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Analysis of Land Use Efficiency in Central San Juan Metropolitan Area

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Abstract

This project is a study of the efficiency of land use within the central San Juan metropolitan area of Puerto Rico. Interviews with academics and professionals revealed causes for land use inefficiencies. We used comparisons of population, transportation, construction, and green-space in Puerto Rico to other areas, and to the ideals of the Smart Growth concept, in order to show that land in the San Juan region of Puerto Rico has been used inefficiently when compared with other regions.

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This report is the product of an education program, and is intended to serve as a partial documentation for the evaluation of academic achievement. The report should not be construed by the reader as a working document.

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Executive Summary

This project, prepared for the Universidad Metropolitana School of Environmental Affairs, is an analysis of land use efficiency in the central San Juan metropolitan area, including the municipalities of Bayamón, Cataño, Carolina, Guaynabo, San Juan, Toa Baja, and Trujillo Alto. We examined and evaluated population growth and density, highway transportation, construction, and agricultural land and green-spaces in the central San Juan metropolitan area. We found a dramatic increase in population and accelerated development in the past four decades, which has led to inefficient land use and development trends that contradict those promoted by the Smart Growth concept.

Since the 1940's with the introduction of Operation Bootstrap, Puerto Rico has begun a rapid transition from an economy based on agriculture to one based on industry and manufacturing. This transition was further fueled by the introduction of IRS code Section 936, which brought many large manufactures from the United States to Puerto Rico in the 1960's. With the industrialization of Puerto Rico, a tremendous increase in development occurred. People began to flock to cities, for instance San Juan, looking for jobs and places to live. As the population of San Juan began to grow, and the land became increasingly more developed and populated in the 1960's and 1970's, residents of the cities started to move to the rural areas surrounding San Juan, such as Bayamón and Carolina. This immigration to the suburbs still continues in the metropolitan San Juan area today, and it is further fueled by the massive amounts of highway infrastructure that have been constructed in these areas. The residents of this central San Juan metropolitan area are now moving further away from San Juan and into municipalities such as Loiza and Vega Baja, causing the metropolitan area of San Juan to grow larger

still. As this growth occurs, there is a demand created for more transportation infrastructure and further construction of housing units; inadequately controlled, this growth contributes to loss of agricultural lands and green-space in the metropolitan area. Furthermore, as our literature review states, this unplanned growth can cause greater pollution, traffic congestion, and development that is greatly distanced from commercial centers; all of these phenomenon lead to a lower quality of life.

The Smart Growth concept is a plan for the design of sustainable developments located close to commercial centers, with adequate transportation infrastructure, areas of preserved green-space, and mixed-income and multi-use housing. We evaluated transportation, construction, green-space, commute time, population and population density, planning and development processes in the central San Juan metropolitan area, and compared them against the standards established by the Smart Growth concept in order to determine whether land has been used efficiently in Puerto Rico. We determined that land in the central San Juan metropolitan area was not use efficiently.

In order to examine these land use inefficiencies, we have compared our findings in Puerto Rico and the central San Juan metropolitan area to statistics from other areas in the United States. We took cities, metropolitan areas, and states of similar characteristics as Puerto Rico and made comparisons involving population densities, highway mileage, construction of single-family and multi-family homes, and agricultural lands and green-spaces. Through both the use of these statistical comparisons, and our interviews with planning board officials and professors of local universities we were able to draw conclusions about the growth and development of the central San Juan metropolitan area.

We were thus able to identify causes and instances of inefficient land use, and the trends that contributed to these inefficiencies.

When a metropolitan area is growing rapidly, its development must be closely monitored. Land use plans and zoning regulations need to be created, and implemented properly to ensure efficient growth. When these regulations are not successful, then urban sprawl, or inefficient development or expansion can occur. It is the responsibility of government agencies, such as planning boards, zoning offices, and permitting offices, to oversee the development. In the central San Juan metropolitan area it was determined that a lack of sufficient observation of planning and zoning regulations contributed to inefficient development trends such as commercial development on zoned residential land, and construction of exclusively single-family developments. Solutions to inefficient land use include community involvement in the planning process and the review and refinement of existing planning and zoning regulations.

Introduction

Uncontrolled growth throughout Puerto Rico has led to unsustainable development that is consuming precious rural and agricultural land. The current growth trend of the infrastructure and population, in addition to inadequate planning measures and strong political response to economic forces have contributed to this inefficient land use. These trends are aggravated by the fact that Puerto Rico has one of the highest population densities in the world.

The School of Environmental Affairs of the Universidad Metropolitana* has received a grant from the Environmental Protection Agency to gather and disseminate information about the inefficient pattern of land use in Puerto Rico. Universidad Metropolitana (UMET) has commissioned this project to examine land use in the central San Juan metropolitan area in order to determine causes of inefficiency, and methods by which development in Puerto Rico could become agreeable with concepts promoted by the Smart Growth Network.

The specific objectives of this project included researching past and future population growth, development and land use planning. Once researched, we used this data to determine whether or not land has been used efficiently in comparison to other regions within the United States. Lastly, we applied the Smart Growth concept to development trends in Puerto Rico to make recommendations whereby Puerto Rico might alter its pattern of inefficient land use. The Smart Growth concept defines a set of development ideas that encourage sustainable development, and a high quality of living

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* This report was prepared by members of Worcester Polytechnic Institute Puerto Rico Project Center. The relationship of the Center to the School of Environmental Affairs of the Universidad Metropolitana and the relevance of the topic to the School of Environmental Affairs of the Universidad Metropolitana are presented in Appendix A.

for residents of Smart Growth communities. These ideals include distributed, localized commercial centers, mixed-income, multi-use, high-density housing, preservation of green-space, and transportation infrastructure that minimizes commute-times.

Having researched current land use trends, highway planning, and population growth, we found Puerto Rico's land to have been used inefficiently. The inefficient pattern of use is the result of rapid growth during the 1950's and 1960's that contributed to excessive highway development, and insufficient implementation of zoning and planning regulations.

The findings from this project will be of use not only to the School of Environmental Affairs at the Universidad Metropolitana, but to many other agencies with similar interests. Organizations such as the Environmental Protection Agency (EPA), Sea Grant, and local groups may be interested in the current developments concerning the environment of Puerto Rico. Local organizations involved in urban planning, transportation, and zoning will also be interested in our conclusions. In addition, our research will serve as a basis for further studies conducted by organizations specified in the UMET EPA grant proposal in **Appendix D**.

The School of Environmental Affairs at the Universidad Metropolitana is planning to inform the people of Puerto Rico about Smart Growth. Our research will lead to the creation of an educational video and publication, entitled; "Puerto Rico's Road to Smart Growth", and a Smart Growth Congress regarding urban development in Puerto Rico. Ultimately, these projects will educate the public about Smart Growth and possible ways by which it may be employed to halt or slow unsustainable growth in Puerto Rico.

The methodology used to accomplish the goals of this project consisted of two parts, qualitative and quantitative analysis. The qualitative data was obtained through interviews with planning professionals and professors. The quantitative data was collected from the Planning Board, the Department of Transportation and Public Works and the Department of Agriculture. From these agencies we collected census data, transportation statistics, construction reports, and agricultural and green-space statistics. This data was used in comparative analyses with data of other regions within the United States to determine in what way growth in Puerto Rico and the San Juan Area is similar to or different from growth in the United States. Based on our conclusions from the analysis and case studies of similar growth in other regions, we suggested possible alternatives to current patterns of growth in urban Puerto Rico. These suggestions took into consideration measures present in the Smart Growth concept.

The Interdisciplinary Qualifying Project (IQP) is a research project completed by Worcester Polytechnic Institute students as an undergraduate degree requirement. The IQP is a project in which students must relate technology to society and learn research and data collection and analysis methods. Our project fulfills the goals of an IQP through our use of comparative data to assess the efficiency of land use in the central San Juan metropolitan area.

Literature Review

Guide to Literature Review

In order to prepare ourselves to complete this project, we researched background information concerning the United States' involvement with Puerto Rico and basic information about Puerto Rico's government and geography. Understanding urban sprawl and urban development, particularly in context of Puerto Rico, is critical to our project and is therefore a major focus of this literature review. A proposed solution to the problem of urban sprawl is Smart Growth, or Sustainable Growth, which is thus another primary focus of this review.

Background Information on Puerto Rico

Geography of Puerto Rico

The island of Puerto Rico is located at the northern edge of the Caribbean Sea to the east of the Dominican Republic and to the west of the Virgin Islands. According to Rafael Pico (1974: 14), it is approximately 111 miles in length, 38 miles in width, and covers 3,435 square miles. Puerto Rico is the smallest of the Greater Antilles;

Table 1: Comparison of Islands in Greater Antilles

Other Islands (of the Greater Antilles)	Size in Comparison with Puerto Rico
Jamaica	1.2x
Hispaniola	9.0x
Cuba	13.0x

Source: Pico, 1974: 13-14

it is estimated to be twenty five percent level or flat terrain, forty percent mountains, and thirty five percent hills. The terrain is said to be "rugged" according to Ronald Fernandez (1998: 11). Pico (1974: 247) states that the topography of the island limits growth and

agricultural expansion; moreover the industrialization process developed during the 1940's, has greatly influenced the island's crowded condition. With the limited amount of flat area available in Puerto Rico, land use is an important issue on the island, especially with the growth of industry (Pico, 1974: 247).

Soils and Agriculture in Puerto Rico

According to Pico (1974: 21), though the agriculture industry is not very predominant on the island of Puerto Rico, it is not due to the lack of pure quality soil content. Soil quality is the measurement of the agricultural potential of an area. The Federal Government's studies rate soil quality to be of grade one to ten, where grade one soil is the best, grade five average and grade ten unusable for agricultural purposes. Pico (1974: 21) states that a total of twenty eight percent or 400,000 acres of the island's land has been evaluated to be within the range of one to five. The remaining soils of Puerto Rico range from grades six to ten.

The damaging effects of erosion cause many problems for the farmers and agriculturists of Puerto Rico. In order to maintain productive lands, Pico (1974: 21-23) observes that heavy and complex conservation techniques must be implemented. A total of twenty eight percent of land in Puerto Rico shows minimal soil erosion, and the remaining areas show moderate to high erosion. Furthermore, Pico (1974: 24) discusses programs that have been implemented and are ongoing to minimize soil erosion, and restore and conserve land to preserve its agricultural productivity.

As Pico (1974: 205) maintains, there have been 352 documented types of soils recorded on Puerto Rico ranging from soils of the humid and subhumid regions to soils of the arid and semiarid regions. Areas of interest to our project are Cataño, Carolina,

Bayamón, Guaynabo, Loiza, Toa Alta, Toa Baja, Trujillo Alto, Vega Alta, and Vega Baja. Pico (1974: 207) indicates that these areas show concentrations of the following types of soil: Alluvium, Peat, Sabana Seca & Lares, and Coto & Bayamón. The Coto & Bayamón soils of the northern limestone region tend to be rich in iron and aluminum, but poor in nitrogen and phosphorus, which make the land virtually useless to agriculture. Pico (1974: 210) further observes that the Sabana Seca & Lares soils, found on the north coast plain, are similar to those Coto & Bayamón soils in that they too contain high concentrations of iron and aluminum, while possessing low amounts of nitrogen and phosphorus. The Alluvial soils of the north, east and west coasts are very fertile, supporting sugar cane production, but are found on less than four percent of the island of Puerto Rico (Pico, 1974: 211). Generally the soils found in these urban areas located outside of metropolitan San Juan have little agricultural value with the exception of the Alluvial soils in the north coastal plain.

The Beginning of the United State's Involvement in Puerto Rico

On April 21, 1898, the Spanish-American War began, and so did the United States involvement with the island of Puerto Rico. American troops invaded the island on July 25, 1898, and the United States gained control of it in August 12, 1898 after signing the Paris Treaty with Spain. Puerto Rico was considered a colony of the United States until 1952. The United States Congress then granted Puerto Rico commonwealth status, which meant that Puerto Rico has the same level of control over their affairs as the fifty states (Tuller, 1993: 103).

Industrialization of Puerto Rico

As Ronald Fernandez (1998: 13) observes, beginning with the signing of the Paris Treaty with Spain, the United States has influenced the Puerto Rican people and their island. This process is one that has changed the Puerto Ricans, causing their culture to be a mixture of Puerto Rican and American traditions. Pico (1974: 253) believes that the United States' influence can be felt in the development of industry on the island. There are close relationships that exist between private enterprises and the governments of both Puerto Rico and the United States. These relationships have allowed many of the United States' technical advances to increase Puerto Rico's economic prosperity. Having been influenced by the United States, Puerto Rico's economy has been developed to resemble that of the United States with respect to industry size and efficiency. Puerto Rico has the economic and political stability found in the fifty states (Tuller, 1993: 104). According to Lawrence Tuller (1993: 104), manufacturing industry within Puerto Rico is considered to be the most proficient, high-tech industrial centers in the hemisphere in comparison to regions of similar size. Also, Puerto Rico, in relation to any Caribbean or Latin American nation, has by far the greatest number of industrial parks, demonstrating the full effect of the United States' involvement with the island (Tuller, 1993: 104).

Government Influenced Industrialization

As Tuller (1993: 106-107) describes, the Puerto Rican government offers a variety of foreign investment incentives to attract companies from Europe, Japan, and the United States to the island: grants for employee training, government-paid leasehold improvements, defrayal of equipment transportation charges, tax holidays, and free trade zones. Free trade zones in Mayaguez, Ponce, and San Juan allow foreign companies to

import equipment and supplies duty free, if the imports are used in the production of exports. By allowing duty free imports the government stimulates the growth of Puerto Rico's industry and helps create jobs for the Puerto Rican people. Additionally, measures were undertaken in the past by the Internal Revenue Service (IRS) to encourage industrial growth in Puerto Rico. As Tuller (1993: 111) describes, the IRS code section 936 allowed U.S. companies to operate on the island essentially tax free, effectively saving them the millions of dollars that they would have paid had they operated in the United States. Incentives like these helped to attract companies to the island. By encouraging companies to come to Puerto Rico, the government creates jobs for the citizens living on the island, which in turn contributes to the further development of the region (Tuller, 1993: 111).

Population Growth

According to the U.S. Census of Puerto Rico, there was a large amount of growth within the last few decades in Mayaquez, Ponce, and San Juan, centers of industrial growth (Fernandez, 219-221). Furthermore, Fernandez (1998: 219) observes that in contrast the populations of mountainous regions like Adjuntas and Lares have either remained nearly constant or declined over the last century.

Table 2: Puerto Rico Population Growth 1898-1990

Region (city)	Population-1898	Population-1940	Population-1990
Adjuntas	19,484	22,556	20,176
Lares	20,883	29,914	29,419
Mayaquez	35,700	78,487	103,259
Ponce	55,477	105,116	195,217
San Juan	13,760	169,247	449,285

Source: Fernandez, 1998: 219-221

According to Fernandez (1998: 11-12) there has been a substantial amount of urbanization throughout Puerto Rico. A comparison of the populations of various municipalities from the years of 1940 and 1990 reveals substantial growth in urban areas such as Bayamón, Carolina, Cataño, Toa Baja, Toa Alta, Guaynabo, Canóvanas, Loiza, Trujillo Alto, Vega Baja, and Vega Alta, all of which border metropolitan San Juan. Conversely, limited growth has occurred in the mountainous regions. The following table illustrates the growth of those urban areas from 1940 to 1990.

Table 3: Population Growth 1898-1990

Region (town)	Population- 1898	Population- 1940	Population- 1990
Bayamón	12,778	37,190	221,815
Carolina	14,442	24,046	178,695
Cataño	2,737	9,719	35,369
Guaynabo	6,957	18,319	92,997
Loiza	15,522	22,145	29,374
Toa Alta	7,908	13,371	42,152
Toa Baja	4,030	11,410	89,413
Trujillo Alto	5,683	11,726	61,916
Vega Alta	6,107	14,320	36,478
Vega Baja	10,305	23,105	58,124

Source: Fernandez, 1998: 217-221

The total population of those areas in 1940 was 185,351; by 1990 it had risen to 846,330. The total increase in those areas of Puerto Rico was 457 percent over the course of five decades.

Superaquaducto

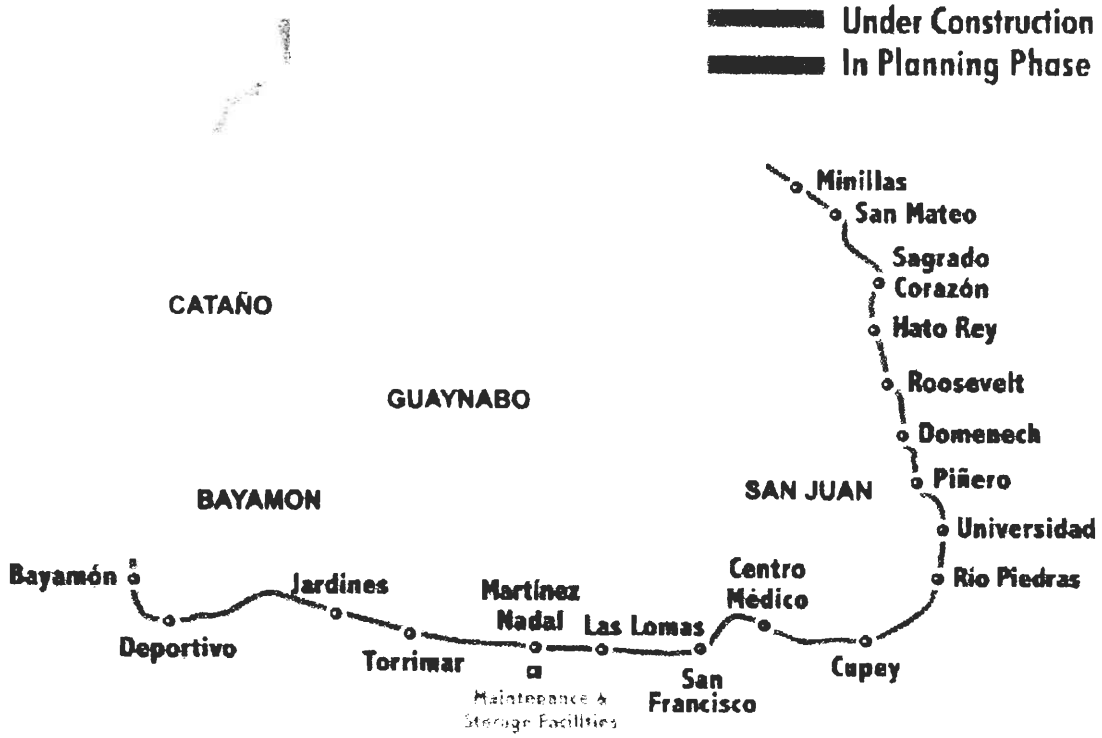
In September of 1999, Thames-Dick Superaquaduct Partners began construction of the "Superaquaducto", an enormous aqueduct designed to bring 75 millions of gallons daily (MGD) from a water source in Arecibo to the metropolitan area (Virella, August 1999: 10). The construction of the aqueduct will alleviate the water shortages the

metropolitan area has been experiencing in the past. Water shortages left 600 thousand people without water in January of 2000 (Santos, January 21, 2000: 3), and are expected to last until the construction of the superaquaducto (McPhaul, September 16, 1999: 7). Once constructed, it will further development in the area which has previously been hindered by the prohibitive cost of building water and sewer infrastructure. Interconnections to the aqueduct from Manatí, Vega Baja, and east Vega Baja will also further development in those areas (Virella, August 1999: 10).

The Urban Train

The Urban Train is being constructed in order to alleviate the traffic congestion in and around the Metropolitan San Juan area. The project is to be carried out in five phases starting with a route from Bayamón into San Juan and up and along Ponce De Leon Ave with stops in many areas; for example Centro Medico, Rio Piedras, Universidad, Hato Rey, and Minillas, which is illustrated in figure 1 (Gonzalez, 1999).

Figure 1: Urban Train Phase 1



Source: Gonzalez, 1999

This phase of the project is currently under construction, and it is scheduled to cost approximately 1.6 billion dollars (Gonzalez, 1999: presentation), as shown in figure 2 (Gonzalez, 1999).

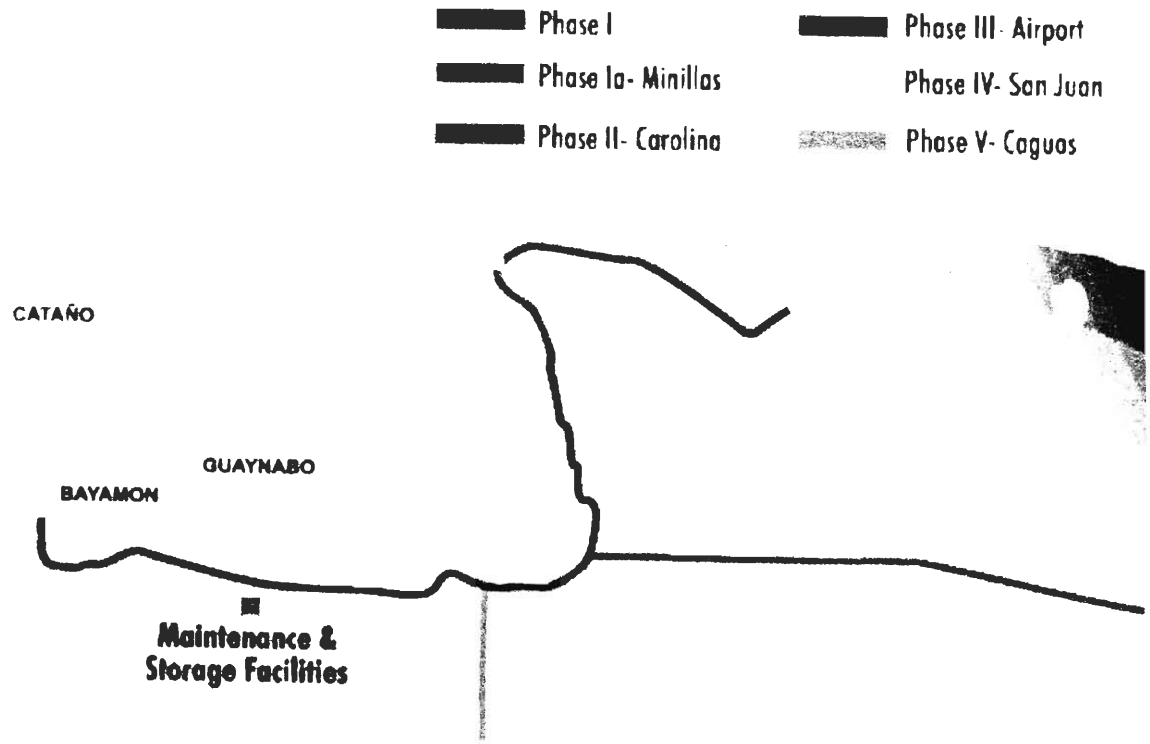
Figure 2: Budget for Urban Train Phase 1

Work Breakdown Forecast at Structure Completion	Award Value	Changes	Claims	Contingency	Forecast at Completion
Right of Way	$ 87.3	$ 0.0	$ 0.0	$ 0.0	$ 87.3
GMAEC / Const. Mgment	144.5	85.0	0.0	0.0	229.5
Bayamón	68.3	6.3.	3.8	(0.1)	78.3
Río Bayamón	36.7	2.2	2.6	0.6	42.2
STTT	544.2	95.3	5.7	11.1	656.4
Centro Médico	71.5	4.5	3.9	1.1	81.1
Villa Nevárez	71.5	3.0	3.0	0.4	77.9
Río Piedras	225.6	31.6	17.2	5.1	279.4
Hato Rey	117.4	19.6	1.2	(4.1)	134.1
CDC Lab Replacement	1.5	3.0	0.0	0.0	4.4
Communication/Radio Syst.	0.0	0.0	0.0	0.0	0.0
Fare Collection	9.3	(9.3)	0.0	0.0	0.0
Art Program	2.0	0.0	0.0	0.0	5.0
TOTAL	$1,379.8	$241.1	$37.4	$17.3	$1,675.6

Source: Gonzalez, 1999

The other scheduled phases in the project include connections to Carolina, the Airport, San Juan, and Caguas as shown in figure 3 (Gonzalez, 1999).

Figure 3: Urban Train Master Plan



Source: Gonzalez, 1999

Environmental Protection Agency

The Environmental Protection Agency (EPA) provides direction, develops policy, and encourages and enables others to effectively protect and restore the nation's wetlands and associated ecosystems, which include bodies of open water and free flowing streams (EPA Region 2). The EPA's wetlands program consists of two fundamental ideas: to establish national standards, and to assist others in achieving those standards.

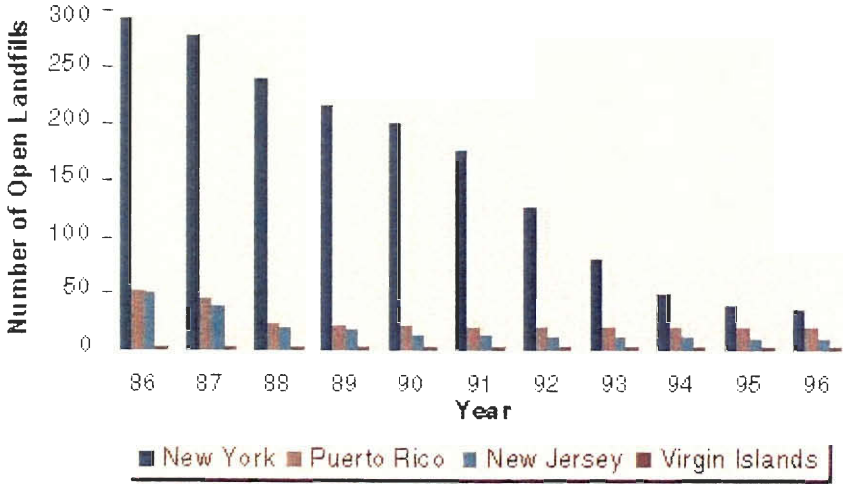
EPA Presence in Puerto Rico

According to EPA Region 2 (1998), the presence of the EPA can be seen in Puerto Rico through its Caribbean Environmental Protection Division (CEPD). Its main office, located in San Juan, Puerto Rico, works closely with the governments of Puerto Rico and the Virgin Islands solving environmental problems which face these regions. The EPA Region 2 (1998) encourages residents to learn about the programs it offers, and to express their concerns and ideas regarding environmental issues affecting their community.

Caribbean communities possess a unique set of environmental problems that the EPA is currently working to resolve. For example, the EPA Region 2 office (1998) claims Puerto Rico has an ongoing problem with the disposal of solid waste through incineration facilities, landfills, exportation, and recycling. There are no solid waste incineration facilities on the island to dispose of the waste created by the residents of Puerto Rico. Moreover, Region 2 (1998) states that there is scarcely land suitable for use by existing landfills and very little soil available for daily landfill cover. An approach considered was the exportation of solid waste to the continental United States, however the cost of doing this was deemed prohibitive.

The effects of ongoing EPA involvement in improving Puerto Rico's solid waste management systems are noticeable. EPA Region 2 (1998) has observed that the number of operating landfills has decreased from sixty-two in 1986 to thirty-two in 1996. As a result of EPA involvement, the amount of recycled waste has risen from eight percent in 1990 to fifteen percent in 1995; too few facilities are available for recycling however, therefore no island-wide recycling plan has been established.

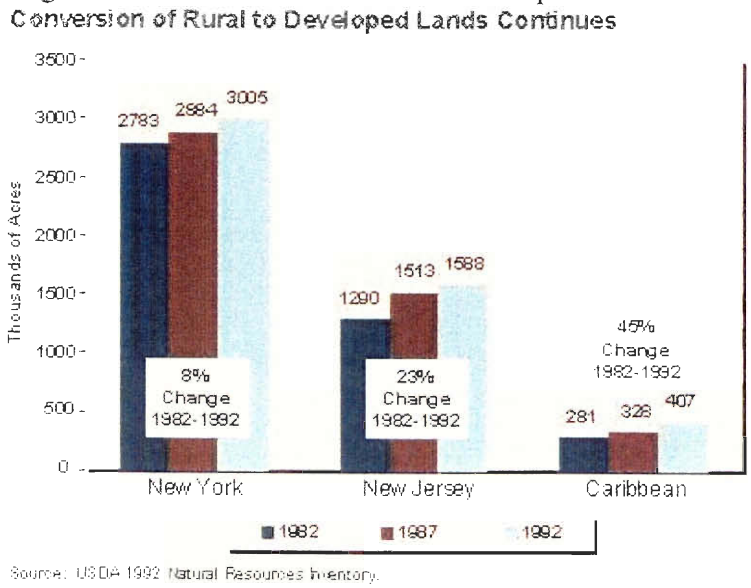
Figure 4: Number of Open Landfills



Source: EPA Region 2

Another problem, which is of concern to the EPA Region 2 (1998), is the conversion of rural lands to developed lands throughout Puerto Rico. The U.S. Department of Agriculture has collected data from 1982 to 1992, which shows a dramatic increase in land that is classified as either developed or comprising urban and suburban areas of ten acres or more.

Figure 5: Conversion of Rural to Developed Lands



Source: EPA Region 2

According to EPA Region 2, the EPA has not only been involved with curbing urban sprawl, but also with trying to improve the urban environment in Puerto Rico. Many urban areas have been affected by pollution, lack of quality water, and unhealthy indoor environments. In partnership with communities, states, and federal agencies, the EPA program of economic redevelopment works to revitalize idle or unused industrial and commercial facilities in urban areas. EPA Region 2 (1998) further insists that cleaning and restoring these facilities can help to reduce pollution, and boost economic growth.

The inability to provide drinking water to residents in Puerto Rico is another significant problem facing the island. EPA Region 2 (1998) has observed that water shortages created by shrinking reservoir volumes, which in turn result from the increase of sedimentation in the reservoirs and dry weather conditions, are causing problems for residents of Puerto Rico. When the water supply lines run dry from water shortages, it can cause contamination problems once the water supply resumes. In order to combat the water shortage problems in San Juan, a "Superaqueduct" is being constructed to ensure that a constant supply of water from reservoirs in the mountains reaches the heavily populated city of San Juan. EPA Region 2 (1998) claims another problem associated with the water supply, involves those households not served by the Puerto Rico Aqueduct and Sewer Authority (PRASA). This population consists of only three percent out of the four million residents of Puerto Rico, but is still of concern to the EPA. These residents, located in rural areas, are served by approximately 250 non-PRASA systems, which many of which do not comply with the drinking water standards. An agency called the

Partnership for Pure Water (PPW) was established in 1992 to ensure that non-PRASA residents receive safe drinking water. The PPW has rehabilitated seventy-seven drinking water systems, installed chlorinators and disinfecting systems, repaired pipes and storage tanks, and delivered lectures on the health risks of using unsafe water. EPA Region 2 (1998) notes that as a result of these actions approximately 50,000 residents have been provided with clean, safe drinking water. Also, the CBEP, in partnership with the Puerto Rico Environmental Quality Board, seeks to enhance the local capacity for preventing ground water contamination by initiating the first local wellhead protection program in the north-central region of Puerto Rico. Through the PPW and CBEP, the Environmental Protection Agency has been involved in resolving the problem faced by the residents of Puerto Rico concerning the quality and quantity of their drinking water.

Humans and Urbanization

The Urban Trend

According Richard Geddes (1997: 33), the trend towards urbanization has been ongoing over the centuries. Modern and future cities must be constructed with much more forethought and planning based on analysis if they are to properly provide for their residents. Furthermore, Geddes (1997: 33) asserts that such planning is absent to the degree required in modern cities. They are, in fact, both economically and environmentally challenged.

History of Urbanization

To discuss that which is urban, a common definition is first needed. As Lowenstein (1971: 5) states, historically those who were involved in agriculture were considered to be rural dwellers, and those who lived in closer approximation with each other and did not work in agriculture were considered urbanites. It is self evident that this distinction no longer applies; today only a very small fraction of the population works in agriculture. According to Lowenstein (1971: 5), in 1790, ninety five percent of the US population was considered rural, eighty five percent of which was agricultural. Furthermore, Lowenstein (1971: 5) states that it was the Industrial Revolution of the late nineteenth century that inspired a movement towards urban areas; as of 1900, over forty percent of the population was urban, and less than sixty percent had remained agrarian. This trend has continued over time.

According to Edward Butler (1997: 35), prior to the industrial revolution cities with a great number of residents were difficult to sustain for numerous reasons. As he observes, agricultural methods were primitive in comparison to the streamlined and machine driven farms of today; it would have been nearly impossible to feed the cities of today using these methods. He further concludes that the second great change that facilitated the creation of larger urban areas was the drastic change in transportation technology. Additionally, sanitation technology greatly improved; the ability to provide clean water, and dispose of waste was lacking in the cities of old. Butler (1997: 35) notes that without these necessities, it is no surprise that the cities of the past were plagued with illness such as the Black Death and high rates of mortality.

Perspective on Urbanization

As Geddes (1997: 33) observes, cities in developing nations are typically unable to meet their residents' needs adequately, causing environmental instability. The populations of developing cities frequently grow faster than infrastructure can provide for them. Furthermore, Geddes (1997: 33) concludes that this rapid population growth has resulted in an underclass that is poorly provided for. Geddes (1997: 33) goes on to state that insufficient planning gives rise to unsanitary conditions in which air and water pollution are prevalent.

Case Study of Mexico City

According to Diane Davis (1994: 2), Mexico City is the embodiment of all that can go wrong when little or no planning is exercised, and growth allowed to flourish. The absence of design in the city is striking; the epitome of what can occur when very rapid and focused industrialization occurs with negligible administration. Davis (1994: 2) claims that the city is characterized by its lack of basic services, monumental pollution, and profound administration problems resultant from its unlimited growth. Furthermore, Davis (1994: 2) states that insufficient consideration for transportation needs combined with the outward sprawl of the city resulted in severe problems with the transportation system circa 1960.

Figure 6: Traffic Congestion in Mexico City

Source: Davis, 1994, Figure 16

Davis (1994: 2) observes that widespread congestion was lessened by the creation of a system of "central arteries" in the late 1970's.

Figure 7: Congestion Relief in Mexico City

Source: Davis, 1994:figure 17

Davis (1994: 2) states that this latent construction typifies sprawling urban growth, where design and planning never anticipate the needs of the city, but instead are years, or even decades, late in providing adequate infrastructure.

Urban Sprawl

According to Lowenstein (1971: 21), when a city grows outward, with little or no planning or design in the growth process, the result is generally referred to as "urban sprawl." Typically, urban sprawl results in the annexation of nearby towns, which slowly become assimilated with the growing city so long as development continues to be unhindered. Large, unused tracts of land separating scattered developments characterize the sprawl growth pattern. Geddes (1997: 33) asserts that uncontrolled growth such as this results in severe short and long-term impacts.

Effects of Unplanned Urban Growth

As Mexico City has demonstrated, inappropriate planning can result in profound problems with transportation systems (Davis, 1994: 3). As the city expands outward, suburban residences are established, and their occupants typically seek employment in the city. According to Davis (1994: 3), the transportation these residents require contributes to the pollution of the air of the city, and the fuel consumed by the vehicles employed to move them from their homes to their jobs contributes to the energy consumption of the city.

Energy Waste

As William Weisel and Joseph Schofer (1980) state excess energy consumption must be eliminated as aggressively as possible in an age where the population is so reliant on limited energy resources for transportation. In the case of urban sprawl, such consumption is minimized through proper planning. During the sprawl process, the city expands, assimilating nearby towns, as explained previously. Residences are typically built on the edge of the city, and are available cheaply where the city is merging with the nearby town. Binkley et al. (1975: 1-2) observe that the process of urban sprawl forms large suburbs just outside of the city, which causes residents to travel excessively to reach their employment within the city. Weisel and Schofer (1980) maintain that this process can have enormous impacts on energy consumption, and pollution. By planning the growth of the city "one can have an impact on such characteristics of the transportation system as accessibility, trip lengths, congestion, environmental impacts and-consequently energy efficiency".

Water Pollution

Lack of proper planning can result in critically inadequate water supplies. Typically, soil acts as a filter for impurities and pollutants in water as it penetrates through the soil (Geddes, 1997:45). Lack of growth planning, however, in the case of urban sprawl causes the misallocation of this valuable agricultural land. In Puerto Rico especially, it is most crucial that this limited and valuable resource be utilized, both for the preservation of natural methods of water purification, and for agriculture.

Air Pollution

Another serious effect of unplanned growth is air pollution. As Geddes (1997: 34) states, pollutants of this nature are generally sulfur dioxide, nitrogen dioxide, carbon monoxide, and various suspended particles. These contaminants are emitted by the combustion, abrasion, and evaporation processes so prevalent in modern cities. Geddes (1997: 34) furthermore states that, with improper planning, industrial growth and transportation can cause the amount of toxic pollutants in the air to rise dangerously.

Health Concerns

Geddes (1997: 40-41) concludes that pollutants are so harmful, in fact, that there is an established relationship between their presence in the atmosphere and illness or even death. Tables 3, 4, and 5 illustrate the relationship between the percent increase in contaminants and higher mortality rate or respiratory illness.

Table 4: Effects of Particulates on Daily Mortality

Effects of Particulates on Daily Mortality		
Particulate Measure used in Study[a]	Percent increase in Mortality for a 10μg/m^3 increase in daily PM10[b]	Study Location
Total Suspended Particles	1.2%±0.2	Philadelphia, PA
Total Suspended Particles	1.0%±0.3	Detroit, MI
Total Suspended Particles	0.7%±0.2	Steubenville, OH
PM10	1.0%±0.4	Birmingham, AL
PM10	1.5%±0.7	St. Louis, MO
PM10	1.5%±0.3	Utah Valley, UT
Coefficient of haze	0.8%±0.4	Santa Clara County, CA
Coefficient of haze[c]	0.8%±0.3	New York City, NY
KM	0.4%±0.1	Los Angeles, CA
Total Suspended Particles	0.6%±0.2	Toronto, Canada

Source: Geddes, 1997:40

a – Conversions used: 0.55 X TSP = PM10; Sulfates/0.25 = PM10; 2.2 X KM = PM10; COH/0.55=PM10
b – Plus or minus one standard error
c – 40 X COH = PM10

Table 5: Acute Effects of Particulates on Hospital Admissions

Recent Studies of Acute Effects of Particles on Hospital Admissions		
Particulate Measure used in the Study[a]	Percent Increase in Admissions for a 10 $\mu g/m^3$ Increase in Daily PM10[b]	Study Location
Sulfates	Asthma 2.1%±1.4 Total respiratory: 2.2%±0.4	Buffalo, NY
Sulfates	Asthma: 1.9%±0.7 Total respiratory: 1.0%±0.4	New York City, NY
Total suspended particulates	Pneumonia and influenza for <15 year olds: 15%±0.4	Boston, MA
Sulfates	Total respiratory: 1.0%±0.2	Southern Ontario, Canada
PM2.5	Asthma: 2.2%±1.6 Total respiratory: 3.6%±1.6	Toronto, Canada

Source: Geddes, 1997: 41

a – Conversions used: Sulfates/0.25 = PM10; 0.55 X TSP = PM10; PM2.5/0.60 = PM10
b – Plus or minus one standard error

Table 6: Acute Effects of Ozone on Hospital Admissions

Acute Effects of Ozone on Hospital Admissions	
Percent Increase in Admissions for a 50-ppb Increase in Daily Maximum 1-hr Ozone[a]	Study Location
Asthma: 16%±7.0 Total respiratory: 12%±7.0	Buffalo, NY
Asthma: 8%±3.5 Total respiratory: 4%±1.5	New York City, NY
Pneumonia and influenza for >15 year olds: 20%±.5.0	Boston, MA
Total respiratory: 6%±1.5	Southern Ontario, Canada
Asthma: 16%±7.0 Total respiratory: 19%±7.0	Toronto, Canada

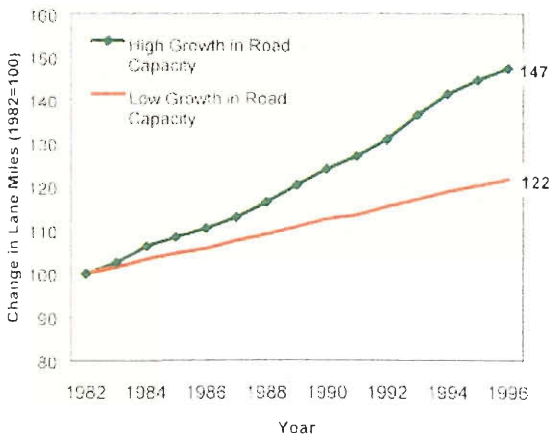
Source: Geddes, 1997: 42

a – Plus or minus one standard error

Transportation and Sprawl

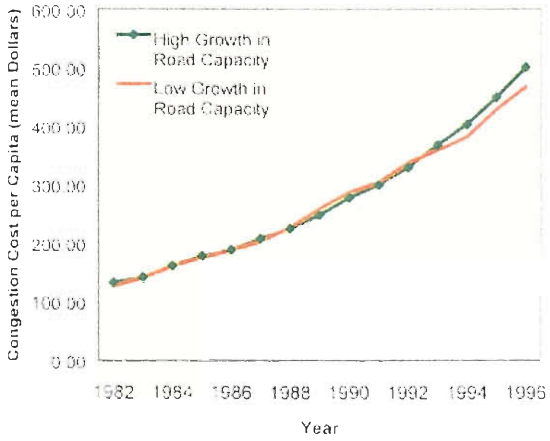
In many cases, the construction of roads is known to have negative effects on the surrounding area, as it not only contributes to sprawl, but encourages otherwise unnecessary use of public transportation systems, and uncontrolled development in the area (STPP, 1998). One group concerned with the problems associated with highways, congestion, and development is Transact, publisher of numerous documents relating to the matter of urban development. Transact also sponsors the Surface Transportation Policy Project (STPP), established to analyze and report on data that the Texas Transportation Institute (TTI) gathered over the course of fifteen years. In 1998 STPP published a study in which they analyzed the results of data collected by TTI, and came to many conclusions regarding urban sprawl in relation to highway systems (STPP 1998).

Figure 8: Lane Miles



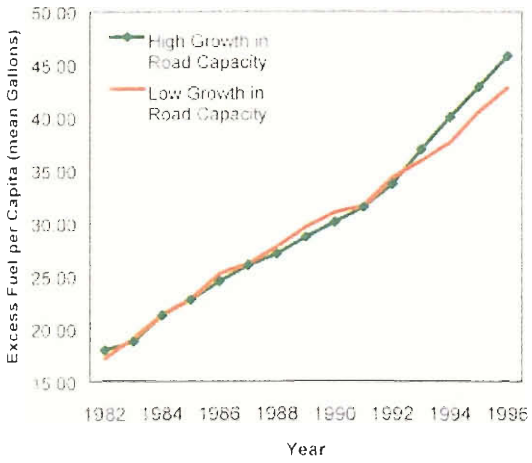
Source: STPP 1998

Figure 9: Congestion Costs



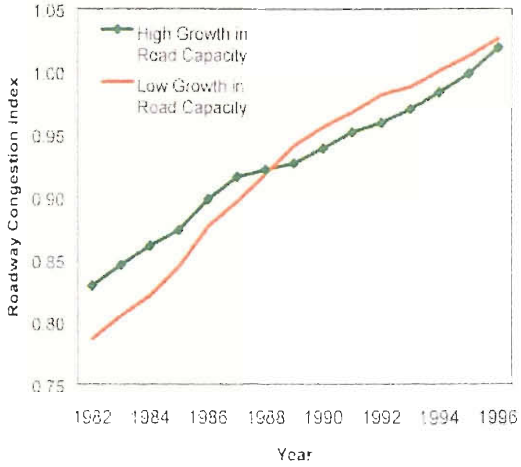
Source: STPP 1998

Figure 10: Excess Fuel



Source: STPP 1998

Figure 11: Congestion



Source: STPP 1998

STPP (1998) concluded that there was little difference in congestion per capita for cities that invested heavily in road expansion in comparison with those that invested very little. Figure 8 illustrates the difference between these two types of cities. Between 1982 and 1996 one group of cities invested heavily, building a total of forty-seven lane miles of highway. The other group built less heavily, adding a total of twenty-two lane miles to their existing infrastructure. Figure 11 demonstrates the effect of these additions in a comparison of congestion by year. Congestion between the two groups was nearly identical, despite the difference in investment in construction. To ensure that those results were not anomalous, STPP further compared the effect of road building with other congestion indicators used by TTI, including Excess Fuel Per Capita, Delay Per Capita, and Roadway Congestion Index. STPP (1998) found the results to be the same; those metropolitan areas that had invested heavily in road construction were no better off than those that had not. This conclusion is illustrated by Figure 10, which graphs excess fuel versus year, and Figure 9 which shows congestion cost by year.

STPP (1998) observes that urban sprawl aggravates this situation; the uncontrolled outward expansion of the metropolitan area causes more roads to be created. As STPP (1998) further asserts, this results in wasted spending and encourages further uncontrolled development. STPP (1998) concludes that dense, heterogeneous metropolitan construction, in comparison to current congestion relief methods and construction practices, is a superior strategy to combat transportation congestion, and results in less unnecessary construction and spending.

EPA and Urban Sprawl

The Environmental Protection Agency Region 2 has recognized the problems associated with urban sprawl, such as the development of open space and woodlands. To combat this problem the EPA advocates growth in existing urban and suburban areas as an effective way to slow down the rate at which urban sprawl occurs. The EPA Region 2 is also involved in transportation planning in accordance with the Clean Air Act by working with states and air pollution control districts in order to promote environmentally safe land use and transportation resolutions. The EPA is pursuing acceptable, sustainable development, and community based environmental protection measures as ways to resist the spread of urban sprawl.

The EPA Region 2 has restricted authority concerning land use planning decisions that may affect wetland ecosystems. These decisions are made through local and federal governments, however the EPA exercises its influence in decisions regarding land use through its ability to review impact statements, and its involvement in the complex air and water issues brought before local and federal governments. The agency works

closely with the U.S. Army Corps of Engineers, Fish and Wildlife Service, and the National Marine Fisheries Service to author various wetlands programs.

Puerto Rico Planning Board Organic Act

On June 24, 1975 the Puerto Rican government approved the Puerto Rico Planning Board Organic Act, which created the planning board and put it under the command of the governor's office (23 L.P.R.A., 1999: 55). The Puerto Rico Planning Board or La Junta Planificacion (JP) was created in order to oversee and guide the development of Puerto Rico to ensure economic stability and general welfare of the all of Puerto Rico's citizens both future and present (23 L.P.R.A., 1999: 58). The board oversees the population distribution, land use, other natural resources, and public improvements.

The planning board is in charge of overseeing all of the development and the impact those changes will have on Puerto Rico. The JP has the control to adopt changes in regulations in the Integral Development Plan, zoning regulations and maps, Four-Year Investment Plan (PICA), and Land-Use Plans (23 L.P.R.A., 1999: 60). The board also, has the power to organize regional offices and to approve the regulations developed by the regional subdivisions. The main function of the Puerto Rico Planning Board is to develop regulations to maintain the maximum land use efficiency (23 L.P.R.A., 1999: 60).

The JP changes the Integral Development Plan to maintain adherence to the "Integral Master Plan for the Socioeconomic Development of the Central Region of Puerto Rico," which is created in cooperation with the Department of Commerce, the

Tourist Company, the Department of Agriculture, the Economic Development Administration and the Department of Natural and Environmental Resources, and the Commissioner of Municipal Affairs. The planning board creates the Integral Development Plan after compiling information concerning economic, environmental, and societal studies and analyses. It is created to ensure that all of the government agencies are familiar with plans for future development in Puerto Rico and plan accordingly (23 L.P.R.A., 1999: 71).

The Planning Board has the power to adopt and amend the Zoning Regulations in Puerto Rico. These regulations were created to control the development of both private and public lands. Also, the zoning regulations are a tool to be used in order to control and limit urban expansion into rural communities (23 L.P.R.A., 1999: 77).

The Planning Board creates the Four-Year Investment Program in order to outline the social and economic goals and objectives that Puerto Rico's government wishes to accomplish within the next four fiscal years. They show urban and rural development patterns, along with estimates and descriptions of each of the government bodies expenditures. All of the government bodies have to submit their planned budgets, which are then printed in the planning board's PICA publication (23 L.P.R.A., 1999: 75).

The Land-Use Plans are included as part of the Four-Year Investment Program. These plans are dependent on the type of region; rural, urban, or municipal. Each plan specifies what areas are designated for urban, rural, agricultural, mining, or forestry uses. All projects to be undertaken in these areas must agree with the Land-Use Plans, which are the basis for the zoning regulations and maps (23 L.P.R.A., 1999: 73).

The Puerto Rico Planning Board plays an integral part in planning and regulating the development of Puerto Rico. The planning board approves all of the private and public projects that occur on the island of Puerto Rico, as well as planning for future projects and development.

Zoning Regulations

According to Young (1993: 66), one of the ways in the United States that state and local government can influence the development of certain areas of their territory is through the use of zoning regulations, or restrictions. Platt (1996: 251) asserts that state or local governments can use zoning control as a tool to affect land use within their boundaries. There are often state standardized zoning regulations that are modified for local use, under planning enabling acts, by local planning commissions. Planning boards comprised of volunteers, who are familiar with their town's geography and interests concerning growth and development, make the modifications. Platt (1996: 270) insists that the most qualified level of government for regulating land use is the local level of government. Platt (1996: 270) further concludes that local governments are familiar with their inhabitants, and can pay closer attention than state government to the development of their towns. The purpose of zoning regulations is to protect public health, safety, and welfare of its inhabitants. Platt (1996: 275) also states that zoning can affect property values by limiting the range over which a property may be utilized or developed in the future.

Zoning regulations allow the government to control zoning districts, which can be comprised of industrial, commercial, or residential areas. As Young (1993: 66) describes, regulations range from limiting land use size to limiting the type of structures which may

be erected, and depend on the intended use of that land under the adopted zoning plan. Each zoning district has a set of land use codes, or classifications, which restrict the development in that particular region. The implementation of zoning codes allows a town to control their future growth and development.

The Autonomous Municipalities Act

The Autonomous Municipalities Act lets municipalities regulate land use in their respective municipalities (21 L.P.R.A., 1999). The first step for municipalities wishing to become autonomous is the preparation of three types of ordinance plans. The territorial plan includes dividing the municipality into urban land, urbanizable land, and rural land. The extension program and plan will establish details of development for the urbanizable lands. The area plan can be used to guide use of land in certain areas that require special attention (21 L.P.R.A., 1999). After the plans are completed and approved by the Planning Board, the municipality can gain levels of autonomy. There are five levels of autonomy that a municipality can be granted by the Planning Board. The level of autonomy granted to the municipality depends on how much of the territorial, extension, and area plans are accepted by the Board (21 L.P.R.A., 1999). The first is the ability to grant use permits for existing structures or lots and permits for billboards. The second levels adds the ability to authorize preliminary plans, construction permits and use permits for construction less than 1,000 square meters and on lots less than 1,500 square meters. The third level includes amendments to the Ordinance Plans on lots of a surface area not greater than 1,000 square meters along with the ability to authorize preliminary plans, construction permits and use permits for construction less than 1,000 square meters

and on lots less than 1,500 square meters. The fourth and fifth levels increase the lot sizes for amendments to the Ordinance Plans and the preliminary plans, construction permits and use permits for construction (21 L.P.R.A., 1999).

State of Urban Development in Puerto Rico

According the San Juan Star (Oct. 27,1998: 6) the population density in Puerto Rico is 1,050 per a square mile. This population density qualifies the whole island as an urban area. According to the San Juan Star (Oct. 28, 1998: 5) in 1942 the urban cores of each municipality were mapped out. At the time, most of the land was zoned for agricultural land, but the Planning Board has allowed zoning changes that has permitted construction outside of the original cores. The Star reports that these zoning changes were made without thought to future consequences.

The San Juan Star further reports (Oct. 25, 1998: 5) that the Agriculture Department approves zoning changes that allows 7,000 acres of agricultural land to be developed a year. Most of this land is not able to used for commercial farming because is surrounded by buildings caused by bad planning or unpermited growth. The Planning Board can overrule the Agricultural Department's zoning decisions, usually on outskirts where services are already available and where there is a demand for housing. The Star (Oct. 25, 1998: 5) reports that over the last 25 years the island has lost 32 percent of agricultural land. In 1962, there was 1.9 million acres and in 1997 there was 1.3 million acres. Since 1972, 66,000 acres of agricultural land were zoned as forest.

While growth was occurring in agricultural land, it was not occurring in the planned urban cores. According to the San Juan Star (Oct. 28, 1998: 5), although the

urban cover of the island is ten percent greater now than in 1986, twenty percent of municipality core areas are empty. The San Juan Star (Oct. 27, 1998: 6) reports that there is no market for dense housing in Puerto Rico. Cheap gas, good roads, and infrastructure problems in the city such as parking and sewer availability cause the lack of a dense housing market.

The Municipal Autonomy Act lets municipalities make planning decisions that were made in the past by the Planning Board. The San Juan Star (Oct. 26, 1998: 5) reports that resident groups feel that the Act will not be helpful since the planning board has already made most of the decisions. Other groups feel that the Act is letting the Planning Board "off the hook." The Star (Oct. 26, 1998: 5) reports that a complete overhaul of the planning system is needed.

Caimito

A continuing problem in San Juan and its surrounding municipalities is the loss of vegetation to development. Typically, such losses contribute to an ambient rise in temperature of a city, in addition to increased pollution. A survey conducted in 1996 showed that most cities had vegetation covering at least fifty per-cent of the land. For example, Dallas had fifty seven percent, Atlanta sixty-three per-cent, and Portland, Oregon sixty-five per-cent (Tirado, September 1997: 4). In contrast, San Juan had only seventeen percent. This situation became climatic in September of 1997 when the residents of Caimito, San Juan, realized that the Planning Board had proposed approximately one hundred development projects in the region. Caimito represents about thirty per-cent of San Juan, and encompasses much of the capital city's rivers and green areas; so much so, in fact, that it is referred to as "green lung" of San Juan. The projects

proposed by the planning board would create a great deal of housing in the area, turning the area into a high-density R-5 district, while before it had remained a low-density R-1 and R-0 district (Bonilla, September 1997: 51). The residents of Caimito, having learned of the proposed development, assembled and in mid-September proposed a one-year mortatorium on construction for the region to allow time for an appropriate land-use plan to be constructed. San Juan mayor Sila Calderón supported the moratorium, while members of the planning board disagreed with the decision, saying that a land-use plan developed in 1982 had previously included the region of Caimito for development (Cavallaro, September 12, 1997: 4).

The development for the area has a potential for many profound effects. The deforestation of the area, which would occur during development, is supposed to be alleviated through a reforestation attempt by the developer after construction. According to Senator Fransisco González Rodríguez, during such attempts developers typically reforest using "little trees that will soon die, which results in erosion and floods" (Diaz, June 9, 1998: 7). The Caimito area is also important as it acts as a reservoir for the San Juan area. Any topsoil removal or deforestation in the area could easily contribute to further sedimentation of Lake Carraízo and the San Juan Bay Estuary, two bodies of water important to the health of the region (Gutierrez, November 1999: 11). In November of 1999, such flooding occurred in the Caimito region after much development of the region had occurred.

Protecting Agricultural land in Australia

Queensland, Australia is an example of a region concerned with the effect of urban sprawl on agriculture. According to Peterson (1996: 1), the characteristics associated with good farmland, which included good road access and flat topography, also make it a primary target for developers.

The state of Queensland, Australia, has set specific guidelines concerning the use of agricultural land for urban development. Capelin and Kohn (1998: 1) note that the state expects the loss of some agricultural land but protects the land because of its importance as a natural resource. Before a local government approves a new planning scheme, it must be demonstrated that the proposition includes provisions for the protection of quality agricultural land. Plans include an assessment of the impact the development would have on surrounding agricultural land. According to Capelin and Kohn (1998: 2), the final plan must be one that minimizes agricultural impact.

Smart Growth

Definition of Smart Growth

According to the EPA (1999: 30), "Smart growth" is another name for sustainable development or sustainable growth. Sustainable development is development that promotes the environment and the economy of a community. The Environmental Protection Agency reports that smart growth includes energy efficiency, water conservation, recycling programs, transportation, and development. In its Annual Report, Reinventing Environmental Protection (1999: 30), the EPA also includes, as part of the Smart Growth definition, communities that combat urban decay by providing services and new jobs, stopping inferior developments, and cleaning up "brownfields."

Brownfields are abandoned or contaminated plots of land in cities. The cities clean up and reuse these lands for new development (EPA, 1999: 31).

Smart Growth Concept

There are many ways to stop urban sprawl. Reid Ewing (1997: 108) maintains that there are three phases to stopping urban sprawl in developing communities. The first phase is discovering how much growth should be allowed. The second phase involves determining where and when growth should happen. The third phase is deciding what type of growth should be allowed. Two ways of stopping urban sprawl are slowing new developments or containing developments around existing infrastructure. Another way is enacting zoning ordinances that encourage high-density developments. According to the EPA (1998: 6-5), mixing types of zones will make communities easily accessible to pedestrians, and eliminate the need for more roads. Concentrating growth near bus stops or commuter trains will often tend to lower traffic and pollution. Local community tax revenue increases as a result, which in turn may alleviate the cost of new infrastructure (EPA, 1998: iii). Edward McMahon (1997: 4) feels that planned development is the solution to urban sprawl; however, it is important to place the development in proper areas and to protect surrounding land. These solutions demonstrate that planning of new growth is an important part of fighting urban sprawl. Ewing (1997: 115) states that governments need to start planning growth instead of responding after the damage has been done. Nevertheless, the EPA (1999: 30) feels that development decisions are a state and local matter and, therefore, supports communities through grants. Consistency between the state and local growth plans, say Pelley and Albizo (1997: 15), will also help land use regulations succeed.

Smart Growth Network

The Smart Growth Network consists of organizations that embrace the concept of sustainable growth and provides information about sustainable growth. The Environmental Protection Agency leads the coalition.

Members of the Smart Growth Network

The Smart Growth Network comprises organizations involved in the environment, community planning or local government. The EPA (1999: 31) states that in two years, over 300 members have joined the network. The partners are American Farmland Trust, American Planning Association, Center for Neighborhood Technology, Congress for the New Urbanism, The Conservation Fund, Growth Management Leadership Alliance, International City/County Management Association, Local Government Commission, National Association of Counties / U.S. Conference of Mayors joint center for Sustainable Communities, National Association of Counties, National Association of Local Government Environmental Professionals, National Neighborhood Coalition, National Trust for Historic Preservation, National Resources Defense Council, The Northeast-Midwest Institute, Scenic America, State of Maryland, Surface Transportation Policy Project, Sustainable Communities Network, Trust for Public Land, Urban Land Institute and the Urban Economic Development Division of the U.S. Environmental Protection Agency (Smart Growth Network). According to the EPA (1999: 31), many of these organizations have put their differences aside for this coalition with the idea that urban sprawl is bigger than these differences.

Purpose of the Smart Growth Network

According to the EPA (1998: 6-7), the Smart Growth Network favors sustainable developments and provides information on stopping urban sprawl. The public can access the information through the Network's website and learn more about what their communities can do about urban sprawl. They can find information about zoning and brownfields as well as problems associated with urban sprawl and environmentally friendly industrial and commerce parks. The Smart Growth Network (2000) website has a library of speeches concerning the Smart Growth idea, including speeches made by Vice-President Gore about Smart Growth. This information allows businesses, individuals, and organizations to learn what they can do to help their communities fight sprawl.

Case Study of Smart Growth-Maryland

One state that has employed the Smart Growth concept is the state of Maryland. The state has serious urban sprawl problems. Pelley and Albizo (1997:4) believe that Maryland has many examples of how new infrastructure wastes the taxpayers' money. For example, based on growth projections, twice as much land has sewer service than will actually be needed until the year 2020. McMahon (1997: 4) illustrates this point through another example; Maryland taxpayers built sixty new schools, while sixty old schools closed in the same county during a span of twenty years. The state is a partner in the Smart Growth Network, and has passed the Smart Growth Act.

The Act is helping the state save money many different ways. Governor Glending (1998: 2) reported that eighty four percent of money spent on schools goes to repairing and upgrading existing schools compared to forty three percent before he became governor and supported the Smart Growth Act. Pelley and Albizo (1997: 10) assert that

the Chesapeake Bay area has the potential of becoming an urban sprawl disaster area because of the amount of growth in the bay environment. By slowing development, the state is also preserving the Chesapeake Bay area, which will mean a more lucrative tourist industry for the state.

Solutions

Pelley and Albizo (1997: 10) have identified three concepts that the people of Maryland can use to slow low-density development. The first concept involves the Maryland property owners transferring their properties' development rights to land trusts and receiving tax breaks in return. The second concept allows property owners to sell their property rights to developers and receive a tax break. The reason for doing this is that in a situation where a developer has a large plot of land, but local development laws restrict development to a limited area on the plot, the developer may use the rights to the purchased plot of land thereby increasing the development area on the first plot. Therefore, the rights to the purchased plot of land become nullified, and the plot may never be developed on, while the developer has simultaneously increased the possibility for development on the first plot. For both of the previous concepts, once the development rights to the property have been transferred, they will never be reissued; this option can be beneficial to farms. The final concept, clustering developments cover only a part of the property, while the remaining portion of the property is restricted from development.

Governor Glendening (1998:5) states that the Smart Growth Act is successful because it balances rural and urban issues and it does not place all the control with the state. Other parts of the Smart Growth Act include programs that provide compensation

to developers that redevelop historical buildings and to homeowners who buy houses near their jobs.

Arguments Against Smart Growth

Some people think that the smart growth idea will not end many of the problems plaguing communities. Peter Gordon and Harry Richardson (1997: 96) feel that high-density communities are not a beneficial planning objective. In addition, they point out that there is enough agricultural land for sufficient food production. Also, they argue that urban sprawl is preferable to high-density cities. They feel that most of the arguments for stopping urban sprawl are weak and lacking proof. For example the argument that high-density development is more efficient than low-density development is one that they dispute. McMahon (1997:4) states that limiting growth will hurt the free market; instead policies that have nothing to do with the free market such as mortgage tax breaks and flood insurance are causing urban sprawl.

Methodology

The methodology used in this project consisted of two distinct parts. The first part was qualitative; in this phase of the methodology, we conducted interviews with academics and professionals in order to learn about development and planning processes as they occur in Puerto Rico. Based on information gathered from this phase of the project, we constructed hypotheses regarding inefficient land use practices as they occur in the central San Juan metropolitan area. Then, in the quantitative phase of the project we gathered statistics to validate our hypotheses. Finally, we made conclusions based on our qualitative and quantitative research, and recommendations based on the Smart Growth concept designed to improve the quality of life of the people of the central San Juan metropolitan area and Puerto Rico.

The Smart Growth development method outlines several fundamental principles for development designed to maximize the quality of life enjoyed by residents within Smart Growth communities. The Smart Growth principles we used in our analysis included the following:

- Residential areas should be close to commercial centers.
- Housing should be mixed-use, high-density, and mixed-income.
- Green-space and ecosystems should be liberally preserved within communities.
- Many forms of transportation should be available, adequate, and maximize quality of life (minimize commute-time).
- Brownfields should not exist within the community

Qualitative Methods

The qualitative analysis can be broken down into several steps. Initially, we reviewed regulations and law regarding development such as zoning regulations and the Municipality Autonomy Act. This was the preliminary step in understanding

development trends in Puerto Rico. Next, we interviewed professors of Geography and Environmental Science who were expert in the areas of urban planning and development to understand the development process in Puerto Rico. Through these interviews we learned how development had occurred, and were able to direct our quantitative analysis to maximize its accuracy. Furthermore, by analyzing the interviews we were able to determine whether the development process in Puerto Rico was consistent with guidelines established by the Smart Growth concept. Summaries of interviews conducted during the qualitative phase of the project can be found in **Appendix B**.

Quantitative Methods

The quantitative analysis compared statistical information regarding use of land in central metropolitan San Juan and in Puerto Rico as a whole to selected regions from around the world. The regions used in comparison to central metropolitan San Juan included Atlanta, Honolulu, Los Angeles, New York, Philadelphia, and Seattle. Regions used in comparison with Puerto Rico included California, Rhode Island, Hawaii, New Jersey, Oregon, and Washington. The intent of these comparisons was to demonstrate whether land in central metropolitan San Juan and in Puerto Rico had been or was being used efficiently in comparison to these other regions, and in accordance with principles promoted by the Smart Growth concept.

Furthermore, our qualitative research led us to hypothesize that land in central metropolitan San Juan and in Puerto Rico was used inefficiently in comparison to other regions. Based on this hypothesis we constructed further hypotheses, each of which expressed how certain elements of land use would be inefficient in a region in which land was not used efficiently. Associated with each hypothesis were a number of statistics

used as evaluative measures to prove or disprove the hypothesis. Through comparison, these measures were used to demonstrate whether land in Puerto Rico and the central San Juan metropolitan area had been used efficiently or inefficiently in comparison to the other regions. Statistics used in the quantitative analysis can be found in **Appendix C**. The hypotheses may be found below, each accompanied by a brief description of the contrasting Smart Growth ideal for each hypothesis.

Hypotheses

Population and Population Density

Hypothesis 1: *Puerto Rico and central metropolitan San Juan will have lower population density when compared to other regions.*

Smart Growth: High-density, multi-use development maximizes the quality of life.

Transportation

Hypothesis 2: *Puerto Rico will have more miles of highway relative to land area than other areas.*

Hypothesis 3: *People living in the municipalities within the central metropolitan San Juan area will experience long commute times, and the majority will work outside of their resident municipality.*

Smart Growth: Infrastructure should accommodate many forms of transportation, including primary and alternate methods. Public transportation should be available, and roadways should be designed for maximum utility. Furthermore, commercial areas should be decentralized; therefore, Smart Growth communities should have low commute times, and little congestion.

Construction

Hypothesis 4: *Construction of new living units in Puerto Rico and central metropolitan San Juan will consist of a greater number of single families versus multi family homes.*

Smart Growth: Multi-family homes help achieve high-density development. Also mixed-use and mixed-income housing is promoted, and brownfields should be eliminated.

Agricultural Land and Green-Space

Hypothesis 5: *Puerto Rico and central metropolitan San Juan will have less green-space and preserved-space than other areas.*

Smart Growth: Smart Growth development should design around ecosystems, establish runoff control methods and drainage systems, and preserve wetlands and green-space wherever possible.

Results and Analysis

Interviews

Introduction to Interviews

In order to understand the development process in Puerto Rico, we interviewed experts who contributed to planning and development on the island. This included professors from the University of Puerto Rico and the Universidad Metropolitana, and members of the planning boards of Puerto Rico and its surrounding municipalities. From these interviews we came to understand the planning process as it occurs in Puerto Rico. This allowed us to construct hypotheses regarding land use on the island. We will begin discussion of the interviews by first describing the intricacies of the planning processes, including the role of the planning board.

As our literature review states, the Puerto Rico Planning Board was established by Law 76 of the L.P.R.A. It functions as the central planning agency for the island, overseeing zoning, development, and planning. As of 1992, and the creation of the Autonomous Municipality Act, the authority and functionality of the Planning Board can be transferred to municipalities, at the request of the municipality and after an approval process by the Planning Board. We interviewed a member of the Puerto Rico Planning Board, the Autonomous Municipality of Carolina, the Municipality of San Juan, Academics from local universities, and others in order to get a complete perspective of the planning process in Puerto Rico. The summaries of the interviews can be found in **Appendix B**.

Analysis of Interviews

Planning Regulations

To begin our interviews, we asked the interviewees to discuss their opinion of the regulations established by the Puerto Rico Planning Board. Dr. Carlos Guilbe of the Geography Department at the University of Puerto Rico, said that the regulations were not sufficient, due to influence by developers and lack of a unified political agenda at all levels of the government that contribute to the planning process. Secretary of the Puerto Rico Planning Board Max Vasquez stated that the regulations are sufficient; however, exceptions, loopholes, and variances in zoning regulations allowed developers to exploit the process. Javier Bonnin, an Architect and consultant to the Urban Department of the Municipality of San Juan, supported this assertion saying that political corruption existed at the lower levels of the Planning Board, and citing as an example of this corruption an inappropriate development occurring in the south of the Municipality of San Juan that was undergoing judicial review. Jose Santana on the other hand, stated that corruption occurred in the high levels of the government rather than on the lower levels, and he agreed that implementation of the regulations had not been effective. The Sub-Director of the Carolina Planning Office, Juan Ogualdo Budet, agreed that the regulations were sufficient, but he emphasized that due to lack of enforcement and the economic influence of the developers, the implementation of the regulations suffered. Dr. Jose Molinelli said, in a radio program, that Puerto Rico could develop intelligently if it had a government that did not respond to economic interests.

Development Regulations

To further understand regulation and the development approval process, we asked those interviewed their opinion of the development process as it occurred on the island. Mr. Vasquez explained that during the process the Planning Board first approved development and then the developer would request a zoning change from ARPE, the zoning agency. Dr. Guilbe stated that this practice of Planning Board approval before zoning is backwards compared to the planning process prevalent in other states and countries where the approval of development depends on zoning.

Zoning Regulations

The next question we asked of those interviewed was their opinion regarding zoning regulations in Puerto Rico. Dr. Guilbe explained that unregulated changes in zoning allowed for unplanned growth, or uncontrolled urban expansion. He continued, saying that this unplanned growth would not create a quality living environment for residents, instead encouraging those residents, who were financially able, to move away from the city to rural communities. He also stated that these frequent changes led to land speculation. Additionally, he noted that if the zoning officials could change the regulations without being monitored, then they would also be able to change the zoning in a certain area, if it were to benefit them. In accordance zoning as it ributes to sprawl. Secretary Vasquez asserted that with the statements made by Dr. Guilbe, Javier Bonnin urged that San Juan give up its presecontnt a lack of implementation of the regulations occurred at the zoning level. Dr. Severino stated that changes in political agendas contributed to zoning regulation which frequently varied, and to an inconsistent land-use plan. He continued, describing how the zoning regulations have changed with the

changes in political office, since the political parties have different views on how the land should be used.

Development Trends

The interviewees were then asked to discuss the development movement to build lower-density suburban homes. Secretary Vasquez asserted that the Puerto Rico Planning Board was promoting multi-family development, for example walk-ups and townhouses, rather than the past development trend of single family homes. In addition, he said that the Planning Board was trying to distribute the commerce of the region so that rather than remain centralized as it is, it would be spread out amongst the municipalities, thereby lowering traffic congestion, and increasing the quality of life enjoyed in the municipalities. In contrast, Dr. Guilbe stated that the trend in construction of single-family developments would continue since the government was allowing the developers to expand into rural areas. This practice, he continued, resulted largely from the fact that government had not created any incentives for developers to develop in the cities, rather than in the rural areas. He further stated that this trend in Puerto Rico was not sustainable. One way to make it sustainable would be to focus development around the concept of the neighborhood. He also explained that with increased highway development, the population would feel that they were more mobile and could live further away from the cities. Ultimately, this results in an increase in the demand for houses further away from the cities, a symptom to urban sprawl.

The Sub-Director of the Carolina Planning Office, Juan Ogualdo Budet, explained that the Autonomous Municipality of Carolina is encouraging and planning for multi-family homes in the urban area. The Municipality is conducting studies to analyze the

viability of commercial areas around the planned urban housing to see if these areas will be able to sustain the neighborhoods. Furthermore, Budet said that a goal in Carolina is to encourage multi-use development, for example development whereby buildings are commercial at the ground level, and residential above. In implementing this plan, the Municipality hopes to create density in the urban area, and slow development of rural land. Included in these plans for developments are parking garages to be located under the first commercial level, intended to ameliorate the historically poor parking found in urban areas in the Municipality, and island-wide.

Loss of Agricultural Land

The next question posed to the interviewees concerned the loss of agriculture land in Puerto Rico. Secretary Vasquez stated that agricultural land is more valuable to developers than it is to farmers; therefore it is extremely difficult to preserve the land for agricultural purposes. Dr. Guilbe said that Puerto Rico does not have enough land to sustain large farms. Furthermore, small farms are not very profitable, so the government is forced to subsidize them. Since the zoning codes are easily changed, the process of stopping development from encroaching on agricultural lands is rather difficult. Dr. Severino pointed out that one way for Puerto Rico to increase the value of its agricultural land, and thereby help preserve it, was to begin growing crops that catered to a specific niche, for example medicinal plants.

Loss of Green-Space

When asked about the preservation of green-space, the interviewees agreed that preservation is important, however the location of where the preservation should occur was a matter of controversy. Sub-Director Juan Ogualdo Budet stated that the Puerto

Rico Planning Board only looks at the whole island when planning for green-space preservation and development, not taking into account the needs of individual municipalities. Green-space is preserved, but it is not equally distributed amongst the municipalities and the populated areas. The Autonomous Municipality of Carolina is trying to preserve green-spaces within its borders. Secretary Vasquez stated that in the south of Puerto Rico the Valle de Lejas has been set aside to be preserved from development. He stated that it is important; however, in the metropolitan area to maximize use of infrastructure. He elaborated on this point, saying that much of the land within the metropolitan area already has the necessary infrastructure for development; therefore, it would be beneficial to maximize the use of this infrastructure, rather than preserve the green-space that surrounds it. Dr. Guilbe states that preserved land in urban areas is necessary and could help to bring back the concept of neighborhoods, however the land value is so high that it is not feasible to keep the land undeveloped. Javier Bonnin emphasized this point further, stating that no tools existed at present to assist in the preservation of green-space.

Autonomous Municipality Act

In our interview with Max Vasquez, he discussed the Autonomous Municipality Act, and its impacts on future development in the metropolitan San Juan area. According to Mr. Vasquez, the adoption of this Act allows the planning, and zoning to be brought to the community, and helps to alleviate the need for central planning done by the Puerto Rico Planning Board. It gives the municipality a strong voice in terms of how they want their land to be developed. Javier Bonnin stated that it was important to bring the power of land use and zoning regulation down to the municipality level for at least two reasons.

First, it makes the politicians responsible and allows for the people to have a voice concerning planning in their communities. Second, he stated that the municipalities are better off now being in control of their own planning, than when the Puerto Rico Planning Board was in control.

By interviewing both members of planning boards and academics, we have gathered a strong sense of how the development process occurs in Puerto Rico. We have discussed the regulations created by the Puerto Rico Planning Board, the development process, zoning regulations, and recent trends in development and planning. The analysis of quantitative data gathered regarding land use and development in Puerto Rico will address the hypotheses we created based on our qualitative research.

Quantitative Analysis

Introduction to Analysis

This analysis will use the hypotheses generated based on our qualitative research to determine how land in Puerto Rico and central metropolitan San Juan has been used. In order to determine the degree to which land has been used efficiently or inefficiently in Puerto Rico we made relevant comparisons to other areas. Based on the results of the comparisons we will determine how efficiently land has been used in Puerto Rico. For the purposes of our analysis the central San Juan metropolitan region consists of San Juan, Carolina, Bayamón, Cataño, Guaynabo, Toa Baja, and Trujillo Alto. Although this area includes fewer municipalities than the San Juan-Bayamón Primary Metropolitan Statistical Area, as defined by the U.S. Office of Management and Budget and used by the Census Bureau, the area is comparable to other Primary Metropolitan Statistical Areas. Unless noted, all other cities used in comparisons are Primary Metropolitan Statistical Areas.

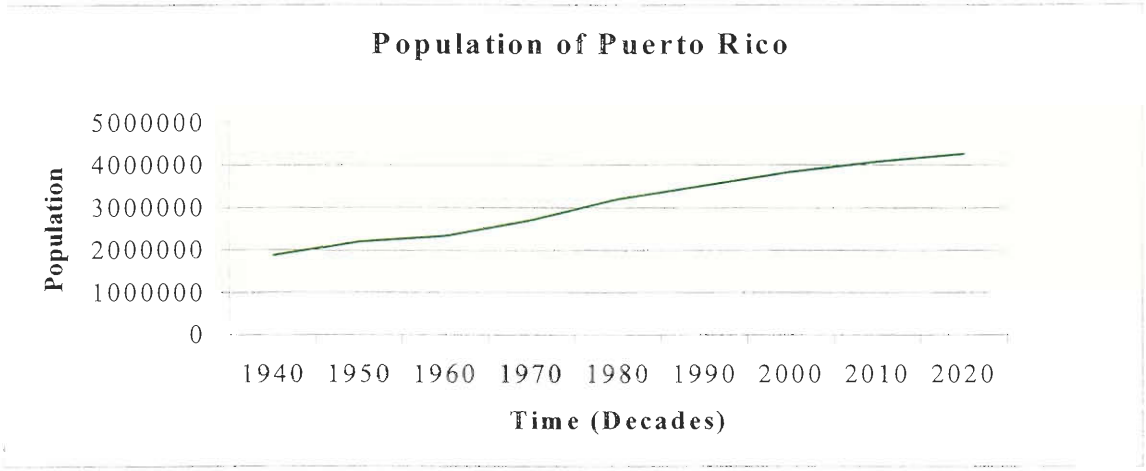
Population and Population Density

***Hypothesis 1**: Puerto Rico and the central metropolitan San Juan will have lower population density when compared to other regions.*

In order to understand the development trends in central metropolitan San Juan and Puerto Rico, we first looked at the populations and the population densities of the municipalities. The population density is the population of the municipality divided by the total land area of the municipality. To begin the analysis, we examined population growth in Puerto Rico. This allowed us to understand where substantial growth occurred,

and when it occurred. By observing this pattern in growth, we better understood the trends in growth in the central metropolitan area, and on the island as a whole. Figure 12 shows the population of Puerto Rico from 1940 to the present, and projected growth to 2020.

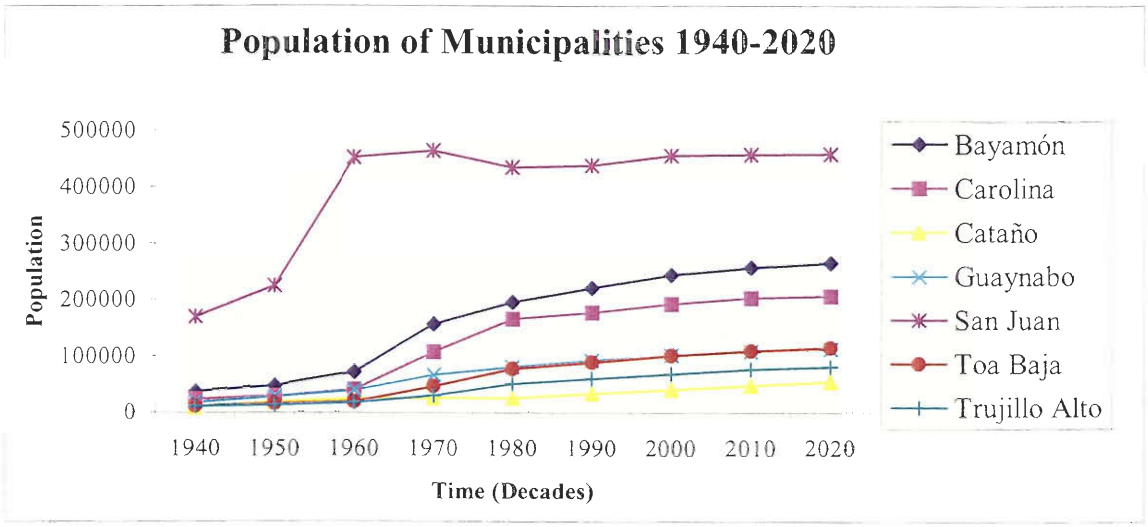
Figure 12: Population of Puerto Rico 1940-2020



Source: U.S. Bureau of the Census, Puerto Rico Planning Board

Next, we looked at the population of San Juan, with respect to the populations of its surrounding municipalities. Figure 13 shows the growth in population of both San Juan and its adjoining municipalities.

Figure 13: Population of Municipalities 1940-2020

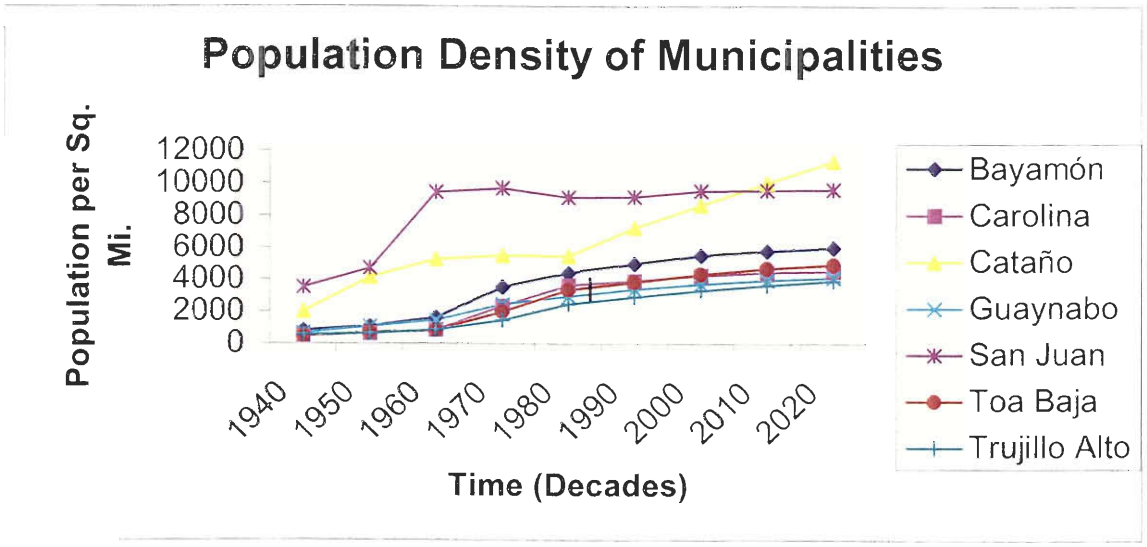


Source: U.S. Bureau of the Census, Puerto Rico Planning Board

This figure demonstrates how from 1950 to 1960 growth in San Juan was tremendous; the population more than doubled during this decade. The population continued to grow from 1960 to 1970, at a much slower pace, and then decreased slightly from 1970 to 1980. During this same decade growth in the neighboring municipalities became rapid. The population of Carolina, for example, more than quadrupled from 1960 to 1980,and the population of Toa Baja very nearly did the same. The population of Bayamón more than doubled in this same period.

We next looked at population density. Figure 14 shows the population densities from 1940 to 2020 of San Juan and those municipalities that surround it.

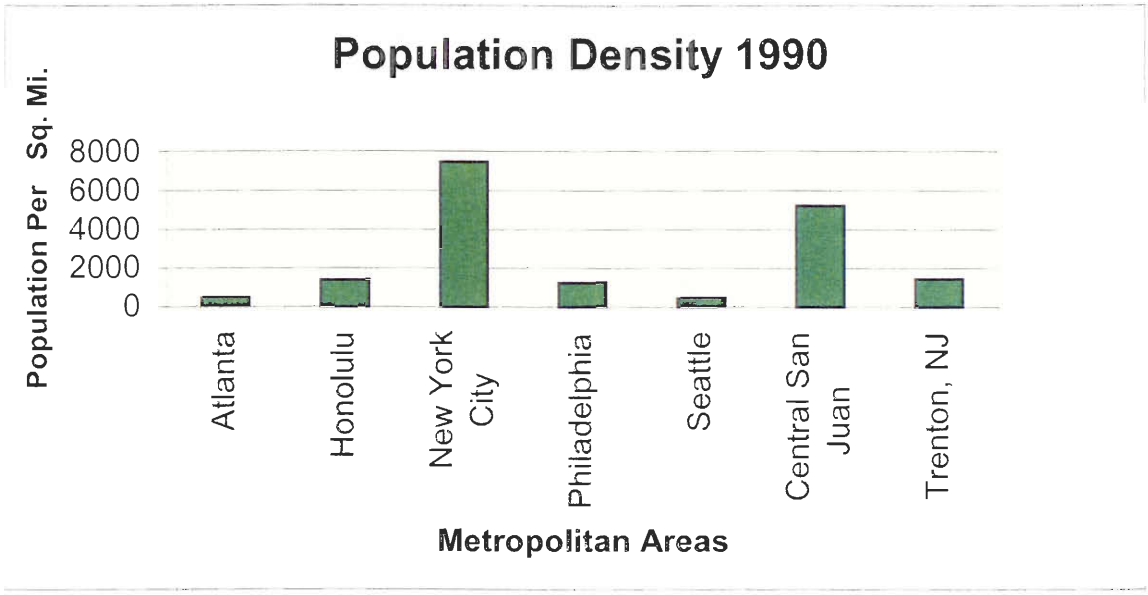
Figure 14: Population Density of Municipalities



Source: U.S. Bureau of the Census, Puerto Rico Planning Board

In this figure, we see a large increase in density in San Juan from 1950 to 1960. The densities in surrounding municipalities increase from 1960 to the present, with more density predicted for the future. The densities in the municipalities surrounding San Juan are significantly lower than that in San Juan itself. Furthermore, with the exception of Cataño they appear to be reaching a common density, which is less than that of San Juan itself.

Figure 15: Population Density 1990

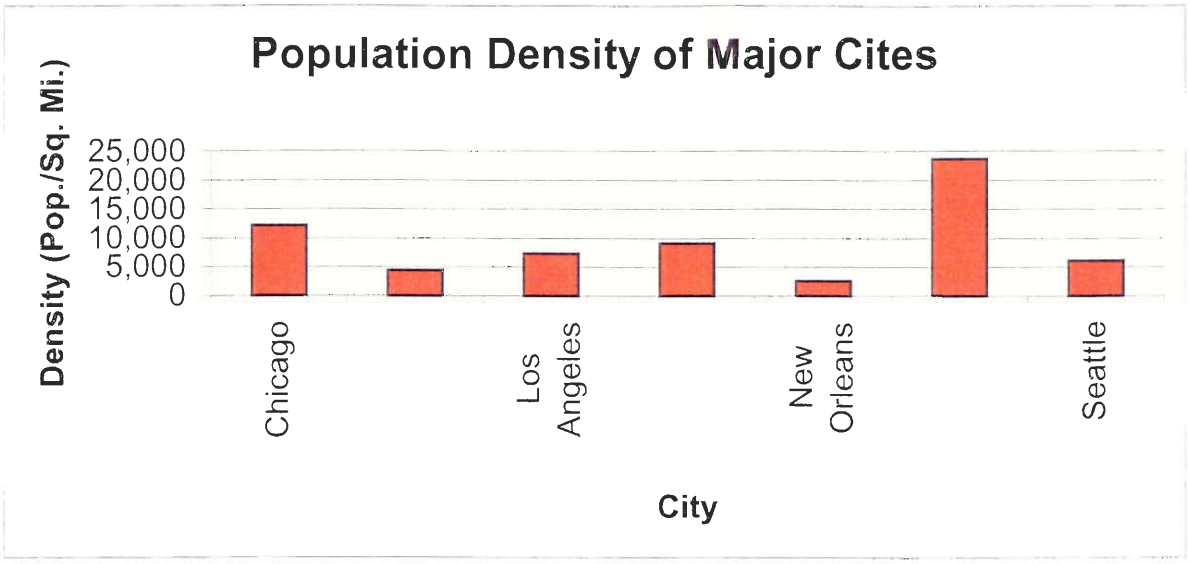


Sources: U.S. Bureau of the Census, Puerto Rico Planning Board

To understand how central metropolitan San Juan related to other regions, we compared the central San Juan metropolitan area with the metropolitan areas of Atlanta, Georgia; Honolulu, Hawaii; New York City, New York; Philadelphia, Pennsylvania; Seattle, Washington and Trenton, New Jersey. Figure 15 shows the results of this comparison; central metropolitan San Juan had the second highest density, all other areas in the comparison with the exception of New York City were very nearly three times less dense than central metropolitan San Juan. Since the central San Juan metropolitan area was compared with Primary Metropolitan Statistical Areas, the density may be slightly lower when the San Juan-Bayamón Primary Metropolitan Statistical Area is used in the comparison.

To further investigate population densities, we compared the municipality of San Juan against other major cities in the United States, as shown in Figure 16.

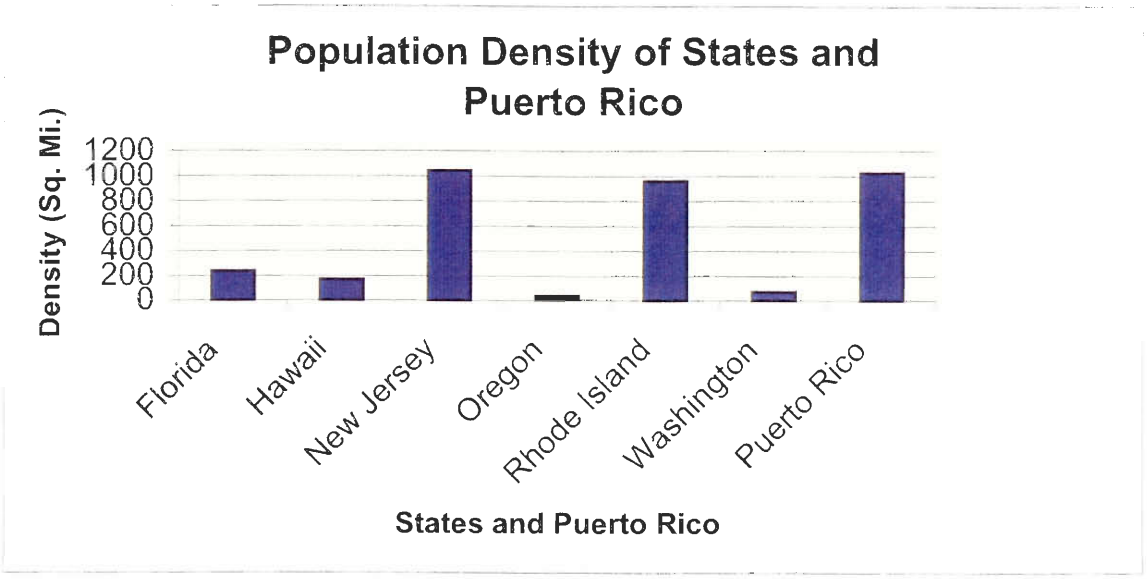
Figure 16: Population Densities of Major U.S. Cities



Source: U.S. Bureau of the Census

By comparing the population densities above, we are able to accurately evaluate the Municipality of San Juan with other cities that are in a similar stage of growth. Central metropolitan San Juan has a relatively high density when compared with other regions, but the fringes of central metropolitan San Juan, the municipalities, are not fully developed. Furthermore, outlying areas of central metropolitan San Juan are in a less mature stage development than comparable areas in the United States.

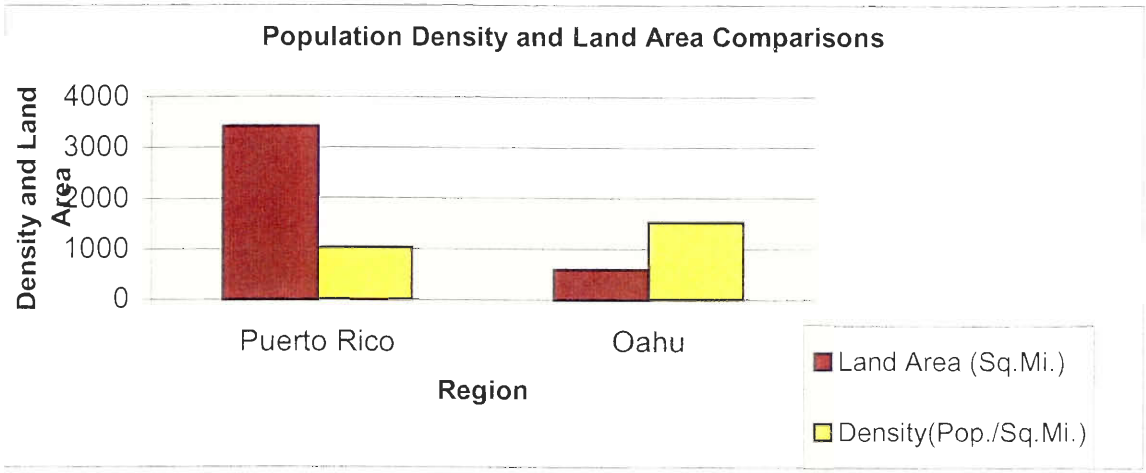
Figure 17: Population Density of States



Sources: U.S. Bureau of the Census, Puerto Rico Planning Board

To understand how this trait extended to the rest of the island, we compared Puerto Rico with six states: Florida, Hawaii, Rhode Island, Oregon, New Jersey, and Washington. Figure 17 shows that Puerto Rico was the second densest region, the region of highest density being New Jersey. Additionally, Rhode Island was found to be nearly as dense as Puerto Rico. All other states in the comparison, with the exception of Rhode Island and New Jersey, have under a fifth the density of Puerto Rico.

Figure 18: Population Density and Land Area (Oahu and Puerto Rico)



Sources: Puerto Rico Planning Board, Hawaii State Data Center

We further compared Puerto Rico to Oahu, the Hawaiian Island that contains Honolulu, and an island with some similarities to Puerto Rico: both were once U.S. territories, are tropical, and are heavily populated. Puerto Rico has more than three times the land area of Oahu, but its density is more than two-thirds that of Oahu. Figure 18 shows the extent to which Puerto Rico has been urbanized.

After examining the population densities with other states, and the central metropolitan area with other areas, we have concluded that Puerto Rico and central metropolitan San Juan have higher population densities.

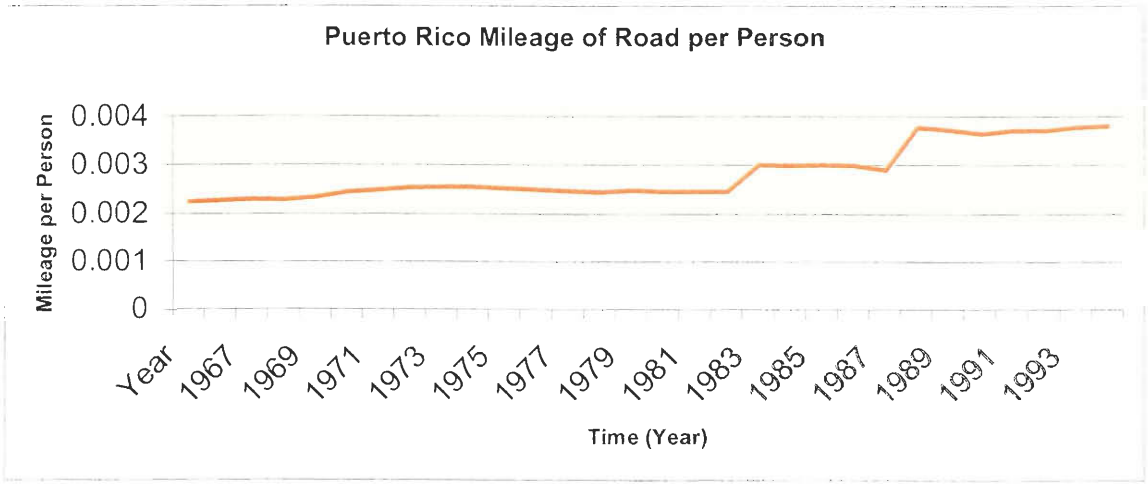
Transportation

***Hypothesis 2**: Puerto Rico will have more miles of highway relative to land area than other areas.*

From our literature review we understood transportation to have an important role in development, therefore we examined the transportation infrastructure of Puerto Rico. In our methodology we constructed the above hypothesis regarding the highway system in Puerto Rico. The measure considered in the analysis was highway mileage per land

area. Prior to this we looked at the amount of roads compared to the population of Puerto Rico. This ratio was calculated to show the growth of roads in comparison to the growth of the population. Figure 19 shows that the growth in population is less than the growth in the highway infrastructure.

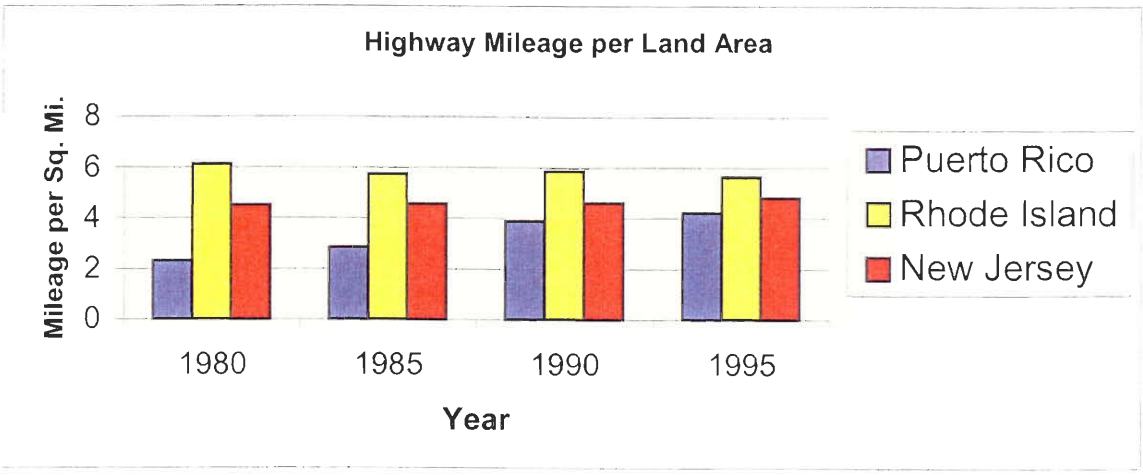
Figure 19: Puerto Rico Mileage of Road per Person



Sources: Federal Highway Administration

After looking at the growth trend of highway infrastructure, we investigated our first hypothesis; Puerto Rico will have more miles of highway relative to land area than other areas. In order to relate the amount of highway mileage in Puerto Rico, we took into account land area. In Figure 20 we compared the highway mileage density with those of Rhode Island and New Jersey. The highway mileages statistics were obtained from the Federal Highway Administration, which include federal roadways within state lines, state highway, state park, state toll, state agency roadways, and local town roads.

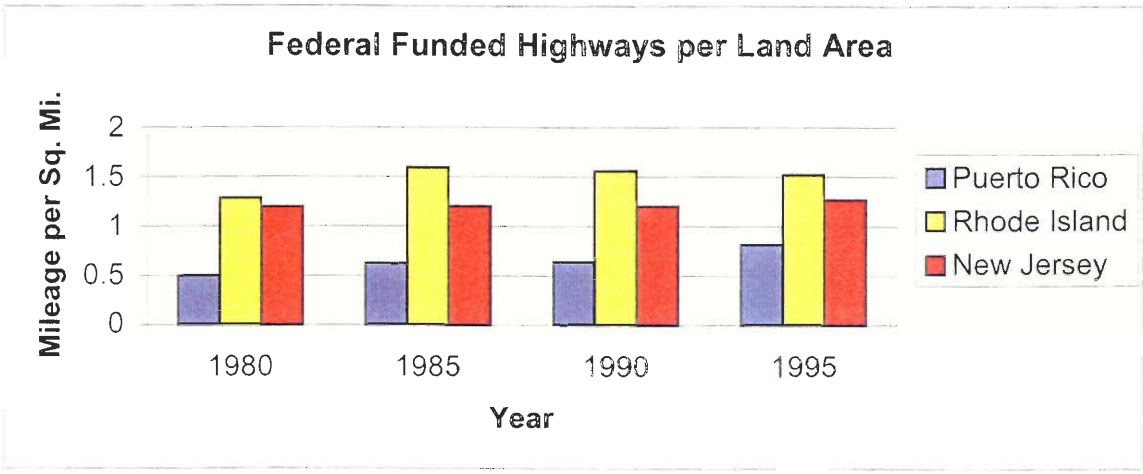
Figure 20: Highway Mileage per Land Area



Sources: Federal Highway Administration

As shown in Figure 20, Puerto Rico has fewer roads per square mile than Rhode Island or New Jersey. Moreover, Puerto Rican state highways are much narrower with lower capacities when compared with other states. However, between 1980 and 1995 there has been a dramatic increase in the mileage that shows Puerto Rico has recently been building large amounts of highways in comparison to other regions. Another important aspect is amount of federal funded highways per land area. As Figure 21 demonstrates, Puerto Rico has comparatively fewer federal funded highways per land area than New Jersey and Rhode Island. Federally funded highways are typically expressways.

Figure 21: Federal Funded Highways per Land Area

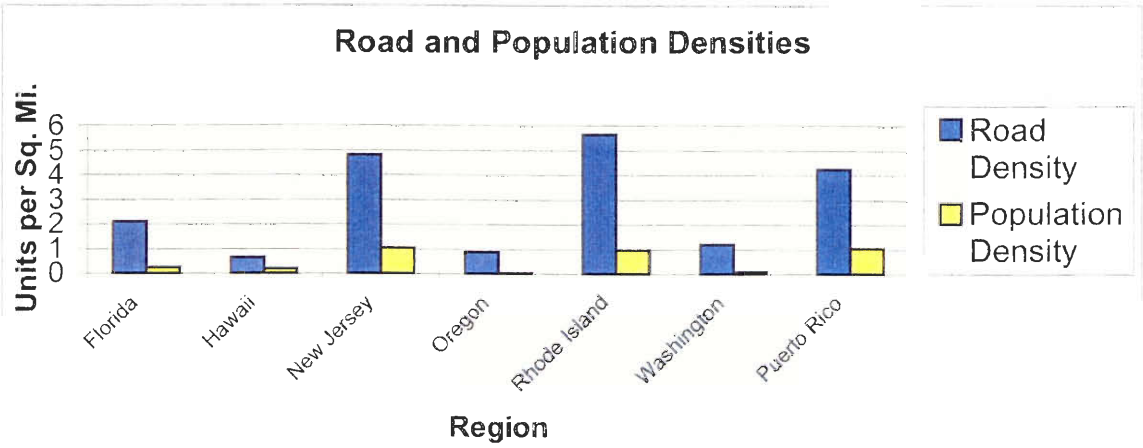


Sources: Federal Highway Administration

Although Puerto Rico has the least mileage per a square mile of these high-density states, Figure 21 shows that its miles of federally-funded highways are growing the most rapidly.

Next, we took into account the populations in comparison with other regions. In the following figure, we compared the mileage densities and population densities of states in the United States with Puerto Rico.

Figure 22: Road and Population Densities by Region



Sources: U.S. Bureau of the Census, Puerto Rico Planning Board, Federal Highway Administration

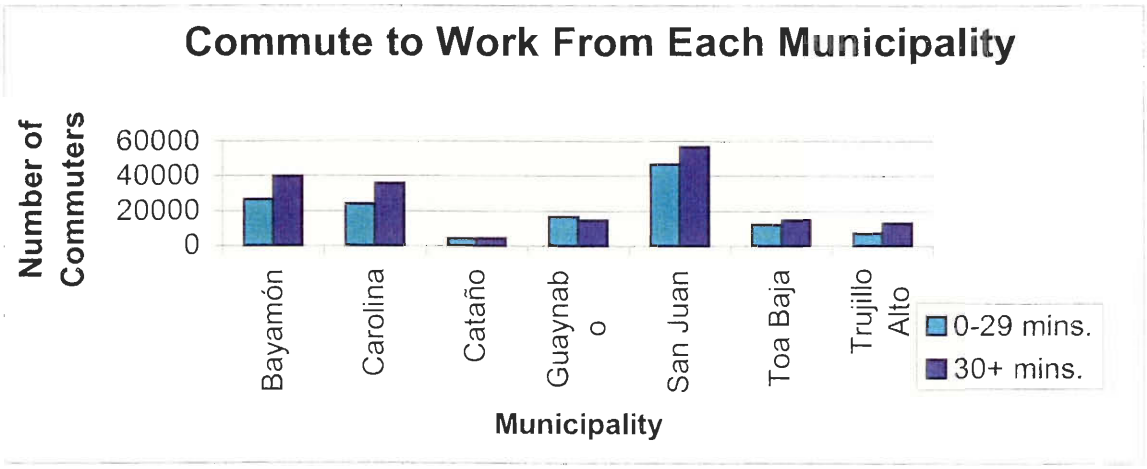
Puerto Rico has both the highest population densities and road mileage densities, except for Rhode Island and New Jersey, which are areas of similar size.

After examining the amount of mileage in Puerto Rico, and comparing it with statistics from other areas, we can conclude that Puerto Rico does not have the most mileage per land area, but has an infrastructure that is growing rapidly.

Hypothesis 3: *People living in the municipalities within the central metropolitan San Juan area will experience long commute times, and the majority will work outside of their resident municipality.*

Following this analysis of the overall highway infrastructure on the island, we investigated congestion in the central metropolitan area of San Juan based on commuting statistics provided by the 1990 Census. From this data, we constructed Figure 23, which is a breakdown of daily commute times by municipality.

Figure 23: Commute to Work From Each Municipality



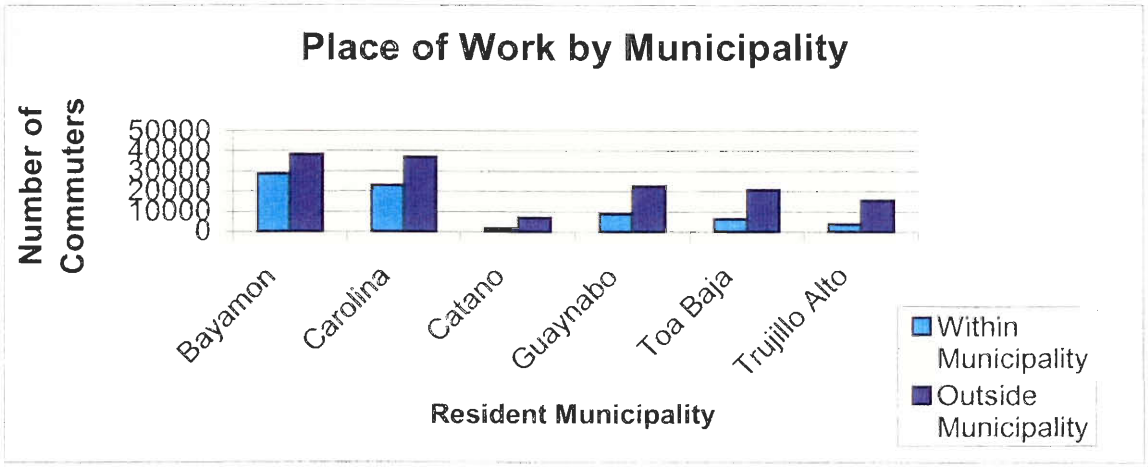
Source: Estudios Tecnicos, 1990 Census

As the above figure reveals, the average one-way commute to work from each of the municipalities in the central San Juan metropolitan area is greater than a half hour. The exception is Guaynabo, which boarders the Municipality of San Juan. Furthermore,

this graph shows that more than 120,000 people enter and leave San Juan by automobile each day, and that over half of them spend more than twelve percent of their working day traveling to work.

Another, aspect we examined was whether the residents worked within their resident municipality. When commuters travel outside their respective municipality, there can only be an increase in the amount of congestion. In Figure 24, we compared the number of commuters who either worked in or out of their residential municipalities.

Figure 24: Place of Work by Municipality



Source: Estudios Tecnicos

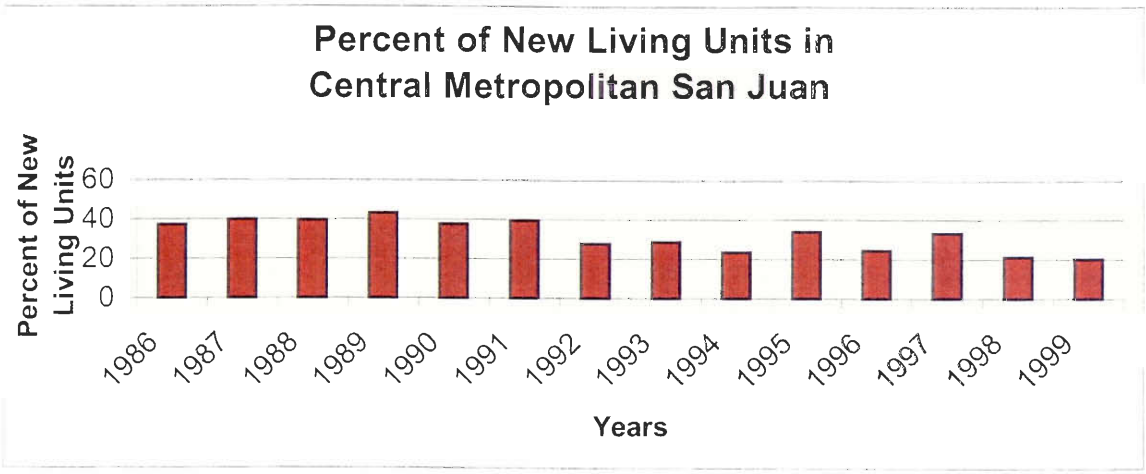
As the Figure shows, in every municipality the majority of commuters travel outside their municipality to work, with the exception of San Juan, which is not shown. We did not include San Juan, because approximately three quarters of the residents work inside the city. After analyzing the commute times and areas to which residents travel to work, we can conclude that a majority of residents have a long commute that takes them out of their resident municipality.

Construction

Hypothesis 4: *Construction of new living units in Puerto Rico and central metropolitan San Juan will consist of a greater number of single families versus multi family homes.*

As our next step in analyzing land use efficiency we took into account the development trends concerning housing units. One aspect of efficient land use is the number of new housing units. The number, location, and type of unit built are all important factors to be considered. Based on our qualitative analysis we formulated a hypothesis dealing with the type of new housing unit, either single family or multi-family. Prior to this we examined the percentage of new living units built in the central metropolitan area out of all of the houses constructed on the island, as shown in Figure 25. The central metropolitan area in the following figure consists of San Juan, Cataño, Carolina, Bayamón, Trujillo Alto, Rio Piedras, and Guaynabo. The change in the definition of the central metropolitan area was due to classifications in the Construction Statistics Office in the Puerto Rico Planning Board, which does not classify Rio Piedras as part of San Juan.

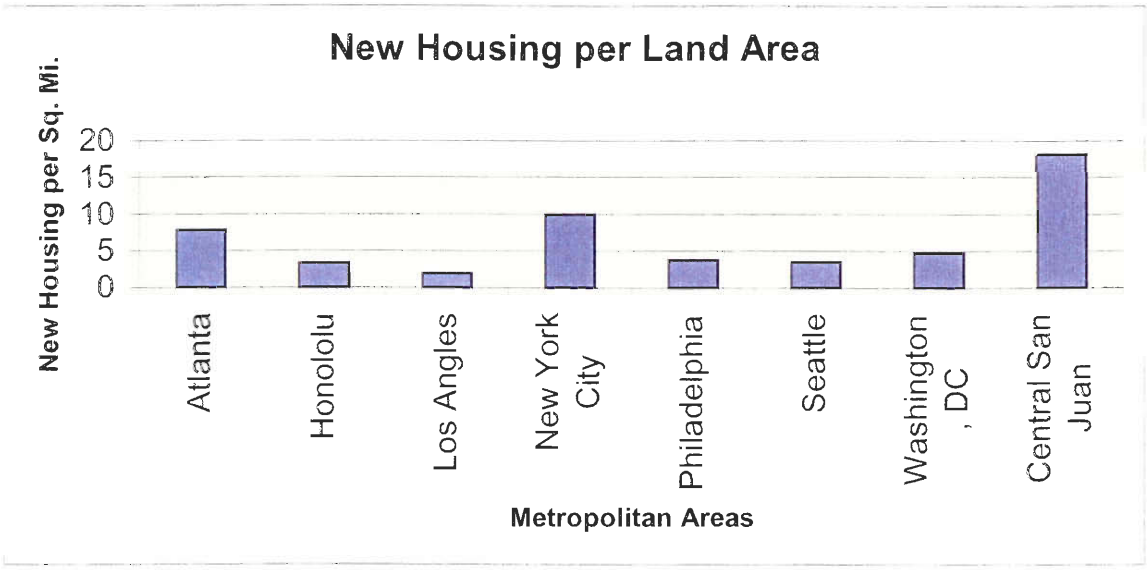
Figure 25: Percent of New Living Units in Central Metropolitan San Juan



Sources: Puerto Rico Planning Board

The construction of new living units has slowly been decreasing since the early 1990's. However from 1988 to 1990, forty percent or more of the houses built on the island were constructed in the central metropolitan area of San Juan. We also studied the number of new housing units of the central metropolitan San Juan area compared to other cities. Figure 26 shows that the central metropolitan San Juan area, including San Juan, Cataño, Carolina, Bayamón, Trujillo Alto, Rio Piedras, and Guaynabo, has the highest number of new housing units per square mile compared to the Primary Metropolitan Statistical Areas of Atlanta; Honolulu; Los Angles; New York City; Philadelphia; Seattle; and Washington, DC.

Figure 26: New Housing per Land Area



Source: U.S. Bureau of the Census, Puerto Rico Planning Board

After looking the percent of new housing units built in the central San Juan metropolitan area and new housing per square mile for central metropolitan San Juan and other metropolitan state areas, we investigated our third hypothesis, construction of new living units in Puerto Rico and central metropolitan San Juan will consist of a greater number of single-family versus multi-family homes. In order to investigate this hypothesis, we decided to examine the number of residential building permits issued between the years 1989 and 1999. The central metropolitan area in the following figures includes San Juan, Cataño, Carolina, Bayamón, Trujillo Alto, Rio Piedras, and Guaynabo. Figure 27 shows a decrease in the total number of residential permits issued in the central metropolitan area from around 900 in 1989 to less than 600 in 1999.

Figure 27: Total Residential Permits

Sources: Puerto Rico Planning Board

Figure 28 illustrates the number of single-family residential permits issued between 1989 and 1999. The trend is similar to the trend of the total number of residential permits. In 1989 around 900 permits were issued and in 1999 around 500 were issued.

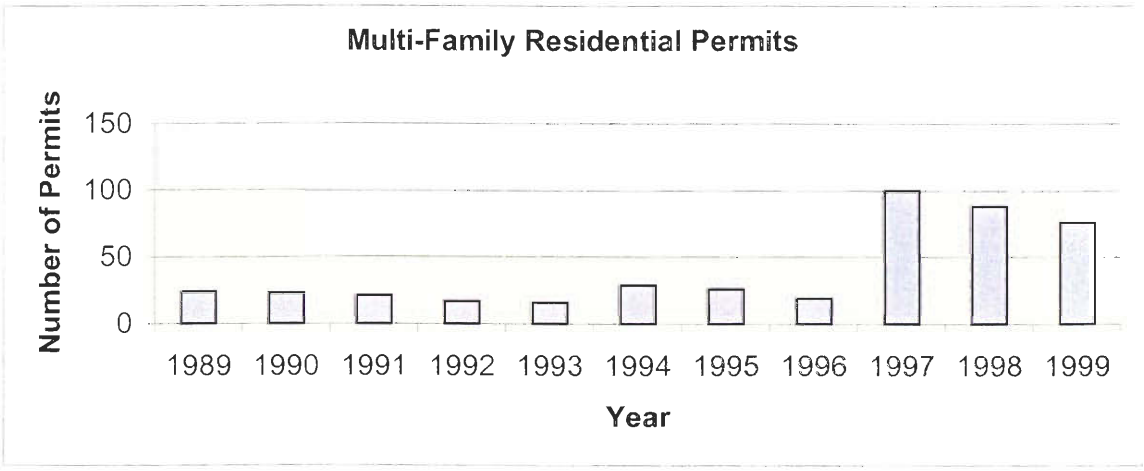
Figure 28: Single-Family Residential Permits

Sources: Puerto Rico Planning Board

Figure 29 shows the number of multi-family residential permits issued. The trend in construction of multi-family homes is dissimilar from the trend in single-family

homes; construction of multi-family homes is increasing, while construction of single-family homes has begun to decrease.

Figure 29: Multi-family residential permits



Sources: Puerto Rico Planning Board

From 1989 to 1996 there were less than 50 permits issued a year; in 1997 the number doubled to around 100. There was a slight decrease from 1998 to 1999, however there were still more permits issued annually than before 1997. After examining the number of new single-family housing units compared to the number of multi-family housing units, we can conclude that there are still more single-family housing units being constructed, but the percentage of new single-family units has been declining.

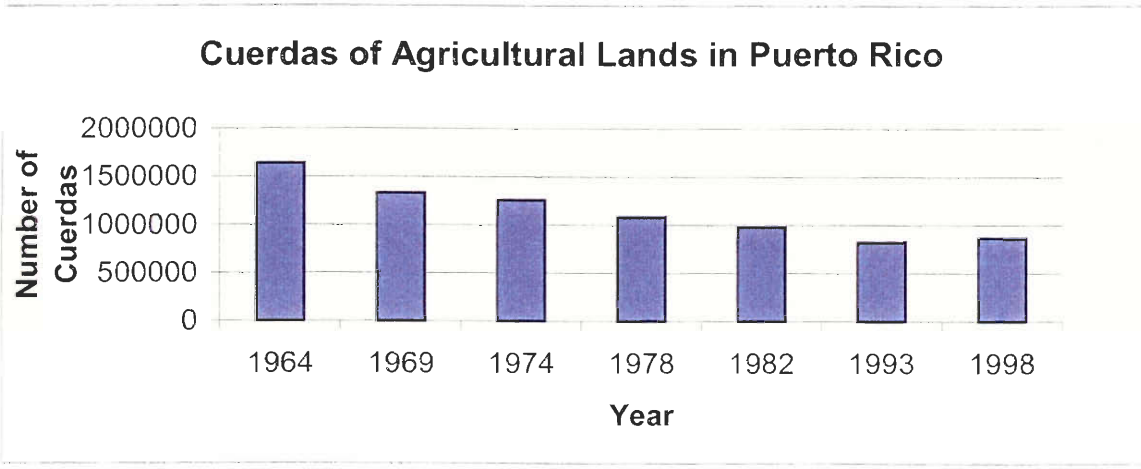
Agricultural Land and Green-space

***Hypothesis 5**: Puerto Rico and central metropolitan San Juan will have less green-space and preserved-space than other areas.*

From our qualitative research we were able to form the above hypothesis concerning agricultural lands and green-spaces in the central metropolitan San Juan area.

To begin the investigation of this hypothesis, we examined the loss of agricultural lands in the central metropolitan area and compared that with the loss of agricultural lands in all of Puerto Rico and in other areas. All areas are shown in cuerdas, a unit of measurement equivalent to ninety-seven percent of an acre. Figure 30 shows the number of cuerdas of agricultural land in Puerto Rico.

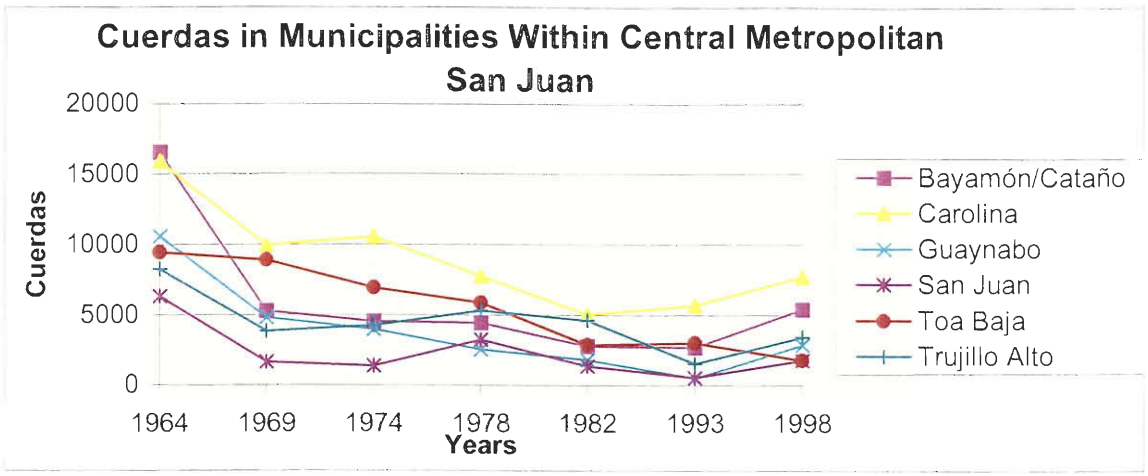
Figure 30: Cuerdas of Agricultural Lands in Puerto Rico



Sources: U.S. Agriculture Department, U.S. Bureau of the Census

As shown in Figure 30, the number of cuerdas of agricultural land has decreased from 1964 to 1993. From 1993 to 1998 this quantity increased, however not significantly. The amount of agricultural land is further stratified by municipality in Figure 31. Just as there was a large decrease in the number of cuerdas of agricultural land in Puerto Rico from 1964 to 1993, so too is there a decrease in the amount of land for each municipality. The decline of agricultural lands in the central metropolitan area is consistent with the loss of agricultural land on the island as a whole.

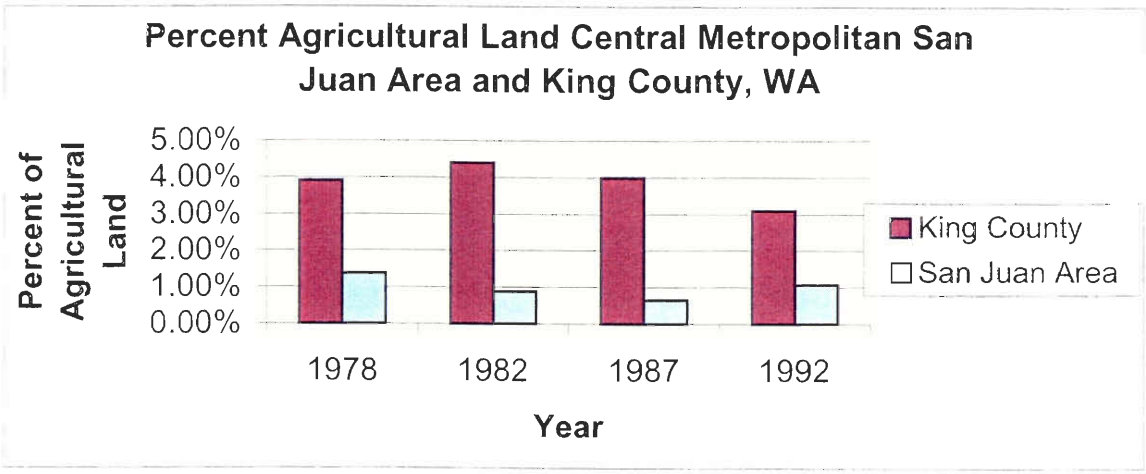
Figure 31: Cuerdas in Municipalities



Sources: U.S. Agriculture Department, U.S. Bureau of the Census

Having examined the amount of agricultural land in Puerto Rico and the central San Juan metropolitan area, we investigated our fourth hypothesis; Puerto Rico and central metropolitan San Juan will have less green-space and preserved-space than other areas. In order to investigate this hypothesis, we compared percentages of agricultural land in Puerto Rico, the percentages of green-space in the central metropolitan San Juan area, and the amount of land developed in Puerto Rico to other areas. In order to understand the loss of agricultural land in Puerto Rico compared to other areas, we looked at the percentage of agricultural land in central metropolitan San Juan and King County, Washington as shown in Figure 32.

Figure 32: Percent Agricultural Land

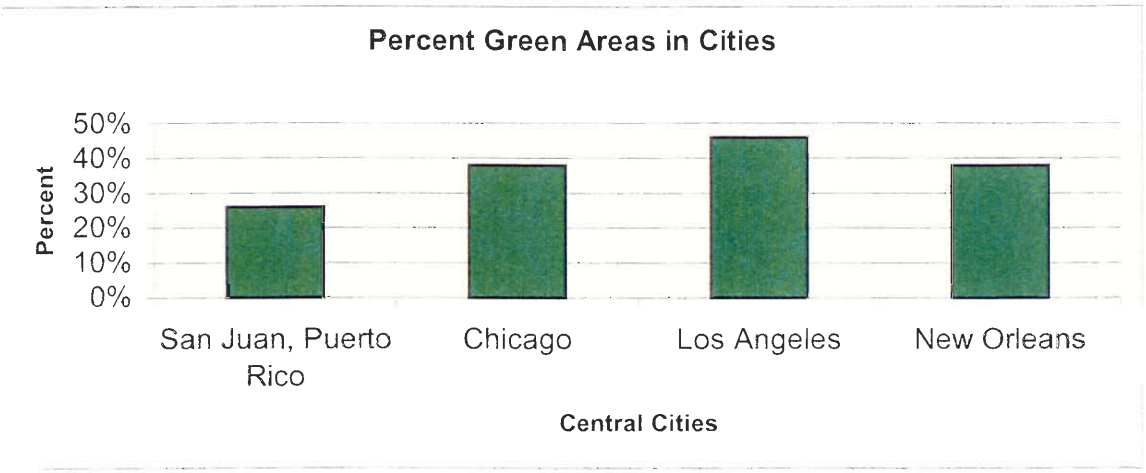


Source: King County Factbook, U.S. Agriculture Department, U.S. Bureau of the Census

In 1978, King County had almost four percent agricultural land, while the central metropolitan San Juan area had only a little over one percent. In 1982, there was an increase in King County and a decrease in central metropolitan San Juan. There was a decrease in both King County and the central metropolitan San Juan area in 1987. Finally, in 1992 there was an increase in central metropolitan San Juan, while the percent of agricultural land in King County decreased.

In order to evaluate the amount of green-space in the Municipality of San Juan we looked at the percent of green-space in San Juan compared to other areas. In Figure 33 we compared the amount green-space in San Juan with those in other major cities in the United States.

Figure 33: Percent Green Areas in Cities

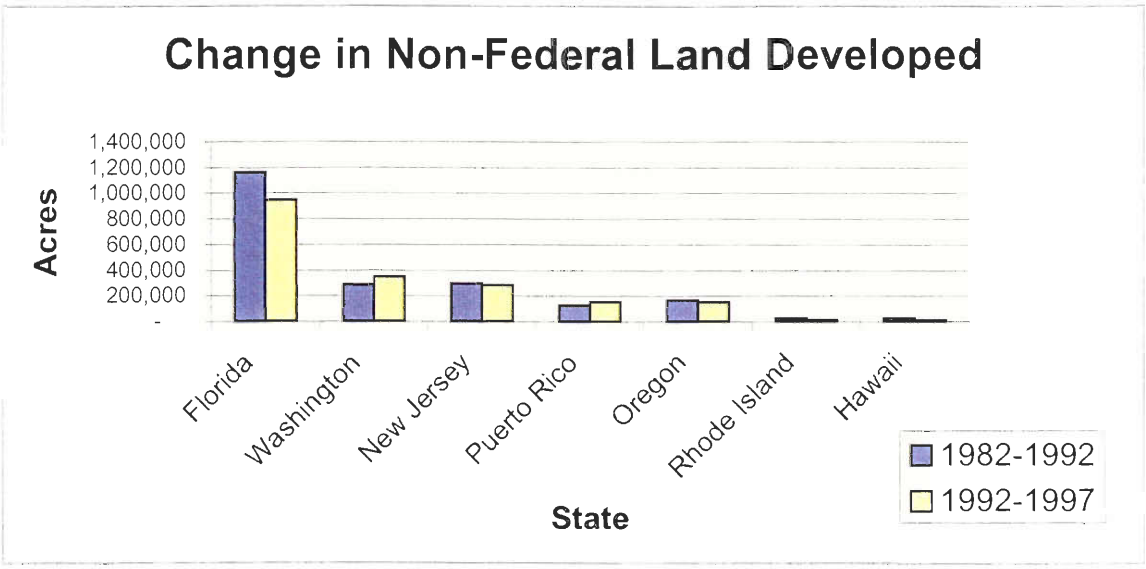


Sources: Plan de Ordenacion Territorial de San Juan

The amount of green-space present in San Juan is low, twenty six percent, when compared with Chicago, New Orleans, and Los Angles, which all are over thirty six percent.

In order to analyze the amount of land developed in Puerto Rico, we examined the total amount of non-federal land developed and the percent of total land developed in Puerto Rico, Florida, Washington, New Jersey, Oregon, Rhode Island and Hawaii.

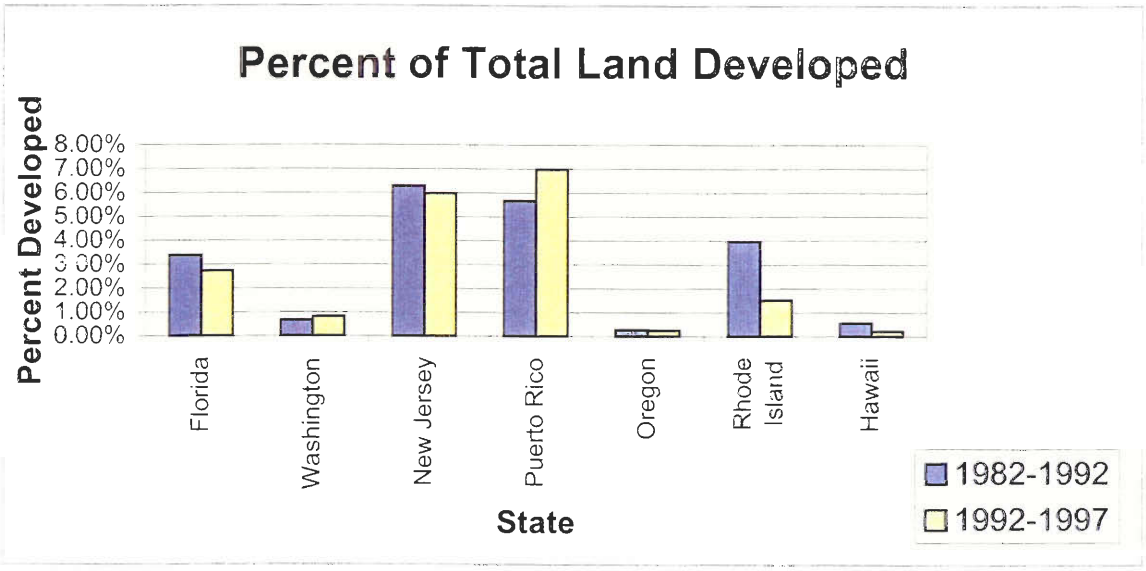
Figure 34: Change in Total Land Developed



Source: USDA-Natural Resources Conservation Service, 1997 National Resources Inventory

As Figure 34 shows, between 1992 and 1997 Puerto Rico developed more acres of land than Oregon, Rhode Island and Hawaii. Compared to the United States, Puerto Rico developed more acres of land than 17 states, including Montana, Connecticut, Nevada and Delaware. We also examined the percent of the total land area developed, shown in Figure 35.

Figure 35: Percent of Total Land Developed



Source: USDA-Natural Resources Conservation Service, 1997 National Resources Inventory; U.S. Census Bureau

Between 1992 and 1997, Puerto Rico developed a higher percentage of land than all states in this comparison: Florida, Washington, New Jersey, Oregon, Rhode Island and Hawaii. From the percentages of green-space and amount of land developed we can conclude that Puerto Rico and central metropolitan San Juan have less green-space than other cities and states.

Conclusions and Recommendations

Conclusions

Our analysis of the efficiency of land use in central metropolitan San Juan and Puerto Rico has led us to conclude that land has been used inefficiently. In each of the areas studied: population distribution and density, transportation, construction, and preservation of green-space and agricultural land, we have found that the use of land does not agree with or follow the guidelines for Smart Growth established by the Smart Growth Network. Below, we will explain for each category the goal of development, and reasons the goals have not been realized in Puerto Rico and the central San Juan metropolitan area.

Population Growth and Density

Smart growth development encourages high-density and multi-use development that maximizes the quality of life for all residents of a community (Ewing and Hodder, 1998: 23). In our research we found that the development occurring on the island of Puerto Rico was high-density. The central San Juan metropolitan area was one of the highest densities when compared to other metropolitan areas in the United States. Further statistics revealed that the Municipality of San Juan was one of the highest densities among major United States cities. This suggested that development might be occurring in the desired manner as mentioned in the Smart Growth concept. Further research, however, revealed that only recently were multi-family and multi-use housing developments being encouraged.

Past development suffered from many failings. First, it was shaped almost exclusively by economic forces, lacking proper regulation fundamental to the Smart

Growth concept. This is exemplified by the development that occurred in the Condado area of San Juan during the 1940's and 1950's, as Carlos Guilbe stated during our interview with him. A boulevard similar to those found in Miami and Florida had been designed for the area, with high-rises and other buildings being separated from the beach by the boulevard. Due to the influence of development forces this idea was unrealized; instead tall buildings were erected much closer to the beach than planned, thereby usurping the view of the ocean for residents of those buildings exclusively. This represents the influence developers have had in the past, and the unfortunate inability of planning agencies to moderate this influence.

Furthermore, development frequently violated, or failed to adequately take into consideration, necessary zoning and planning in the areas where development occurred. Again, this was due to the economic and political influence of developers on the island, and corruption in the agencies responsible for overseeing proper observation of planning and zoning practices. Lastly, only recently, in areas such as the Autonomous Municipality of Carolina, are plans for multi-use, high-density, clustered development being realized; these concepts are fundamental to development following the Smart Growth model.

Transportation

The Smart Growth Network defines a set of parameters for transportation infrastructure that is intended manage traffic and maximize the utility provided by roads, highways, and alternate forms of transportation. The specification includes consideration for biking, walking, highways and roadways, and public transportation. Ewing and Hodder assert that typically "In the design of new communities, the transportation system

is often an afterthought" (Ewing and Hodder, 1998: 11). The result of this, they suggest, is a transportation system designed only with the automobile in mind. In Puerto Rico, it has been our experience both through first-hand observation, and research, that the transportation system is inadequate, and does not follow the guidelines established by the Smart Growth Network for proper transportation design. Instead, it complies with the style of design that Ewing and Hodder suggest "only an automobile could love" (Ewing and Hodder, 1998: 11).

New highway construction is extensive in Puerto Rico, as our analysis of highway construction reveals, and the construction does not appear to be slowing. In fact, it is increasing, despite construction of public transportation systems such as the Urban Train and the fact that continued investment in road systems can hurt such projects. As Dr. Carlos Guilbe stated, incentives must be provided for the train to succeed. Rather than provide such incentives, however, the agencies responsible for the Urban Train have continued the trend of increased automobile infrastructure. As Dr. Guilbe pointed out, this inconsistency could hurt the success of the train.

Despite the vast construction of federally funded roads, such as expressways, there still remains long commute times in the central San Juan metropolitan area. With the construction of highways, as Dr. Guilbe stated, people are encouraged to move further from the central city. As people move further away from the city, commute times and congestion increase. Furthermore, the bus system in Puerto Rico is entirely deficient. During the course of this project, our primary method of transportation to UMET was through the bus system. Frequently, busses were a thirty to forty minutes late in arriving at each stop, and often two or more busses would arrive, one directly behind another.

Our experience led us to conclude that the bus system was clearly inadequate; it rarely met our needs, which were by no means extraordinary. Puerto Rico keeps implementing short-term solutions, for example construction of new highways, rather than investing in long-term solutions, such as efficient integrated mass transit system. Therefore, we conclude that with respect to transportation, central metropolitan San Juan is not using land efficiently according to the ideals set forth by the Smart Growth Network.

Construction

Our research with respect to construction in Puerto Rico reveals entirely unsustainable trends. Smart Growth development should be well planned, and should consist of multi-use, mixed-income, high-density housing (Ewing and Hodder, 1998: 23). Our quantitative research suggests that until 1997 nearly all housing permits issued in Puerto Rico were for the construction of single-family homes. Furthermore, our qualitative research reveals that multi-use structures are only recently being promoted, in areas such as the Autonomous Municipality of Carolina. Otherwise, housing heterogeneity has been left to the will of the developers, who have until recently catered to a market dominated by the construction of single-family. As our qualitative research revealed, developers have great deal of influence in the development process, resulting in many large single-family developments, which have been, and remain, the most lucrative investment. For these reasons, construction techniques in Puerto Rico, and specifically in central metropolitan San Juan, are therefore not in accordance with the Smart Growth philosophy.

Agricultural Land and Green-Space

A primary focus of the Smart Growth movement is the preservation of green-space within dense urban areas. Ewing and Hodder go so far as to suggest that Smart Growth development should design around entire ecosystems, establish runoff control methods and drainage systems, and preserve wetlands and green-space wherever possible (Ewing and Hoddes, 1998: 17). By contrast, development in Puerto Rico has been blamed for recent flooding activities, and green-space in the urban areas is comparatively less than in other metropolitan areas. Most large metropolitan areas preserve green-space in the form of a manicured park system or as urban forests within the urban area. For example, New York and Boston have maintain green-space in the form of Central Park and Boston Commons, respectively. Our research revealed that planners prefer development over green-space in the central San Juan metropolitan area because it is the least costly development method in Puerto Rico. These trends in green-space development have occurred due to the extremely high value of land, especially land within the urban area, and as a result of an economy-centered agenda on the part of the Planning Board.

Recommendations

For Puerto Rico and the central San Juan metropolitan area to begin to use their land efficiently, we recommend reform in the planning process, including strengthening and refinement of planning and zoning laws, elimination of political influence from the planning implementation process, establishment of regional planning, and greater community activity.

As our research has shown, the planning process in Puerto Rico is heavily influenced by both politics and economics. To plan effectively and develop intelligently, as Dr. Molinelli suggested, the government and planning agencies must not cater to economic powers. Thus, the government of Puerto Rico must stop responding largely to the interests of developers and economic forces for Smart Growth to occur. Furthermore, development must be in the interest of both sustainability and the people of Puerto Rico. Therefore, the political influence of developers must not be allowed to corrupt the planning process. As a first step in distancing political and economic influence from the planning process, current planning legislation must be reviewed, and strengthened to eliminate exceptions that, as Secretary Vasquez indicated, cause the implementation of such laws to ultimately fail. Development regulations should be fortified to prevent changing political philosophies from influencing planning and zoning regulations excessively.

Another aspect that should be refined in the planning process, concerns regional planning in the central metropolitan area of San Juan. Regionalism is an aspect of Smart Growth, which involves planning in more than one community within the same area. With the introduction of the Autonomous Municipality Act, the municipalities have begun to regulate development in their communities. As this process continues, regional problems have arisen, and Javier Bonnin suggests that without the presence of a regional planning agency, such problems will continue. An example of problems that have occurred is the situation arising between Guaynabo and San Juan. Guaynabo has zoned residential development near the Caimito area of San Juan; in contrast, the Municipality of San Juan wishes to preserve green-space in the Caimito area. Establishing a regional

planning agency or office will help to eliminate these types of disputes from occurring and will help coordinate the growth of the metropolitan area. There has been a growing need for regional regulations with the introduction of the Autonomous Municipality Act.

The final recommendation we have is for an increase in community involvement in the development process in their communities. As shown through the actions taken by the citizens in the area of Route 66, residents are able to have a great influence on the development in their communities. With the Autonomous Municipality Act, there should be an increase in community involvement as the planning process has been taken to a lower level, where residents can have a greater voice in the decisions concerning development that affects their community than in the past.

Our research has shown that land has been used inefficiently in the central metropolitan San Juan area; however, Puerto Rico has begun to move towards sustainable development. With some of the current trends, an increase in construction of multi-family housing units and the Autonomous Municipality Act, Puerto Rico has begun to implement some ideals present in the Smart Growth concept. By refining the planning process, developing regional planning, and increasing community education and involvement, Puerto Rico and the central San Juan metropolitan area can make use of the Smart Growth concept to its benefit.

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Appendix A: The Universidad Metropolitana, Puerto Rico

The Universidad Metropolitana (UMET), Puerto Rico, was established in 1980, as a private institution and a non-profit organization. The university has 46 academic programs with approximately 5,300 students enrolled each year. Specializing in environmental research, science, technology, and business administration, UMET is located in the San Juan Metropolitan area and operates two off campus learning centers in Jayuya and Aguadilla.

Universidad Metropolitana has developed programs and courses on environmental education and sustainable growth. The university's administrative centers dealing with these subjects include the Environmental Education Institute, Environmental Caribbean Information Center, Environmental Data Analysis Center, Sustainable Growth Initiative, and the Tropical Resources Research Center. The Environmental Education Institute was founded in 1990 in order to enhance curriculum development/teacher training, public awareness, biodiversity protection, and the promotion and identification of sustainable growth. The Environmental Caribbean Information Center was established in 1993 in agreement with the Environmental Protection Agency, or EPA. The center was created to document and organize environmental information for politics that administer industrial, technology, and economic development (urban planning) throughout the Caribbean regions. The Environmental Data Analysis Center was founded in cooperation with The Aerospace Corporation, the Department of Natural and Environmental Resources, and the Economic Development Administration to preserve the Environmental Information System facilities on the island of Puerto Rico. The Environmental Information System is available can be accessed by the government,

student community, and the general public. The Sustainable Growth Initiative was created in order to simulate research in the area of sustainable growth. Finally, the Tropical Resources Research Center is located in Ciales, a State Forest, and was established to encourage research and environmental education outreach programs and projects.

In addition to the centers and institutions, developed in conjunction with UMET, the university boasts graduate programs in environmental management, environmental education, and environmental science. Also, the university offers an environmental technician certificate with emphasis placed on applying basic scientific concepts to the solution of environmental problems. The university is associated with various Puerto Rican and United States Government offices, universities, non-government organizations, foundations, and private firms such as Texaco Corporation, and Johnson & Johnson.

Appendix B: Interview Summaries

Interview with Carlos Guilbe, Professor in the Geography at the University of Puerto Rico (4/11/00)

1. What is your opinion of the development regulations established by the Puerto Rico Planning Board?

There is no communication between the Commonwealth and Municipality. Each of the governments apart of different political parties, which interferes with the communications between the two governments.

A. Have they been effective in controlling development and if not, why?

No, there is no communication between the Commonwealth and Municipality, for example the dispute between the Puerto Rico Planning Board and the Municipality. The Planning Board does not implement the zoning regulations properly. They first develop areas, and then they second zone around that particular area once it has been developed.

B. Do you think that these regulations are lacking any important considerations, or are they sufficient?

They are not sufficient. The developers dictate the development rather than the government controlling the new development. He refers to this development as urban expansion rather than development because development infers that there is planning being involved which is not the case in Puerto Rico. He calls it expansion, or uncontrolled growth, with no vision for the future.

C. Has there been a lack of enforcement and implementation these regulations, specially the zoning regulations, or are they effective?

There is not enforcement of the zoning regulations, which means there is very little implementation of these regulations. For example, Professor Guilbe mentioned that he was walking towards Bayamón from San Juan, and he noticed that there was a Nursery, Porn-O-Shop, and a Gun Store all next to one another in an area zoned as being light residential.

2. What zoning codes changes have you witnessed in the past twenty years?

There have been many zoning changes, along with land speculation. Developers are major contributors for the political parties, which leads to the developers having a lot of influence and connections in the government. This allows the developers to push for zoning changes when beneficial to them, not to the community.

A. How have these changes impacted development in Metropolitan San Juan?

These unregulated changes in the zoning allows for unplanned growth or expansion. This unplanned growth does not create a quality living environment for residents, which encourages those residents, who are financially able, to move away from the city to rural communities.

B. Have these codes been used properly, and to their full potential, therefore positively influencing development?

No, they are not influencing development properly.

C. Are these codes reviewed and updated frequently? (Not asked)

3. The trend in development seems to be for single-family homes in suburban areas, do you think this trend will continue for the next 25 years?

Yes, this trend will continue. The Puerto Rican Government is not pushing for development in the city, but allowing for developers to expand outside the city in rural and urban areas. The government is not enticing developers with any incentives to develop homes in the cities.

A. Considering the size of Puerto Rico, do you think this trend is sustainable? If not, how should it be altered to become more sustainable?

No, at this rate and trend of development Puerto Rico will become an urban city. People need to go back to the inner cities and cut dependence on cars. Puerto Rico is not walkable and they need to change urban life. A long-term goal should be to develop the neighborhoods, and base development there, in the neighborhoods.

B. Will the desire for houses in the suburbs decrease or only increase with the construction of more highway infrastructure?

In the creation of more infrastructure, the desire for more houses further away from the city are going to desired. With the increase of highway miles, the population feels that they are more mobile and can live further away from the cities.

C. With the growth of the construction industry?

Developers want to develop large tracks of land rather than small vacant lots in the cities. It is a lot easier to make more money by developing large tracks of land.

D. Highway development? (Not asked)
E. Public Transportation? (Not asked)

4. It would appear as if loss of agricultural lands has made Puerto Rico dependent upon industry at the expensive of agriculture, would you agree with this?

People would rather associate agricultural lands with the past. Puerto Rico does not have the land to sustain large farms, and large farms are the only really efficient farms. Most of the small farms the government is forced to subsidize.

A. Do you think that the loss of agricultural lands should be stopped, or is Puerto Rico's industry sufficient strong?

Agriculture in Puerto Rico is no longer a popular industry. Puerto Rico is longer able to sustain itself from their agricultural industry. Professor Guilbe likes to refer to agricultural lands as Green lands.

B. Have the necessary measures been taken to stop development from encroaching on agricultural lands, if no, then why not?

It is so easy to change the zoning codes there is no way to stop it.

5. How important is preserved green-space to San Juan?

Green land space prevents erosion of the soil.

A. Should more land be set aside as preserved?

There is not a lot of green land in San Juan. The land value is too high and the maintenance costs are too great. In Bayamón the land is $250 per square meter.

B. What should be done to create more?

Yes, there should be more land set side for green land. The green land could help to bring back the concept of neighborhoods.

C. How should this land be preserved, as parks, or Urban forests? (Not Asked)

D. Is it more advantageous to have lots of smaller preserved spaces, or few very large spaces? How should this be taken into consideration for San Juan? (Not Asked)

6. <u>*Show DTOP plan*</u>

A. Where will development occur in the future if these highways are constructed according to this map? (Not Asked)

B. Is the current plan going to hurt the urban train by causing growth in areas not served by the train?

Yes, people would rather drive their cars than take the train. The government is going to have to encourage people to take the train to work, through gas taxes, or incentives by decreasing the rates of the train, so it is more economical to take the train than to drive to work in San Juan. Also, the government needs to look into changing the density surrounding the Urban Train to high density.

C. Is the highway growth going to force people to use cars more, even though there are more public transportation options?

Low-density development does not allow for improvement in transportation.

D. Are there excessive a number of highways in Puerto Rico in comparison with other countries?

Yes, as of 1999 there are 25,000 Km of roads in Puerto Rico. The density of roadway to land is the highest in the world.

Other Comments:

The merge of Spanish and American planning is evident on the island of Puerto Rico.

Four out of the five largest department stores have their largest gross sales in Puerto Rico (JC Penny, Sears, and Kmart). There are 25 million square feet of shopping centers in Puerto Rico. Puerto Rico is the shopping mall for the Caribbean, drawing people from all around to shop in our malls and department stores. The end result is uncontrolled construction of mass department stores and malls, since the developers have political connections.

Interview with Juan Ogualdo Budet, Sub-Director of Carolina Planning Board (4/19/00)

1. What is your opinion of the development regulations established by the Puerto Rico Planning Board?

Reaction to problems is retroactive; there is little pro-active planning. In the 40's and 50's there was a design for a boulevard similar to those found in Miami and other areas in Florida. This idea was unused, however, because of the money and influence of developers, and the need for jobs. Incidentally, the Condado region was developed without a boulevard, and instead, developments took place closer to the shore than originally planned.

A. Have they been effective in controlling development and if not, why?
Not Asked

B. Do you think that these regulations are lacking any important considerations, or are they sufficient?

The regulations are sufficient.

C. Has there been a lack of enforcement and implementation these regulations, specially the zoning regulations, or are they effective?

The enforcement is a problem. Money, and the influence of developers makes it difficult for the regulations to be implemented.

2. What zoning codes changes have you witnessed in the past twenty years?

Much growth forces changes in zones from rural to urban.

A. How have these changes impacted development in Metropolitan San Juan?
Not Asked

B. *Have these codes been used properly, and to their full potential, therefore positively influencing development?*

No, the Planning Board still has much influence. If municipalities become autonomous, zoning would improve, as it would be done on a smaller scale.

C. Are these codes reviewed and updated frequently?
Not Asked

3. The trend in development seems to be for single-family homes in suburban areas, do you think this trend will continue for the next 25 years?

Carolina is trying to encourage, and is planning for, a change from single-family suburban homes to more urbanized homes. High-density growth is being encouraged, especially more diverse growth such as multi-use housing. This includes buildings that have lower-level commercial and upper-level residential uses. Parking is also a problem; to remedy this, parking is being encouraged within new structures. There is also a study being conducted to determine how sufficient services and commerce are in the metropolitan area. Development of plans for urban areas is occurring. Furthermore, development in rural areas now takes into consideration the character of the rural area; for example, rural towns should not be broken up by new development. In addition, development should occur, and is planned to occur, around important environmental areas and natural resources. A problem that is encountered is the following: originally, plots of land in rural areas were intended to be no less than 5 cuerdas, and thus low density. There was an exception, however, that when a landowner dies, the inheritors may split the land to less than the minimum lot size. This exception has become the rule, and has caused problems and inconsistencies. Ponce has decided that a single plot in a rural area should be 25 cuerdas. Another thing that Carolina is doing to retain rural character is to encourage Transfer of Development Rights (TDR's), an important smart growth concept.

4. Since developers are so powerful in Puerto Rico, and Carolina seems to be more carefully planning the use of its land than has previously been done in Puerto Rico, has the Carolina Planning Board experienced adversity from developers?

Since Carolina is in its fourth level of autonomy, and hasn't yet achieved the fifth, the municipality still doesn't have the final say as to what will be developed. To try to encourage appropriate development, Carolina planning members talk to developers when an area is planned to be developed, and discuss what is expected and desired for the area. Developers must use existing infrastructure, for example road access, for their developments, and Carolina determines where this can occur. Thus, the municipality can, in a small way, influence development. When it becomes fully autonomous, this will no longer be such a problem, and development may be more fully controlled by the municipality.

5. What about public transportation in Carolina?

Two studies are being done. The first is to evaluate internal transportation infrastructure. The study is looking at parking, for example, and the layout of one-way streets. A second study is looking at a bus terminal for Carolina, to improve bus access in the municipality. The urban train doesn't seem to be servicing sufficiently dense areas, as was planned. Carolina would like to make suggestions that would improve the train, and expand its ability to service the municipality, especially its more dense areas.

Interview with Max Vasquez, Secretary to the Puerto Rico Planning Board (4/19/00)

1. What is your opinion of the development regulations established by the Puerto Rico Planning Board?

Regulations are sufficient. The implementation of these regulations has some problems. Variances or exceptions in planning regulations are cause for problems as they encourage ad hoc planning and development, and holes in regulations that allow developers to exploit the planning and zoning processes. Agencies responsible for implementation of regulations are ARPE, which is responsible for permits, PRASA, the sewer and water authority, and the power authorities. Regulations also need to be simplified, as some are to technical, or complicated. The process of simplification is underway.

2. What zoning codes changes have you witnessed in the past twenty years?

Parking in commercial areas is a problem, because it wasn't properly planned for. As a result, many residents are unhappy. Incentives for the construction of parking lots are being given to developers, and those projects that don't plan for parking adequately are being denied in order to improve this situation. Zoning changes may occur in each municipality to accommodate changes in urban population.

3. The trend in development seems to be for single-family homes in suburban areas, do you think this trend will continue for the next 25 years?

The Planning Board is promoting multi-family development, for example walk-ups and townhouses. Also, they're trying to distribute the commerce of the region so that its not centralized, but spread out amongst the municipalities. This will lower congestion, improve other less central commercial areas.

4. It would appear as if loss of agricultural lands has made Puerto Rico dependent upon industry at the expensive of agriculture, would you agree with this?

Between crop loss to hurricanes and product competition, it is much more lucrative for farmers to sell agricultural land to developers than to continue farming it. This is a problem that has led to the loss of much agricultural land. The end of section 936 has led to an increase in employment in the service industry, and construction.

5. How important is preserved green-space to San Juan?

The south of Puerto Rico, Valle de Lejas, has been zoned to preserve the land, and prevent development. It is important, though, in the metropolitan area to maximize use of infrastructure. Much of the land within the metropolitan area already has necessary infrastructure. It is therefore beneficial to maximize the use of this infrastructure, rather than preserve the green-space that surrounds it.

6. With regard to sustainability?

With the creation of the Autonomous Municipality Act planning will be taken to the lower levels, alleviating some of the need for the central Planning Board to plan for these areas, but more importantly allowing municipalities to plan themselves. This takes the planning process and extends it more to the community. Also, projects are occurring such as the Superaquaducto, which are now planning for the future more than has been done historically. Instead of the Planning Board doing everything, and taking all blame for errors as in the past, now the process is being distributed, and more sustainability-oriented projects are occurring.

Interview with Javier Bonnin, Consultant for the Urban Department of the Municipality of San Juan (4/25/00)

1. What is your opinion of the development regulations established by the Puerto Rico Planning Board?

The land use policies established by the Puerto Rico Planning Board are good, but the regulations have too many loopholes. Also, said that there was much political corruption at the lower levels of the planning board. An example of this corruption has occurred in the southern part of San Juan in a rural zone. There is a 110 acre industrial development going into the area zoned as rural. It consists of 18 one-acre industrial, 10 commercial, and 65 residential lots. Those responsible for the development, the Environmental Quality Board, did not adequately follow procedure in accordance with the environmental regulations, yet the development was approved by the Puerto Rico Planning Board. Since it is an election year, the mayor of San Juan, a candidate for governor of Puerto Rico, does not want the administration to appear anti-development.

2. What zoning codes changes have you witnessed in the past twenty years?

The zoning changes have occurred freely. He states that the present zoning promotes urban sprawl. He also, said that San Juan should discard the present zoning regulations and construct new zoning regulations, since the current regulations were based on the United States.

3. The trend in development seems to be for single-family homes in suburban areas, do you think this trend will continue for the next 25 years? (Not Asked)

4. It would appear as if loss of agricultural lands has made Puerto Rico dependent upon industry at the expensive of agriculture, would you agree with this? (Not Asked)

5. How important is preserved green-space to San Juan?

Presently, there are no tools available for green-space preservation.

6. With regard to sustainability and the Autonomous Municipality Act?

He said that it was important to bring the power of land use and zoning regulation down to the municipality level. It makes the politicians responsible and allows for the people to have a voice concerning planning in their communities. He stated that the municipalities are better off now being in control of their own planning, than when the Puerto Rico Planning Board was in control. However, there is a problem developing in that there is a lack of regional planning among the municipalities, or a lack of regional planning. For example, Guaynabo is presently planning for the construction of large residential areas, which are neighboring San Juan. This development will draw homebuyers away from San Juan, and all of their income taxes as well.

Interview with Jose Rivera Santana, Estudios Tecnicos and Professor at UMET (4/28/00)

1. What is your opinion of the development regulations established by the Puerto Rico Planning Board?

The regulations are not good. They have the principal elements, but the implementation is lacking. Also, the Puerto Rico Planning Board does not give economic incentives for developers to build in the city, and lack the protection of the rustic areas.

2. What zoning codes changes have you witnessed in the past twenty years?

Zoning is not efficient. The majority of Puerto Rico is not zoned, especially in the rural areas. This means that the zoning codes are not being used efficiently. The Autonomous Municipality Act allows restructuring of the zoning codes, and will be useful if followed.

3. The trend in development seems to be for single-family homes in suburban areas, do you think this trend will continue for the next 25 years?

The trend will continue with current regulations, and there is a lack of implementation of these regulations. There has been a change from single-family construction to multi family housing units, within the last few years, but the change was been very small.

4. It would appear as if loss of agricultural lands has made Puerto Rico dependent upon industry at the expensive of agriculture, would you agree with this? (Not Asked)

5. How important is preserved green-space to San Juan? Since green-space is so expensive?

The pressure to develop in the metropolitan area is high. Communities need to be active in pressuring the politicians to preserve green-space. Another way to preserve green-space is through legislation. The pressure to develop is coming from the construction industry and from corruption in high levels of the government.

6. With regard to sustainability? (Not Asked)

Comments:

In the future, Carlos Santana believes there are going to be some positive changes in the developmental process in Puerto Rico, with an increase in community involvement and as there are more professionals aware of the problems of urban sprawl. The professionals are more willing to help communities, but these changes may not be occurring fast enough, since the development of Puerto Rico is occurring rapidly.

Interview with Dr. Carlos E. Severino Valdez, Director of the Geography Department at the University of Puerto Rico (4/28/00)

1. What is your opinion of the development regulations established by the Puerto Rico Planning Board?

No, the Planning Board has not been effective. Economic factors have prevailed over planning issues rather than the regulations that have been set forth. The economical forces have pushed the political forces. There is a lack of will to create an environmental where regulations are followed. The central city of San Juan, the municipality, has a low density, since most of the population lives on the outskirts. There has been a lack of incentives by the government to bring people back in to the cities from the rural communities.

2. What zoning codes changes have you witnessed in the past twenty years?

The zoning regulations do not work. There has not been a consensus over the years with the frequent changes in politics. The regulations change when new political powers take over office. The zoning regulations are not followed with frequent changes in residential areas from R1 to R2, and the construction of commercial developments in residential areas. Worse than the problem of corruption, the officials in charge of urban planning are not aware of what urban planning is or how it is supposed to be implemented.

3. The trend in development seems to be for single-family homes in suburban areas, do you think this trend will continue for the next 25 years? (Not Asked)

4. It would appear as if loss of agricultural lands has made Puerto Rico dependent upon industry at the expensive of agriculture, would you agree with this?

The agricultural land is more valuable to the farmers to sell rather than to work. The costs are too high to work the agricultural land and Puerto Rico is lacking the manpower to do so. Also, the farmers are planting the wrong crops, in that they are trying to compete with other islands like the Dominican Republic, who can produce the products cheaper those farmers in Puerto Rico. They need to find a niche so they produce products without having to combat other islands that can produce those products cheaper. Other products like no food agriculture is a suggestion, like grass, flowers, and other plants rather than the traditional products. This would help to save some of the land in the metropolitan area.

5. How important is preserved green-space to San Juan?

They need to enroll the communities, in that they have a strong power and pull in the government.

6. With regard to sustainability? (Not Asked)

Comments:

The government needs to shape the economic forces rather than going against them. They need to install incentives for developers to build in the cities, rather than on the fringe of the cities, like is done in many U.S. cities.

Appendix C: Tables Used in Analyses

City Densities 1990

	Land Area (Sq. Mi.)	Population 1990	Density (per Sq. Mi.)
Chicago	227.2	2,768,483	12,185
Honolulu	82.8	371320	4484.541063
Los Angeles	469.3	3,489,779	7,436
Municipality of San Juan	47.8	437745	9157.845188
New Orleans	180.6	489,595	2,711
New York City	308.9	7311966	23670.9809
Seattle	83.9	519598	6193.06317

Source: U.S. Bureau of the Census, Puerto Rico Planning Board

State Densities 1990

	Land Area (Sq. Mi.)	Population 1990	Density (per Sq. Mi.)
Florida	53937	12938000	239.9
Hawaii	6423	1108000	172.5
New Jersey	7419	7748000	1044.3
Oregon	96002	2842000	29.6
Rhode Island	1045	1003000	960.3
Washington	66581	4867000	73.1
Puerto Rico	3426.5	3522037	1027.9

Source: U.S. Bureau of the Census, Puerto Rico Planning Board

Population 1940-2020

	1940	1950	1960	1970	1980	1990	2000	2010	2020
Puerto Rico	1869255	2210703	2349544	2712033	3196520	3522037	3839954	4086669	4264356
Central Metropolitan Area									
Bayamón	37190	48000	72221	156192	196206	220262	244045	256617	264755
Carolina	24046	29224	40923	107643	165954	177806	192534	202305	205693
Cataño	9719	19865	25208	26459	26243	34587	41392	47923	54349
Guaynabo	18319	29120	39718	67042	80742	92886	101635	107309	111708
San Juan	169247	224767	451658	463242	434849	437745	455595	456639	457884
Toa Baja	11410	15761	19698	46384	78246	89454	100892	108956	114560
Trujillo Alto	11726	13605	18251	30669	51389	61120	69057	76345	81738
Total	281657	380342	667677	897631	1033629	1113860	1205150	1256094	1290687
Outlying Municipalities									
Canóvanas					31880	36816	41020	44425	47146
Loiza	22145	24755	28131	39062	20867	29307	36410	44628	53312
Toa Alta	13371	14155	15711	18964	31910	44101	54414	64554	74530
Vega Alta	14329	16521	17603	22810	28696	34559	40177	44826	48880
Vega Baja	23105	28925	30189	35327	47115	55997	62466	67998	72615

Source: U.S. Bureau of the Census, Puerto Rico Planning Board

Population Density 1940-2020

	Land Area (Sq. Mi.)	1940	1950	1960	1970	1980	1990	2000	2010	2020
Puerto Rico	3426.50	545.53	645.18	685.70	791.49	932.88	1027.90	1120.66	1192.67	1244.52
Central Metropolitan Area										
Bayamón	44.40	837.61	1081.08	1626.60	3517.84	4419.05	4960.90	5496.51	5779.66	5962.95
Carolina	45.40	529.65	643.70	901.39	2370.99	3655.37	3916.40	4240.84	4456.06	4530.68
Cataño	4.80	2024.79	4138.54	5251.67	5512.29	5467.29	7205.60	8623.33	9983.96	11322.71
Guaynabo	27.10	675.98	1074.54	1465.61	2473.87	2979.41	3427.50	3750.37	3959.74	4122.07
San Juan	47.80	3540.73	4702.24	9448.91	9691.26	9097.26	9157.80	9531.28	9553.12	9579.16
Toa Baja	23.20	491.81	679.35	849.05	1999.31	3372.67	3855.80	4348.79	4696.38	4937.93
Trujillo Alto	20.80	563.75	654.09	877.45	1474.47	2470.63	2938.50	3320.05	3670.43	3929.71
Total	213.50	1319.24	1781.46	3127.29	4204.36	4841.35	5217.14	5644.73	5883.34	6045.37
Outlying Municipalities										
Canóvanas	32.80					971.95	1122.44	1250.61	1354.42	1437.38
Loiza	19.40	1141.49	1276.03	1450.05	2013.51	1075.62	1510.67	1876.80	2300.41	2748.04
Toa Alta	27.40	487.99	516.61	573.39	692.12	1164.60	1609.53	1985.91	2355.99	2720.07
Vega Alta	27.80	515.43	594.28	633.20	820.50	1032.23	1243.13	1445.22	1612.45	1758.27
Vega Baja	45.90	503.38	630.17	657.71	769.65	1026.47	1219.98	1360.92	1481.44	1582.03

Source: U.S. Bureau of the Census, Puerto Rico Planning Board

Puerto Rico Highway Mileage

Year	Mileage	Population	Mileage per Population
1966	5895	2624000	0.00225
1967	6023	2645000	0.00228
1968	6129	2669000	0.00230
1969	6203	2717000	0.00228
1970	6360	2715942	0.00234
1971	6750	2765988	0.00244
1972	7091	2846492	0.00249
1973	7275	2862454	0.00254
1974	7374	2885302	0.00256
1975	7484	2933474	0.00255
1976	7637	3024084	0.00253
1977	7685	3078404	0.00250
1978	7685	3115081	0.00247
1979	7729	3165241	0.00244
1980	7950	3206041	0.00248
1981	7994	3245409	0.00246
1982	8004	3261708	0.00245
1983	8012	3265000	0.00245
1984	9812	3269000	0.00300
1985	9811	3282000	0.00299
1986	9818	3273000	0.00300
1987	9822	3292094	0.00298
1988	9829	3395553	0.00289
1989	13185	3499368	0.00377
1990	13396	3604761	0.00372
1991	13486	3709324	0.00364
1992	14034	3779593	0.00371
1993	14089	3800875	0.00371
1994	14377	3806530	0.00378
1995	14498	3812569	0.00380

Source: Federal Highway Administration

State Highway Densities

	Land area (Sq. Mi.)	Highway Mileage	Highway Mileage per Land Area
Florida	53937	113778	2.1
Hawaii	6423	4133	0.6
New Jersey	7419	35646	4.8
Oregon	96002	83944	0.9
Rhode Island	1045	5893	5.6
Washington	66581	79710	1.2
Puerto Rico	3426.5	14498	4.2

Source: Federal Highway Administration

Highway Mileage and Densities
for Puerto Rico, Rhode Island, and New Jersey

State and Federal Highways

Highway Mileage				
	1980	1985	1990	1995
Puerto Rico	7,950	9,811	13,396	14,498
Rhode Island	6,396	5,997	6,111	5,893
New Jersey	33,438	33,880	34,252	35,646
Highway Mileage per Land Area				
	1980	1985	1990	1995
Puerto Rico	2.320152	2.863272	3.909529	4.23114
Rhode Island	6.120574	5.738756	5.847847	5.639234
New Jersey	4.507076	4.566653	4.616795	4.804691

Federal Funded Highways

Federal Funded Highway Mileage				
	1980	1985	1990	1995
Puerto Rico	1,708	2,138	2,178	2,792
Rhode Island	1,338	1,662	1,631	1,588
New Jersey	8,891	8,918	8,948	9,433
Federal Funded Highways per Land Area				
	1980	1985	1990	1995
Puerto Rico	0.498468	0.62396	0.635634	0.814826
Rhode Island	1.280383	1.590431	1.560766	1.519617
New Jersey	1.198409	1.202049	1.206092	1.271465

Source: Federal Highway Administration

New Private Residential Construction Permits 1989-1999

Total Residential Permits	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Bayamón	304	306	480	233	285	320	362	225	254	221	201
Carolina	293	221	286	159	284	304	276	248	177	175	176
Cataño	27	20	19	13	14	15	8	9	5	9	10
Guaynabo	107	123	79	67	63	81	102	49	75	83	58
San Juan	48	38	36	32	20	28	53	32	58	65	34
Toa Baja	63	53	45	39	64	52	68	67	49	58	37
Trujillo Alto	70	78	83	82	111	116	109	99	97	128	82
Total	912	839	1028	625	841	916	978	729	715	739	598

Single Family	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Bayamón	300	303	478	228	281	316	356	219	224	196	174
Carolina	290	218	281	158	282	300	271	244	154	146	149
Cataño	27	20	19	12	14	14	8	9	3	8	9
Guaynabo	103	120	75	64	57	70	94	47	67	73	52
San Juan	35	25	28	26	18	20	48	28	41	55	23
Toa Baja	63	53	45	38	63	52	67	65	42	55	37
Trujillo Alto	70	77	81	82	110	115	108	98	84	118	78
Total	888	816	1007	608	825	887	952	710	615	651	522

Multi Family	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Bayamón	4	3	2	5	4	4	6	6	30	25	27
Carolina	3	3	5	1	2	4	5	4	23	29	27
Cataño	0	0	0	1	0	1	0	0	2	1	1
Guaynabo	4	3	4	3	6	11	8	2	8	10	6
San Juan	13	13	8	6	2	8	5	4	17	10	11
Toa Baja	0	0	0	1	1	0	1	2	7	3	0
Trujillo Alto	0	1	2	0	1	1	1	1	13	10	4
Total	24	23	21	17	16	29	26	19	100	88	76

Source: Puerto Rico Planning Board

New Private Living Units

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Puerto Rico	8204	9967	10739	11711	10345	10492	8945	9785	11268	13685	13959	15464	14973	14056
Central Metropolitan Area														
Bayamón	699	909	586	1320	971	688	438	371	689	991	729	649	620	321
Carolina	283	744	994	842	528	832	369	469	340	1094	926	548	896	551
Cataño	110	525	493	191	20	20	14	15	16	5	9	6	23	28
Guaynabo	695	635	949	708	781	592	281	606	363	1131	157	766	301	202
Rio Piedras	838	769	663	1377	1054	1119	929	860	750	711	1058	1907	566	1096
San Juan	338	293	290	329	262	284	116	72	78	131	72	248	157	80
Trujillo Alto	94	120	301	295	292	618	338	426	422	593	502	1056	614	580
Total	3057	3995	4276	5062	3908	4153	2485	2819	2658	4656	3453	5180	3177	2858
Percent Central Metropolitan San Juan of Puerto Rico Total														
	37.26	40.08	39.82	43.22	37.78	39.58	27.78	28.81	23.59	34.02	24.74	33.50	21.22	20.33

Source: Puerto Rico Planning Board

City Housing Density 1995

	Land Area (Sq. Mi.)	New Private Living Units-1995	Housing per Land Area
Atlanta	6126.2	48277	7.88
Honolulu	600.2	4544	3.33
Los Angles	4060	7763	1.90
New York City	1147.5	7296	9.98
Philadelphia	3855.8	13148	3.78
Seattle	4424.9	13673	3.55
Washington, DC	6510.7	29051	4.76
Central Metropolitan San Juan	190.3	4656	18.15

Source: U.S. Bureau of the Census, Puerto Rico Planning Board

Percent Green Area in Cities

	Population	Area (Sq. mi.)	Density (per Sq. mi.)	Percent Green Areas
Municipality of San Juan	4322760	47.8	9175.8	26%
Chicago	2768483	227.2	12185	38%
Los Angeles	3,722,500	469.3	7961	46%
New Orleans	496968	180.6	2752	38%

Source: Plan de Ordenacion Territorial de San Juan

Number of Cuerdas in Farms 1964-1998

	1964	1969	1974	1978	1982	1993	1998
Puerto Rico	1641042	1334800	1259917	1084444	982457	826893	865478
Bayamón/Cataño	16564	5283	4554	4471	2788	2703	5431
Carolina	15935	9937	10557	7771	5054	5700	7695
Guaynabo	10595	4802	3998	2574	1844	504	2883
San Juan	6316	1673	1377	3259	1399	536	1785
Toa Baja	9447	8916	6913	5862	2911	3029	1774
Trujillo Alto	8270	3861	4279	5340	4618	1551	3462
Total	67127	34472	31678	29277	18614	14023	23030

Source: U.S. Agriculture Department

State Rankings by Acreage and Rate of Non-Federal Land Developed

1992-1997 Rank	State	1992-1997 Change in Total Land Developed (Acres)	1992-1997 Average Annual Conversion Rate (Acres)	1982-1992 Rank	1982-1992 Change in Total Land Developed (Acres)	1982-1992 Average Annual Conversion Rate (Acres)
1	Texas	1,219,500	243,900	1	1,392,500	139,250
2	Pennsylvania	1,123,200	224,640	10	431,100	43,110
3	Georgia	1,053,200	210,640	5	766,300	76,630
4	Florida	945,300	189,060	2	1,163,100	116,310
5	North Carolina	781,500	156,300	3	935,800	93,580
6	California	694,800	138,960	4	800,200	80,020
7	Tennessee	611,600	122,320	9	441,100	44,110
8	Michigan	550,800	110,160	7	462,300	46,230
9	South Carolina	539,700	107,940	11	400,100	40,010
10	Ohio	521,200	104,240	6	468,600	46,860
11	New York	492,400	98,480	24	225,100	22,510
12	Virginia	467,200	93,440	8	453,600	45,360
13	Alabama	445,300	89,060	14	320,900	32,090
14	Kentucky	354,100	70,820	13	362,800	36,280
15	Washington	350,000	70,000	17	288,300	28,830
16	New Mexico	348,500	69,700	26	166,300	16,630
17	Mississippi	312,600	62,520	31	144,300	14,430
18	Minnesota	311,300	62,260	21	235,600	23,560
19	Missouri	310,500	62,100	25	204,500	20,450
20	Illinois	292,200	58,440	20	246,000	24,600
21	New Jersey	283,200	56,640	16	298,600	29,860
22	Wisconsin	282,800	56,560	19	247,600	24,760
23	Massachusetts	281,500	56,300	22	233,100	23,310
24	West Virginia	275,600	55,120	34	114,100	11,410
25	Indiana	274,400	54,880	23	228,300	22,830
26	Arkansas	237,200	47,440	36	95,800	9,580
27	Oklahoma	224,500	44,900	28	156,800	15,680
28	Maryland	222,300	44,460	30	146,900	14,690
29	Arizona	199,400	39,880	12	374,600	37,460
30	Kansas	192,500	38,500	33	117,000	11,700
31	Louisiana	172,100	34,420	18	263,200	26,320

32	**Maine**	167,800	33,560	37	92,500	9,250
33	**Puerto Rico**	153,100	30,620	32	124,600	12,460
34	**Oregon**	150,400	30,080	27	164,500	16,450
35	**Montana**	122,700	24,540	42	79,600	7,960
36	**Idaho**	120,800	24,160	39	85,900	8,590
37	**Colorado**	120,300	24,060	15	307,400	30,740
38	**New Hampshire**	107,300	21,460	29	149,200	14,920
39	**Utah**	105,100	21,020	35	106,900	10,690
40	**Iowa**	102,900	20,580	45	52,300	5,230
41	**Nebraska**	81,200	16,240	46	39,200	3,920
42	**South Dakota**	76,700	15,340	44	60,600	6,060
43	**Connecticut**	63,400	12,680	40	84,200	8,420
44	**Wyoming**	52,700	10,540	48	33,700	3,370
45	**North Dakota**	49,700	9,940	38	86,000	8,600
46	**Nevada**	41,500	8,300	41	82,700	8,270
47	**Delaware**	35,100	7,020	47	35,300	3,530
48	**Vermont**	26,000	5,200	43	64,900	6,490
49	**Rhode Island**	10,200	2,040	49	26,500	2,650
50	**Hawaii**	8,700	1,740	50	23,600	2,360
	Total	**15,966,000**	**3,193,200**		**13,884,100**	**1,388,410**

Source: USDA-Natural Resources Conservation Service, 1997 National Resources Inventory

Percent of Total Land Developed

	1982-1992	1992-1997
Florida	3.37%	2.74%
Washington	0.68%	0.82%
New Jersey	6.29%	5.96%
Puerto Rico	5.68%	6.98%
Oregon	0.27%	0.24%
Rhode Island	3.96%	1.53%
Hawaii	0.57%	0.21%

Source: USDA-Natural Resources Conservation Service, 1997 National Resources Inventory

Percent of Agricultural Land

	1978	1982	1987	1992
King County, WA	3.90%	4.40%	4.00%	3.10%
Central Metropolitan San Juan	1.38%	0.88%	0.66%	1.08%

Source: King County Factbook and U.S. Agriculture Department

Place of Work by Municipality 1990

	Within Municipality	Outside Municipality
Bayamon	28687	38258
Carolina	23022	36905
Catano	1613	6884
Guaynabo	8772	22580
Toa Baja	6420	20700
Trujillo Alto	3971	15750

Sources: Estudios Tecnicos, 1990 Census

Commute to Work From Each Municipality 1990

	0-29 minutes	30+ minutes
Bayamón	26687	39712
Carolina	23896	35635
Cataño	3965	4494
Guaynabo	16419	14580
San Juan	46572	56786
Toa Baja	12076	14865
Trujillo Alto	7093	12489
Total	136708	178561

Sources: Estudios Tecnicos, 1990 Census

Appendix D: Sustainable Development Challenge Grant

Sustainable Development Challenge Grant: Puerto Rico's Road to Smart Growth

(2) Project Overview

The Universidad Metropolitana (UMET), which is part of the Ana G. Méndez University System, is a non-profit private higher education institution licensed by the Council of Higher Education of Puerto Rico and fully accredited by the Middle States Association of Colleges and Universities. Since 1995, UMET has become an environmental beacon in Puerto Rico through the development and implementation of an environmental policy and assuming an active position on environmental issues. Its Graduate School of Environmental Affairs (SEA) offers a Master's Degree in Environmental Management with two concentrations: Environmental Planning; Environmental Risk Assessment. UMET also offers a Bachelor's Degree in Environmental Science through the Science and Technology Department and a Professional Environmental Technician Certification

SEA also provides community outreach services that engage the public in environmental action. SEA is part of consortia with the New Jersey Institute of Technology's Northeast Hazardous Substance Research Center. Through this consortia, SEA is working on environmental justice issues and providing technical and scientific assistance, and environmental assessment to communities in highly contaminated areas, such as Cataño and Vieques. In May 1999, SEA was awarded one of EPA's Brownfields Job Training and Development Demonstration Pilot grants to help the disadvantaged community of Cantera Peninsula in San Juan. SEA also has a continuing education program for communities and offers courses and seminars on sustainable development like ecotourism, solid waste reduction, reuse and recycling, organic agriculture, forests and natural reserves conservation, among others. In 1990, UMET established the Institute of Environmental Education (INEDA, for its Spanish acronym) with seed money from the John D. and Catherine T. MacArthur Foundation. INEDA has developed environmental curriculum and educational training for public schoolteachers and helped create the Association of Environmental Educators. INEDA has also produced videos and books designed to raise awareness on environmental problems and sustainable development. In 1992, with EPA support, UMET established the Caribbean Environmental Information Center (CIAC, for its Spanish acronym), an information depository for environmental issues in the Caribbean Region. Located at UMET's library, it is open to the general public and provides environmental information to the community.

The activities of the first two phases of this project will occur in the San Juan metropolitan area. The last phase of the project will disseminate the results of preceding phases and will educate communities, schoolteachers, municipal leaders (government) and other constituencies both in the metropolitan area and island-wide.

The project's **five (5) goals** are: 1) to create awareness among decision makers regarding unsustainable land use and urban development patterns in Puerto Rico and its adverse effects on communities and the environment; 2) to provide communities with information and tools to promote sustainable development through proper land use planning and conservation; 3) to introduce the Smart Growth alternative in Puerto Rico, and in Spanish, as a viable solution based on local realities; 4) to propel the issue of Urban Sprawl versus Smart Growth to the top of environmental priorities for politicians, communities and industry leaders; and **5)** to establish a Smart Growth Network in Puerto Rico with public and private partners. To achieve these goals, the University proposes the following: 1) to produce, for the first time in Puerto Rico, a publication about the economic, social and environmental impact of Urban Sprawl (using the metropolitan area as an example) and the benefits of Smart Growth strategies for communities; 2) to provide affected communities in the metropolitan area the opportunity to participate in the research and development of Smart Growth alternatives; 3) to conduct, for the first time in Puerto Rico, a Smart Growth Congress in San Juan directed to key decisions makers with the participation of communities in the metropolitan area; **4**) to develop educational material that will be distributed free of charge to the metropolitan area communities about Urban Sprawl versus Smart Growth to help them prepare their own policy statement regarding this issue in order to protect their quality of life; and **5)** to offer these educational materials to communities, municipal governments and other constituencies island-wide.

Finally, the project's expected results are: 1) to initiate changes among key decision makers' unsustainable vision of growth by promoting awareness of Smart Growth alternatives; 2) to provide information and tools that will help citizens to promote sustainable development through proper land use planning and conservation; and 3) to build partnerships between decision makers and communities to increase the capacity of the communities to ensure long term environmental protection through the application of Smart Growth development approaches. We envision that the ultimate impact of this is to change the current unsustainable urban development patterns through legislative projects that provide incentives for Smart Growth and discourage Urban Sprawl.

(3) SDCG Program Criteria

A. Sustainability

A1. Smart Growth integrates environmental protection, economic prosperity and community well being at both community and island-wide levels through an integrated ecosystem approach. It links development decisions with human quality of life and promotes development that is environmentally and economically smart. Smart Growth provides for realistic and viable alternatives to Urban Sprawl such as the revitalization of urban San Juan (inner-cities), redevelopment of Brownfields (bringing jobs and economic prosperity back to the city centers); development of high density housing or cluster housing projects within determined urban growth limits (efficient use of land); expanded and improved public transportation; protection of parks, open spaces, agricultural lands and important natural reserves through proper zoning laws. All these help to maintain economic prosperity and protect the environment by reducing deforestation and destruction of habitats for wildlife, reducing water pollution from urban runoff, decreasing energy consumption and air pollution through expanded mass transit, and reducing maintenance cost of infrastructure (potable water, sewage and power lines), among many other examples.

By conducting studies and surveys, during the first stage of this project, on the economic, social and environmental impact of Urban Sprawl in the metropolitan area, we will be able to obtain valuable information for educating the public about this problem. The results of the studies and surveys will be published in a comprehensive easy-to-read publication with many visual examples. This publication will address the problems of Urban Sprawl and will teach about Smart Growth, a concept that has not yet been introduced to Puerto Rico. Smart Growth alternatives are being used with successful results in some cities and/or states in the U.S. Through this project, the SEA/UMET will be gathering and transferring important information to advance the state of knowledge about a serious island-wide environmental problem, in particular, in the metropolitan area.

During the second phase, we will hold in San Juan a Smart Growth Congress for key decision-makers from the public and private sectors with the help of our project partners. Affected communities in the San Juan metropolitan area will participate in the Congress's workshops and roundtable discussions. After the Congress, INEDA will produce an educational video with a teaching guide for communities, municipalities and schools to demonstrate the difference between Urban Sprawl and Smart Growth. The teaching guide will provide guidelines to help communities to prepare their own policy statements to protect their quality of life against Urban Sprawl (see letter of commitment from INEDA). Due to Puerto Rico's unsustainable urban development patterns and high population density, there are few natural areas and open spaces left for the enjoyment of future generations. We strongly believe that a well orchestrated educational strategy and campaign for Smart Growth is a very viable and possible solution to start changing the beliefs of persons in key positions about economic progress based on the "growth for the sake of growth" concept at community and island-wide levels.

A2. The last remaining rural and natural areas in and around the metropolitan area are disappearing at an alarming rate to accommodate "progress". New superhighways, sprawling commercial centers and single-family-housing suburban developments are displacing traditional communities. Urban Sprawl is also encroaching on the buffer zones of our forests and natural reserves and destroying wetlands. Valuable agricultural lands are being destroyed by residential and commercial developments. By bringing the issue of Urban Sprawl versus Smart Growth for the first time to Puerto Rico, we intend to start leveraging broader public and private investment in sustainable development, encouraging communities, business and government

entities to work cooperatively in integrating environmental protection in policy and decision making at all levels. This will provide future generations a chance to enjoy a better quality of life.

A3. The specific problem we will be addressing is Urban Sprawl, a problem that is affecting the environment and quality of life of many communities. In part, unsustainable land use and poor development strategies in Puerto Rico result from an increasing infrastructure of superhighways to promote ever-expanding residential, commercial and industrial corridors. "Progress" is typified by the following statement by a government official: "Most of the region covered by the new Highway 53 is undeveloped, and all one has to do is drive through it to see the open and beautiful areas that can very well be developed and likely will be in coming years, once the superhighway is completed" (*Highway to development: planning and record investments in highway systems will expand residential, commercial and industrial growth to all sectors* - Caribbean Business, Sept. 12, 1996, front page story). The government ties economic boom to new highways and officials pledge to develop additional economic corridors across the island that would take advantage of the new network of highways under, what its being called, the "Caribbean metropolis corridor" branching out from San Juan. There are five main superhighways criss-crossing the island to form the new urban growth corridors.

The significance of this problem has caused concerns among some groups of professional as shown in headlines such as *Government's urban planning under attack: architects group joining growing choir for reform in planning practices, as well as ease of permitting,* (Caribbean Business, Thursday, November 12, 1998, p. 6.) The local chapter of the American Institute of Architects (AIA-PR) passed a resolution to urge the government to halt chaotic planning. "We would like to see an increase in density in urban areas to preserve the green areas that are left" AIA-PR President said during an interview. (See letters of commitment from the AIA-PR and the *Colegio de Arquitectos y Arquitectos Paisajistas de P.R.* or the Association of Architects and Landscape Architects of P.R. - CAAPR, for its Spanish acronym.) Urban and environmental planners also agree that the present model of horizontal Urban Sprawl is unsustainable. "We are employing an imported continental model of development which presumes large areas for urban expansion when, in fact, we are an island with limited space and we should employ a model consistent with that reality" said urban planner Felix Aponte. (The San Juan Star, October 27, 1998, p. 6– *Experts: P.R. suffers from urban sprawl: densification seen as solution to poor planning*).

The problem is acute given that Puerto Rico is an island of 9, 104 square kilometers with a total population of 3.8 million. The population density of 413 inhabitants per square kilometer is among the highest in the world. In 1995, approximately 1.4 million people, 39% of the population, lived in the San Juan metro area. Due to the rapid urban growth the metropolitan area of San Juan has expanded to twelve bordering municipalities (Cataño, Bayamón, Carolina, Toa Baja, Toa Alta, Guaynabo, Trujillo Alto, Canóvanas, Loiza, Dorado, Vega Baja and Vega Alta). Also, it is projected that the population has been growing at an average rate of 2.46% every five years and will grow a total of 14.8% for the next 25 years, reaching 4.2 million inhabitants by the year 2025 (1990 census and Estudios Técnicos, Inc.)

Although the Urban Sprawl problem has been discussed in professional forums and in the media in Puerto Rico, a comprehensive study about the impacts and viable solutions has not yet been developed. Urban Sprawl and infrastructure projects in the coastal plains of the island have resulted in irreversible damage to coastal ecosystems that include estuaries, lagoons, mangroves and wetlands, as well as marine life. It has also worsened urban runoff due to the increased amount of impervious concrete surfaces. This affects not only the quality of water resources; it causes floods in coastal urban areas and communities close to rivers. As a result, the government has been carrying out hydro-modifications and is confining most of Puerto Rico's rivers in channels, but this can have adverse affects in the ecological systems of these water bodies.

In Puerto Rico construction is characterized by the use of extensive land in coastal plains and agricultural inland. Single family units of approximately 300 square meters represent 68% of all the housing constructed in the last 6 years. Another tendency during this past decade is the proliferation of mega-commercial centers along highways; there are over 22 million square feet of malls excluding parking space and hallways (Estudios Técnicos, Inc.). These unsustainable practices of land use is gradually degrading Puerto Rico's ecosystems, diminishing the possibility of achieving long-term capacity for sustainability and prosperity for local communities. "Growth for the sake of growth" has resulted in loss of green spaces, wildlife habitats; water, air and land pollution, soil erosion (environmental problems); high infrastructure maintenance costs, increasing

transportation costs due to high fuel consumption (unsustainable economic practices); displacement of traditional communities, a lost sense of community, fear due to lack of security (social problems); among other problems.

A4 . The sustainable behavior desired is the adoption of Smart Growth alternatives for the future development of Puerto Rico based on local needs and realities. This includes the revitalization of inner-cities, redevelopment of Brownfields, development of high density housing or cluster housing, improved and expanded public transportation, and zoning for the protection of parks, open spaces, agricultural lands and natural reserves. Each year, large expanses of rural and agricultural lands are permanently lost, as well as buffer zones of natural reserves. Puerto Rico can no longer afford the unsustainable use of land. The San Juan metropolitan area continues to expand beyond the twelve bordering municipalities that are already part of this big metro web. Just along Highway PR 22 from San Juan to Arecibo, more than 9,000 new single residential and commercial units are in the process of getting construction permits (El Nuevo Día, July 19, 1999, p. 94). This in spite of the fact that there were 17,387 vacant residences in the inner-city of San Juan (1990 census). This extensive and rapid use of land for urban expansion around the highways needs to be halted in order to avoid turning Puerto Rico into a sole megapoly.

A5. The Smart Growth strategy as an alternative to Urban Sprawl is based on the sustainable development concept, development that integrates environmental protection, communities and economic goals that meets the needs of present and future generations. The definition of Smart Growth is growth that interconnects development decisions with quality of life. It is a growth that serves not only the economy, but also integrates community and the environment. It recognizes an ecosystem approach to economic growth by integrating people, natural areas, resources and wildlife. Time, attention and resources are invested in restoring community life and vitality to urban centers, older suburbs and Brownfields. It is town-centered, collective transportation and pedestrian oriented. As a result, Smart Growth helps to preserves open space, valuable natural resources and many other environmental amenities by establishing limits to urban expansion.

A6. This project will gather and transfer important information to advance the state of knowledge of communities, government and other constituencies about the unsustainable land use patterns in the metropolitan area and island-wide. It will address how unsustainable land use has resulted in serious water, air and land pollution problems, and a deteriorating quality of life for many communities. It will propose solid and viable solutions based on the Smart Growth concept. This will help to promote community well-being for all people in and beyond the metro area communities by providing knowledge and tools to promote Smart Growth. Communities affected by Urban Sprawl in the metropolitan area will be able to benefit directly from this project by providing valuable information to the research team, by participating in the organization of the Smart Growth Congress and the roundtable discussions and/or workshops. The communities will also benefit through presentations and free educational materials to promote sustainable land use practices in their areas.

A7. The purpose this project's activities are to improve the quality of the environment of the communities, starting in the San Juan metropolitan area. Smart Growth does not exhaust or degrade the environment or shift environmental problems to other communities. On the contrary, Smart Growth integrates environmental protection, economic prosperity and community well-being at both community and island-wide levels through an integrated ecosystem approach as explained before. Smart Growth in the San Juan area will be positively reflected in communities through the island that currently are burdened by Urban Sprawl problems. With the help of some of our partners in the last phase of this project, we will make presentations in different communities using the educational video and teaching guide. We will also be able to transmit the video through Channel 40, our non-profit educational T.V. station and broadcast on INEDA's weekly environmental education radio program in WKVM.

A8. Smart Growth is being proposed as a solution to Urban Sprawl in Puerto Rico. Smart Growth is a long-term economic development strategy that spurs economic vitality through the revitalization of in inner cities, old urban areas and Brownfields redevelopment. Through clustered and higher-density housing and urban growth limits through zoning, Smart Growth helps protect natural open spaces, parks and rural areas. This will help guarantee economic vitality for present and future generations through a more sustainable use of natural resources (renewable and non-renewable), and by protecting traditional communities and the environment.

A9. The Smart Growth concept is a new solution to the urgent problem of Urban Sprawl in Puerto Rico due to our high population density and unsustainable land use patterns. Whereas semi-rural communities bordering the metropolitan area have historically enjoyed a good quality of life, physical security and green open spaces, they are currently suffering from serious deterioration of their environment due to urban sprawl (see letters of commitment from Citizens to the Rescue of Caimito and Communities Against Route 66). Watersheds, whose streams and rivers emerge from many of these upland rural zones, are being impacted by severe erosion problems due to uncontrolled deforestation and construction, thus affecting the water quality and quantity in metro areas. Also, urban communities are struggling to save the last green spaces left within the city to help improve inner-city environment.

A10. Smart Growth is a concept that is successfully being implemented in some states in the U.S. to control unsustainable growth. This concept has not yet reached Puerto Rico. Smart Growth strategies that have been used, for example, in Portland- Oregon, New Jersey and Seattle are having very positive results. In Puerto Rico we do not need to reinvent the wheel. The investigative and research phase of this project, in addition to studying the economic, social and environmental impact of Urban Sprawl in Puerto Rico, will use and adapt tools that are being used for Smart Growth initiative elsewhere. The result of the study will be published in the educational publication ***Puerto Rico's Road to Smart Growth: A Primer***, following the lead of publications such as *Why Smart Growth: A Primer* of the Smart Growth Network and the International City/County Management Association, and *The Economic Benefits of Parks and Open Spaces: How Land Conservation Helps Communities Grow Smart and Protect the Bottom Line* of The Trust for Public Lands. We will establish contacts and access to case studies and publications, as well as speakers for the Smart Growth Congress through the Smart Growth Network and Mr. Geoff Anderson at EPA's Office of Policy in Washington, D.C. EPA's Brownfields Program Initiative, including the Caribbean Environmental Protection Division, can also provide us with important information and contacts.

(B) Community Commitment and Contribution

B1. Two of our partners are grassroots communities that are currently being affected by poor urban planning and sprawl (Citizens to the Rescue of Caimito and Communities Against Route 66). These communities are a representation of other communities in the metro area and island-wide. The Office of Special Communities (OSC) of the Municipality of San Juan is dedicated to social projects in 52 communities in the metropolitan area. The Caribbean Environment and Development Institute (CEDI), a non-profit environmental organization, works directly with different communities around the island to help them protect their environment through sustainable development projects and activities. INEDA has been a provider of environmental training and educational materials to hundreds of public schoolteachers and it helped to create the Association of Environmental Educators. Puerto Rico Senator Kenneth McClintock has an important role in the implementation of policies that can help to control the Urban Sprawl problem. The American Institute of Architects, P.R. Chapter (AIA-PR) and the *Colegio de Arquitectos y Arquitectos Paisajistas de P.R* (CAAPR) are two prestigious professional organizations that represent important private sector leaders responsible for the development of Puerto Rico. Arch. Edward Underwood Ríos, AIA, is member of the City Council for the Municipality of San Juan.

B2. In the first phase of the project, ten (10) communities in the metropolitan area will participate in meetings and/or workshops about Urban Sprawl problems in their areas. Two of our partners, CEDI and OSC, with the help of SEA and Estudios Técnicos, Inc., our research partner, will gather information about the communities' concerns and to discuss possible solutions. The information gathered during these meetings will be used as references and case studies for the economic, social and environmental impact analysis of Urban Sprawl. The communities will receive free copies of the educational publication (*Puerto Rico's Road to Smart Growth: A Primer*) that will be produced from the results of the studies and the recommended Smart Growth alternatives. The communities that participated in the first phase will also participate in the second phase of the project by helping to coordinate and conduct the Smart Growth Congress for decision-makers. Community leaders will be part of the Congress' Organizational Committee and will help to conduct roundtable discussions during the Congress. During the third phase, the participating communities and the other communities in the San Juan metro area represented by OSC, will receive the free video and a teaching guide produced by INEDA about

Urban Sprawl versus Smart Growth. Meetings will be held in the communities to present these educational materials with the help of CEDI and OSC. After the presentation, a discussion session will be held to help the communities define their own policy statement for Smart Growth. In addition to the metropolitan communities, these educational materials will also be presented and distributed for free to key community and municipal leaders, as well as schoolteachers around the island. INEDA will look for new funds to keep reproducing additional copies of the video and teaching guide, and the publication *Puerto Rico's Road to Smart Growth*: *A Primer*, in order to offer to the general public at minimum costs after EPA's grant funds are expended (see INEDA's letter of commitment).

B3. This project has three partners that have legal and regulatory authority to implement solutions to the Urban Sprawl problem. One is PR Senator Kenneth McClintock, Chairman of the Council of State Governments. After the Smart Growth Congress and the publication of the studies, the Senator will hold public hearings on the project's results to publicize our efforts (see letter of commitment). This will encourage legislative projects that provide incentives for Smart Growth and disincentives for Urban Sprawl. The Office of Special Communities (OSC) of the Municipality of San Juan represents the Executive Office of the municipal government and is a key link to San Juan's metro communities. OSC can recommend and implement important municipal regulatory reforms for the benefit of the communities. Arch. Edward Underwood Ríos, City Council Member for the Municipality of San Juan, can propose and help implement new urban policies to encourage Smart Growth.

B4. After the production of the video and the teaching guide about Urban Sprawl versus Smart Growth, CEDI and OSC, with the help of SEA/UMET will coordinate presentations and distribute a free copy to each affected community in the metro area. Other key communities and schools around the island will later receive a free copy of this educational tool (500 copies will be produced). Presentations will be made with the collaboration of the partners in key communities around the island. INEDA will seek additional funding to continue to reproduce these educational materials, including the publication *Puerto Rico's Road to Smart Growth*: *A Primer* for schools and the general public.

With the multi-disciplinary team of partners for this project - AIA-PR, CAAPR, CEDI, the Municipality of San Juan and INEDA, SEA plans to start a local Smart Growth Network, following the footsteps of this movement in the U.S. Through this local Smart Growth Network, and with the support of SEA/UMET's administrative and physical facilities, we will hold continuing education courses, workshops, roundtable discussions and seminars for government officials, professionals and communities about Smart Growth alternatives. This will include the open discussion of legislative and municipal incentives. Additional funding resources will be sought for the continued publication of educational materials and to bring U.S. and international speakers.

(C) Measurable Results and Evaluation

(C1). Short-term objectives (18 months period): **1)** Produce, for the first time in Puerto Rico, 5,000 copies of the educational publication *Puerto Rico's Road to Smart Growth*: *A Primer*. **2)** Provide ten (10)-affected communities in the metropolitan area the opportunity to participate in the research and development of Smart Growth alternatives. **3)** Conduct, for the first time in Puerto Rico, a Smart Growth Congress in San Juan for key decisions makers with the participation of key metro area communities. **4)** Produce and distribute free of cost 500 copies of the educational video and teaching guide about Urban Sprawl versus Smart Growth, as well as the publication *Puerto Rico's Road to Smart Growth*: *A Primer,* to at least 30 of the 52 metropolitan area communities represented by OSC. **5)** Make this educational material available to other communities and municipalities island-wide, schoolteachers, business leaders, and other constituencies through INEDA and CEDI. We will disseminate this educational information through INEDA's weekly environmental education radio program and through Channel 40, the university non-profit T.V. station.

The expected results of these objectives are: 1) to start changing key decision makers' unsustainable vision of growth and progress by making them aware of Smart Growth alternatives and their economic, environmental and social benefits; 2) to provide communities with information and tools to promote sustainable development through smart land use planning and conservation; 3) to build partnerships between decision makers and

communities to increase the capacity of the communities to ensure long term environmental protection through the application of Smart Growth approaches.

The project's long-term objectives or contribution to sustainability are: **1.** to verify, through the news, public hearings and personal contacts that communities are using Smart Growth alternatives to improve their quality of life through negotiations, public participation and meetings with developers and/or heads of government agencies; **2.** to document the approval of sound legislative projects that will provide incentives for Smart Growth and disincentives for Urban Sprawl; **3.** to record evidence through public forums, hearings, siting permits, news media, etc., that Smart Growth alternatives are being adopted and implemented by key politicians, industry leaders, regulatory agencies, as well as news media through reporting related to environment and development; **4.** to initiate a Smart Growth Network with private and public partners.

C2. This is not a planning or visioning proposal. This proposal has specific goals and objectives, and benchmarks that will help us to achieve desired results on a short term and long term basis.

C3. The project's three phases have specific time frames and deadlines that will serve as evaluation benchmarks and measurements of success. These phases are: **1)** the research and development phase to produce 5,000 copies of the educational publication *Puerto Rico's Road to Smart Growth: A Primer*; 2) the Smart Growth Congress; and, 3) the production of 500 copies of educational material (a video and teaching guide). The completion of each of these phases represents a benchmark and measurement of success. The participation of communities in the metropolitan area during the first phase of the project will be qualified and quantified in the evaluation process. The project goal is a minimum of ten (10) communities, including the two (2) communities who are direct partners in this project. During the second phase, we have a goal of a minimum of 250 participants in the Congress. This would include representatives of at least 10 communities in the metropolitan area; leaders from different important government agencies responsible for natural resources, environmental regulation and compliance, land use planning and construction permits; municipal governments representatives; professionals, including architects, engineers, developers, urban planners, among others. In the third stage, we will measure success by the amount of participation of at least 30 of the 52 metro communities represented by OSC in the presentations of the educational video and teaching guide about Urban Sprawl versus Smart Growth. We will also measure responses to the video and teaching guide by recording their reactions in a discussion session after the presentations.

We will be able to assess the project's contribution to sustainability by: 1. Verifying and documenting that communities are using Smart Growth alternatives for economic development and environmental protection in negotiating situations and/or public hearings with developers and/or heads of government agencies. **2.** Witnessing the approval of sound legislative projects that will provide incentives for Smart Growth and disincentives for Urban Sprawl. **3.** Providing evidence, through public forums, hearings and the news, that the Smart Growth concept is being adopted as a new development philosophy by key politicians, decision makers, industry leaders and the news. **4.** Spurring enough interest to start a Smart Growth Network with private and public partner. The media, especially the printed media, will be a key resource for the collection of these success stories over the course of time.

C4. We will transfer the information to other communities by promoting and disseminating through the mass media, INEDA's weekly radio program, and our non-profit educational T.V. station (Channel 40) the Smart Growth Congress, as well as the results of the Urban Sprawl versus Smart Growth study published in *Puerto Rico's Road to Smart Growth: A Primer.* The news media will receive copies of the publication, a press release and an invitation to the Congress. Also, through AIA-PR and CAAPR, we will be able to disseminate the information to the construction industry community. This will assure island-wide dissemination, thus transferring the experiences and knowledge attained during the first two phases of the project to other communities and key constituencies in and outside the metropolitan area. The educational material that will be produced in the third stage of the project (the video and teaching guide) will become part of INEDA's permanent environmental educational tools for schoolteachers, communities, municipalities, and the general public. A free copy of this educational material will be presented and distributed to metropolitan area communities and other island-wide communities (500 copies) with the help of CEDI, OSC and INEDA. INEDA is committed to seek additional funding to reproduce more copies of this educational material after distribution of the initial 500 copies funded with this grant, as well as the publication *Puerto Rico's Growth to*

Smart Growth. Finally, the benefits of this project will be transferred to other communities through the approval of legislative projects and/or municipal urban policies that will provide incentives for Smart Growth.

(4) Project Schedule and Time Frame (18 months period) (July 01, 2000 - Dec. 30, 2001)

PHASE 1:

Convene Project Team and Select Personnel July 01, 2000
(1st. Step)

A kick off event to convene Project Team (partners) will be held at SEA/UMET. The coordinator and secretary of the project will be selected.

Community and Project Team Discussion Groups August 01, 2000 - Dec. 01, 2001.
(2nd. Step)

Ten (10) metro area communities and the Project Team will be convening to start a network of meetings and discussion groups. The meetings will be at least one per month to assists in the research and development of the publication "Puerto Rico's Road to Smart Growth: A Primer".

Development of the "Publication" Aug. 01, 2000 - February 15, 2001)
(3rd Step)

Estudios Técnicos, Inc. will conduct the research and development in the first phase of the project, and the production of the publication with the active participation of the Project Team and the communities.

Printing of the Publication April 25, 2001
(Milestone)

After final review of the publication by the Project Team and the communities, copies will be printed for distribution at the Smart Growth Congress. Additional copies will be distributed to other communities in the metro area and island-wide, municipalities, schools, government agencies, etc. (5,000 copies).

PHASE II

Smart Growth Congress May 1-3, 2001
(Milestone)

The First Smart Growth Congress, a three-day event in San Juan, will be directed toward key decision-.makers with an active participation of the Project Team and at least 10 metro area communities.

PHASE III

Educational Material Production Oct. 01, 2000 - July 30, 2001
(1st. Step)

Video and a teaching guide about Smart Growth versus Urban Sprawl will be produced for presentations and distribution to key communities in the metro area (500 copies).

Distribution of the video and teaching guide September 30, 2001 - continuos
(Milestone)

From February to June, the video and teaching guide will be available for presentations and distribution to key communities, schoolteachers, and municipal leaders island-wide.

Final Report December 30, 2001
(Milestone)

The Project Team will prepare a final report of the accomplishment of the project and the next steps.

(5) Budget Detail

Items	EPA share	Matching Funds	Total
Salaries & Benefits	24,000.00	57,030.00	81,030.00
Art/Printing	20,000.00	5,000.00	25,000.00
Video/Teaching Guide	40,000.00		40,000.00
Meeting Expenses	33,000.00		33,000.00
Travel & Per Diem	5,000.00		5,000.00
Office Expenses	3,000.00		3,000.00
Contractors	106,360.00		106,360.00
Promotion/Event Coord.		24,300.00	24,300.00
Indirect costs	18,520.00		18,520.00
TOTAL	**249,880.00**	**86,330.00**	**336,210.00**

Match:

1. UMET/INEDA 10,770.00
2. Citizens for the Rescue of Caimitos 12,500.00
3. Communities Against Route 66 5,760.00
4. Caribbean Environmental and Development Institute (CEDI) 3,000.00
5. PR Senator Kenneth McClintock, Puerto Rico Senate 10,000.00
6. Office of Special Communities, Municipality of San Juan 9,000.00
7. The American Institute of Architects, P.R. Chapter 10,300.00
8. *Colegio de Arquitectos y Arquitectos Paisajistas de P.R.* 8,000.00
9. Underwood Architects 3,000.00
10. Estudios Técnicos, Inc. 14,000.00

TOTAL **86,330.00**