its implementation and effectiveness. Following this, policy recommendations are explained by the students in terms of housing reforms, healthcare reforms, workforce development, and strengthened social services. Cost estimates and financing strategies for each recommendation are also included.

Ultimately, poverty alleviation in San Juan requires coordinated effort between

the community of the municipality and legislative actors, as well as sustained investment and improved governance of the island overall. For a solution to be made, the island's fiscal limitations must be acknowledged while also advocating for federal equity and deep structural reforms that reach down to the roots of systemic poverty in San Juan, Puerto Rico.

San Juan is the largest processing center of the island, and the metropolitan area has facilities for petroleum and sugar refining, brewing and distilling and produces cement, pharmaceuticals, metal products clothing, and tobacco. The port is one of the busiest in the Caribbean. San Juan is the country's financial capital, and many U.S. banks and corporations maintain offices or distributing centers there. San Juan is the center of Caribbean shipping and is the 2nd largest sea port in the area after New York City (Ibid.), while also being a popular port of call for Caribbean cruise ships.

7. Industry

This section of the report traces how San Juan's economy has grown and struggled over time, showing how outside forces, shifting federal policies, and aging infrastructure have shaped the city's development. San Juan began as a colonial port built by forced labor for agricultural exports, and after the United States took control in 1898, it became increasingly tied to U.S. capital and economic policies.

Industrial growth took off in the mid-20th century through Operation Bootstrap and later Section 936, which drew U.S. manufacturers, especially pharmaceutical and high-tech firms, to the island. These incentives created jobs and raised incomes, but they also made Puerto Rico dependent on companies that were there mainly for tax advantages. When Section 936 was phased out, the limits of this model became clear, contributing to a long period of economic decline starting in 2006.

The crisis eventually led to *PROMESA* in 2016, which placed Puerto Rico under federal fiscal oversight and restructured its debt. While this eased some financial pressure, it also restricted government spending, leaving critical infrastructure, especially the electrical grid, underfunded. Hurricanes Irma and Maria then exposed just how fragile the system had become.

The 2020 handover of PREPA's transmission and distribution system to LUMA Energy was meant to modernize the grid, but power outages continue to disrupt daily life and business operations. Small- and medium-sized businesses are hit hardest because they rarely have the resources to protect themselves from frequent blackouts.

San Juan's environmental and regulatory systems face similar pressures. Multiple agencies share responsibility, but coordination is uneven, and old infrastructure struggles to meet modern demands. *Although recent upgrades in wastewater systems, climate planning, and monitoring show progress, long-term recovery depends on building a more reliable energy system and strengthening cooperation across agencies.*

8. Energy

San Juan, Puerto Rico has an energy grid and infrastructure that is fragile and not self-sustaining. San Juan being the largest city on the Puerto Rican island, consumes a large amount of energy. Puerto Rico being a territory of the United States, utilizes the same systems provided by the US federal government. Puerto Rico does not have significant amounts of fossil fuel resources, nor does it mass produce renewable energy solutions, causing it to be energy dependent importers (U.S. Energy Information Administration, EIA, independent statistics and analysis 2025). In fact, Puerto Rico's is heavily dependent on fossil fuel forms of energy, mainly petroleum, natural gas, and coal.

In Puerto Rico, the government has created a public corporation of the Commonwealth. This public corporation, Puerto Rico Electric Power Authority, known as PREPA, began operating in 1941, after a government mandate was enacted (PREPA). PREPA is the only electrical utility provider in Puerto Rico, and it supplies over 1.5 million people with electricity. PREPA receives funds from the U.S. federal government to maintain and build energy infrastructure for its jurisdiction. *During the 1960s, it built new energy infrastructure and transmission lines, but in the following decades, petroleum, the island's most important fuel source, became incredibly more expensive (Roberts, n.d.). This caused investment in energy by PREPA to go down, since it had begun taking on major amounts of debt. This led to the electrical system falling into disrepair, which was badly affected by the increase in the powerful storms. They severely damaged the system, and Hurricane Maria in 2017 was a major contributor here.*

9. Transportation

As mentioned earlier, San Jaun, the capital city of Puerto Rico, is home to about 300,000 people. Situated on the north coast of the island, the city is the fourth largest seaport in the western hemisphere as well as the second busiest cruise port behind Miami. In addition, the metro population is approaching 2.5 million (Puerto Rico Integrated Transit Authority). *This combination of a growing population and increased tourism compels the island's largest city to plan strategically all aspects of transportation. The city covers both the private and public sector with eight modes of transportation: rail transit, buses, trolleys, automobiles, scooters and bikes, rideshare apps and taxis, ferries, and air travel.* This section will cover these modes of transit extensively while also examining the social issues and challenges that blemish the capital city. Finally, *the section will dive into possible solutions that could be implemented to improve the effectiveness and efficiency of transportation in San Juan.*

10. Wastewater and Solid Waste

San Juan is the capital of the Commonwealth of Puerto Rico and is the home of the majority of Puerto Ricans. Though Puerto Rico is the wealthiest island in the

Caribbean and is considered a developed economy, if it were a state, it would be the poorest in the union. The struggling economy has made it difficult for Puerto Rico to hold to American infrastructure standards. With 3 million people that are overwhelmingly urbanized and mostly concentrated in the coastal city of San Juan, the advance of hurricanes or climate change are important considerations for the development of the Commonwealth. Despite being relatively underdeveloped when compared to the States, Puerto Rico produces 5.56 pounds of solid waste per person, which is substantially higher than the U.S. national average of 4.4 to 4.91 pounds per person. As a relatively small island with a large population, this amount of waste production has become a crisis in recent years as Puerto Rico has begun to surpass landfill capacity and has struggled to maintain existing landfills to EPA requirements (Ibid.).

This section is divided into two main parts, in addition to an intro and conclusion. These are wastewater (sewage and storm runoff) and solid waste (trash). Both main parts are subdivided into sections that establish the context of the issue, issue identification and proposals, and a case study.

Puerto Rico's water and wastewater infrastructure is relatively centralized and publicly owned with 59% of wastewater being owned by the Puerto Rico Aqueduct and Sewer Authority "PRASA" (Puerto Rico Fiscal Agency and Financial Advisory Authority). In San Juan, the rate of public ownership is much higher as most privately owned waste treatment systems are rural septic systems (Environmental Protection Agency). In 2003, PRASA plead guilty to "15 felony counts of violating the Clean Water Act through the illegal discharge of pollutants" (Office of Public Affairs, U.S. Department of Justice, 2015). Puerto Rico was fined 9 million dollars for their violations, the largest ever.

11. Water Management

San Juan's water sector reflects the interplay of geography, governance, infrastructure legacies, and colonial territorial status. The metropolitan region forms one of the most complex hydrological landscapes in the Caribbean: a coastal estuarine system composed of San Juan Bay, the Condado and San José lagoons, the Caño Martín Peña, tidal wetlands, and a flat coastal plain. This natural environment once supported extensive mangroves and marsh systems, which attenuated floodwaters and filtered runoff. Over the last century, however, urban expansion has reshaped the landscape through dredging, channelization, land filling, road construction, and dense residential settlement, particularly in the low-lying zones surrounding the Martín Peña Channel.

San Juan receives roughly 50 - 60 inches of rainfall annually, but precipitation is seasonally concentrated and heavily influenced by tropical storms and hurricanes. Extreme weather events bring sudden high-intensity rainfall that overwhelms drainage systems and exposes the chronic weaknesses of aging water and wastewater infrastructure. The flooding that accompanies such storms is often exacerbated by inadequate sewerage disposal, clogged drainage channels, and insuf-

efficient stormwater capture. The Martín Peña Channel corridor, home to approximately 27,000 residents across eight communities, has become emblematic of this challenge. These neighborhoods are situated on low, marshy terrain historically filled with debris and informal construction, making them acutely vulnerable to tidal flooding, storm surge, and chronic pollution.

San Juan's water sector stands at a crossroad. After decades of underinvestment, environmental degradation, and social inequity, the conditions for transformation finally exist: clear regulatory frameworks, federal partnership opportunities, an increasingly capable territorial utility, and community governance models that protect residents from displacement. However, progress will depend on acknowledging the systemic nature of the challenges, which are technical, financial, institutional, and social.

The way forward requires a multi-pronged approach: reducing NRW to stabilize PRASA's finances; restoring and dredging the Martín Peña Channel while protecting residents; deploying green infrastructure to address stormwater and climate vulnerabilities; and strengthening regulatory and institutional frameworks. While costly, these interventions can be phased and financed through a blend of federal, territorial, municipal, and innovative funding sources.

The environmental problems of developing cities, San Juan included, cannot be solved solely through engineering. They require governance innovation, community participation, and stable financing strategies. By combining these elements, San Juan can move toward a water system that is reliable, equitable, and resilient.

12. Finance

When considering the financial status of San Juan, the connection it has to the United States is vital to understanding the complexity of getting things funded in the territory. Puerto Rico's official legal status is a commonwealth or unincorporated territory; this means that the constitution is selectively applied. For instance, citizens are US residents but cannot vote in presidential elections. To fill in the void of governance left by this system, Puerto Rico established its own constitution in 1952, which has given the territory comparatively more autonomy. Puerto Rico also has had a PROMESA debt oversight board since 2016, stemming from a debt crisis of around \$78 billion. This board must approve major expenditures of the island, including budgets, plans, and debts. Current indications of successful project finance show projects in energy, tourism and housing, infrastructure, and climate resilience have priority.

The island has consistently been ranked as one of the most successful in Latin America and the Caribbean. It is an industrial hotspot primarily for pharmaceuticals. It is also a financial capital for the Caribbean because of its connections to the United States. This connection to the U.S. puts the island territory into a unique position where it can benefit from some of the capital flows of money coming from the government, but it is also not accurately represented by the federal government and PROMESA board, to which the board members are appointed,

serve as a control mechanism over the territory. In a development sense, this is somewhat of an awkward middle ground to finance projects. Any new projects must fit into the PROMESA board's vision of the island, and they have the power to easily reject locally led initiatives.

Prior to PROMESA, the island expressed more autonomy over its financing; it would issue bonds to finance many projects on the island, but with the current rating of their bonds, this avenue has temporarily dried up. The debt crisis of the island for the last decade has begun to subside, and PROMESA is intended to dissipate once the island is in a healthier financial situation. Whether this happens is yet to be seen, but if it does, the island will be able to fund more unique projects that are not directly tied primarily to infrastructure.

As Puerto Rico moves disaster recovery toward long-term redevelopment, the central question becomes whether financial and political structures will evolve to support a more autonomous, development-driven future. The anticipated transition away from PROMESA, coupled with emerging economic opportunities, provides a potential opening for Puerto Rico to redefine its planning and investment priorities. Municipalities like San Juan will need expanded fiscal tools, workforce strategies, and resilience frameworks to move beyond dependence on federal funding cycles. If these shifts occur, Puerto Rico may finally begin to construct a development model grounded in local capacity, equitable growth, and durable economic stability that aligns financial mechanisms with the lived realities and aspirations of its communities.

13. San Juan's Environmental Policies

The City of San Juan's environmental policies reflect a multifaceted approach to sustainability, combining government-led initiatives with community-driven efforts to address climate challenges and promote ecological resilience. In addition, as the largest and most important city in the Commonwealth of Puerto Rico, San Juan has access to many U.S. government programs. Consequently, San Juan has implemented a comprehensive suite of environmental policies aimed at addressing climate change, enhancing sustainability, and protecting its natural ecosystems. Key initiatives include:

13.1. Climate Action and Renewable Energy

- EPA Climate Pollution Reduction Grant: In 2023, San Juan received a \$1 million grant from the U.S. Environmental Protection Agency to develop climate action plans. These plans focus on reducing greenhouse gas emissions and promoting clean energy solutions, particularly in low-income and vulnerable communities.
- Puerto Rico Energy Public Policy Act (Act No. 17-2019): This legislation mandates a transition to 100% renewable energy by 2050, with interim goals of 40% by 2025 and 60% by 2040. It also includes the phaseout of coal-fired power by 2028 and improvements in energy efficiency.

13.2. Green Infrastructure and Ecosystem Restoration

- San Juan Bay Estuary Program: This program implements green infrastructure projects to manage stormwater, improve water quality, and restore ecosystems. Efforts include reforestation, mangrove restoration, and the creation of urban forests to enhance biodiversity and community engagement (ESTUARIO, 2022).
- San Juan Ecological Corridor: Established in 2003, this 971-acre corridor protects secondary forests and green spaces, including the University of Puerto Rico Botanical Garden. It plays a crucial role in preserving the Piedras River watershed and the San Juan Estuary drainage systems (Wikipedia, 2025).

13.3. Water Infrastructure and Pollution Control

- Storm Sewer System Upgrades: Under a 2015 settlement with the U.S. Department of Justice and the EPA, San Juan committed to investing approximately \$180 million to upgrade its storm sewer systems. The goal is to eliminate or minimize discharges of untreated sewage into local water-bodies, thereby protecting public health and the environment (Office of Public Affairs, U.S. Department of Justice, 2015).
- Storm Water Management Program (SWMP): San Juan has developed a SWMP that includes best management practices, public education, and stormwater monitoring to comply with federal regulations and improve water quality.

13.4. Community-Led Environmental Initiatives

- Coastal Restoration in Cantera Peninsula: Community organizations, supported by groups like CRES, are leading efforts to restore coastal ecosystems through mangrove reforestation, waterway cleanups, and environmental education. These initiatives aim to build resilience against climate change and empower residents (Ramos-Gutiérrez, 2024).
- Agroecology and Food Sovereignty: In response to food insecurity exacerbated by natural disasters, young farmers in Puerto Rico are embracing agroecology — a sustainable farming approach that integrates traditional practices. This movement seeks to reduce dependence on imported food and promote environmental stewardship.

14. Conclusion

As the preceding indicative paragraphs show, San Juan has implemented a comprehensive suite of environmental policies aimed at addressing climate change, enhancing sustainability, and protecting its natural ecosystems. Some of these are locally initiated and, others are the result of the city taking advantage of its Commonwealth status to access Federal programs. The following sections will explore the environmental problems of San Juan in detail and suggest an overall environmental plan to alleviate them.

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- EPA Climate Pollution Reduction Grant: In 2023, San Juan received a \$1 million grant from the U.S. Environmental Protection Agency to develop climate action plans. These plans focus on reducing greenhouse gas emissions and promoting clean energy solutions, particularly in low-income and vulnerable communities.
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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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