

STUDY REPORT

Initiation Package







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1 INTRODUCTION

The purpose of the Mass Transit System for the Hatillo-Bayamón (MTSHB) Alternative Analysis Study is to identify and study potential transit solutions to address the current and future mobility and connectivity problems between the north-central municipalities and the San Juan Metropolitan area of Puerto Rico. The main goal of the project itself is to provide residents, workers and visitors with a safe, efficient, economical, and integrated transit system that offers convenient and accessible mobility within the study area, supports the environment, and promotes the community's economic development.

Recent studies of the corridor, including the 2030 Puerto Rico Long Range Transportation Plan and the Long Range Transportation Plan for the North Transportation Planning Region and Urbanized Areas of Arecibo and Barceloneta-Bajadero-Florida, revealed the need for transportation improvements, including a wider range of mobility options to meet the increasing demand for travel throughout the corridor. By providing a better, more robust transit service to the communities, the MTSHB will help to reduce traffic congestion, save travel times, and optimize and stimulate significant public investments in the regional transit system. The Alternative Analysis (AA) study will consider a variety of alignment and transit technologies that would improve regional mobility and meet long-range transit needs.

This Initiation Package provides information on actual transportation problems throughout the Hatillo-Bayamón corridor, the purpose and need of the envisioned transit investments, the evaluation methodology, and the alternatives to be analyzed as part of the study process. The package is also intended to serve as a study briefing for stakeholders as well as to address the requirements of an Alternative Analysis (AA) Project Initiation Package for submittal and review by the Federal Transit Administration (FTA).

2 DESCRIPTION OF STUDY AREA

The study corridor traverses nine (9) municipalities within the north-central region of Puerto Rico; namely: Hatillo, Arcebo, Barceloneta, Manti, Vega Baja, Vega Alta, Dorado, Toa Baja, and Bayamon. In addition to these nine municipalities, the proposed mass transit system is expected to serve several other surrounding municipalities, including Camuy, Utudao, Florida, Ciales, Morovis, Corozal and Toa Alta. Together, these sixteen (16) municipalities, as shown in **Figure 1**, define the system's study area.

The corridor extends approximately 50 miles, starting in the vicinity of PR-119, near the coast in the Municipality of Hatillo, and continuing eastward to end near the existing Tren Urbano Station in Bayamón.

There are currently two alignments under consideration, one along Puerto Rico Highway 2 (PR-2) and the other along Puerto Rico Highway 22 (PR-22). Both alignments have the same termini and only differ in the route.



Figure 1 Project Study Area

Puerto Rico Highway 2 (PR-2) is the longest highway in Puerto Rico (156 miles in length) and connects San Juan and Ponce. The study corridor for this project consists of the segment of PR-2 between Hatillo and Bayamon, which is about 47 miles long. The roadway section along this portion of PR-2 is typically four lanes, widening to six lanes in some of the more urbanized areas. Within the study area PR-2 is heavily traveled and lined with roadside development for much of the corridor. The posted speed limit along this facility ranges from 25 to 50 mph, depending on the existing localized urbanization levels

The second alignment alternative being evaluated runs along Puerto Rico Highway 22 (PR-22). This is a limited access toll expressway, which was constructed parallel to PR-2 in an effort to provide relief to the overly congested PR-2. PR-22 is about 51 miles long and runs between Hatillo and San Juan; the study corridor for this project only includes the 49-mile long segment between Hatillo and Bayamon. This portion of PR-22 is typically a four lane divided highway, which widens to six lanes near Bayamon. This is a high-speed facility with a posted speed limit of 65 mph.

Both corridors serve as critical east-west corridors, linking the northern portion of Puerto Rico with the metropolitan area of the island. As such, both roadways experience significant levels of congestion during the peak periods, as explained in further sections.

According to the 2000 US Census, the 16 municipalities inside the study area hold a population of 892,000 inhabitants. The population by block group obtained from the 2000 US Census is graphically displayed in **Figure 2.** As this figure depicts, this population is concentrated along the proposed corridor.



Figure 2 Year 2000 Population

Additionally, over half of Puerto Rico's pharmaceutical industries are located in the north-central region, thus providing a large concentration of jobs in the area, particularly in the vicinity of the main east-west roadways. As shown in **Figure 3**, census block groups with the highest employment rates in the north-central region are concentrated along the PR-2 and PR-22 corridors.



Figure 3Year 2000 Employment

In terms of economic activity, the study area hosts several industrial parks, with a strong presence of the manufacturing sectors such as the previously mentioned pharmaceutical, as well as chemical and medical industries. Over the years, these companies have driven the development of the region. Therefore, in order not to hinder this socio-economic growth, it is necessary to ensure mobility and connectivity within and through the region as a means to strengthen, enhance, and maximize the opportunities.

3 THE TRANSPORTATION PROBLEM

An important step in any alternatives analysis study is to identify the problems to be addressed through said study. Due to increase in employment and population along the corridor, as well as other concentrations of activity—such as sports venues and other special generators—the existing traffic demand in the Hatillo-Bayamón corridor already exceeds the available capacity, resulting in heavy congestion problems, long delays, and reduced mobility.

Additionally, the northern municipalities of the island also show an increasing tendency in residential and commercial development, and therefore traffic congestion is only expected to worsen in the area, since there is only limited—if any—competitive transit options along the corridor.

The transportation problem can be defined in term of four basic components:

- Limited regional connectivity between activity centers
- Insufficient access to transportation for economically disadvantaged markets
- Increased transportation demand
- Roadway congestion

3.1 Limited Regional Connectivity between Activity Centers

Growth in employment and population in the study area has already caused a substantial increase in the amount of travel along the corridor in recent years. According to the Highway and Transportation Authority (HTA) of Puerto Rico, hundreds of thousands of vehicles are using the main roads of the North Central Region (*RNC* in Spanish), which as a result are congested for longer periods of time in the morning and afternoon hours. Also according to the HTA, most roads feeding PR-22 and PR-2 also maintain high flow of vehicles.

3.1.1 Major Employment Centers

As previously stated, the driving force of employment within the study area is the industries, including pharmaceutical, food and electronics. More than 220 have been identified along the study corridor. Of this total, 15 are located in Hatillo, 30 in Arecibo, 10 in Barceloneta, 23 in Manatí, 24 in Vega Baja, 16 in Vega Alta, 26 in Dorado, 40 in Toa Baja and 40 in Bayamón. The major industrial zones along the corridor are graphically displayed in **Figure 4**.



Figure 4 Industrial Zones

3.1.2 Journey-to-Work Flows (Home-based Work Trips)

In general, workers living within the study area typically also work within the study area or travel east to employment centers in San Juan. Journey-to-work flows show that of the 211,500 surveyed workers residing in the area, 69% are also employed within the study area. As previously shown in **Figure 4**, these major employment centers are located along the proposed transit corridor.

Moreover, of the remaining workers whose employment destination is outside the study area, 59% work in San Juan and its metropolitan region. In other words, the data clearly indicates that the majority of commuters either lives and works within the study area, or commutes between the residence municipality and San Juan. The Journey-to-Work data obtained from the 2000 US Census has been summarized in **Table 1.**

Table 1 Journey to Work Flows

	Workers	Percentage of Workers	Percentage of Workers Outside of Study Area
Workers Residing in Study Area	211,532		
Working in Study Area	146,195	69%	
Working Outside Study Area	65,337	31%	
Working in San Juan	38,854	18%	59%
Working Somewhere Else	26,483	13%	41%

Journey to Work Flows, 2000 US Census

Improved transit connection in the corridor will also be critical to facilitate further access to regional employment centers. For example, the municipalities with the highest number of unemployment in their labor force are Utuado (28%), Ciales (25%) and Hatillo (25%) as shown in **Table 2.** An efficient transport system can provide the unemployed person with the opportunity of seeking employment in another municipality or region. This point will be further discussed in the next section.

Table 2 Civilian Labor Force Employment

Geography	Civilian Labor Force Workers	Employed Workers	Percentage of Employed Workers	Unemployed Workers	Percentage of Unemployed Workers
Arecibo	31,684	26,342	83%	5,342	17%
Barceloneta	7,151	5,854	82%	1,297	18%
Bayamón	86,256	72,784	84%	13,472	16%
Camuy	13,102	10,142	77%	2,960	23%
Ciales	6,431	4,818	75%	1,613	25%
Corozal	10,180	9,161	90%	1,019	10%
Dorado	14,127	12,212	86%	1,915	14%
Florida	4,744	4,039	85%	705	15%
Hatillo	15,529	11,675	75%	3,854	25%
Manatí	16,966	13,006	77%	3,960	23%
Morovis	9,259	7,112	77%	2,147	23%
Toa Alta	27,223	24,631	90%	2,592	10%
Toa Baja	39,055	33,813	87%	5,242	13%
Utuado	11,264	8,120	72%	3,144	28%
Vega Alta	12,907	10,545	82%	2,362	18%
Vega Baja	19,501	15,935	82%	3,566	18%
Study Area Total	325,379	270,189	83%	55,190	17%
Puerto Rico Total	1,408,723	1,176,331	84%	232,392	16%

Civilian Workers 16 years of age and older

Data Set: 2005-2009 American Community Survey 5-Year Estimates Survey: Puerto Rico Community Survey As employment, urbanizations and activity centers continue to develop and disperse throughout the corridor; it will become even more important to provide efficient connections within and throughout the municipalities in the region. The implementation of a transit corridor will improve mobility between these activity and employment centers by providing an alternate means of travel and improving accessibility for transit-dependent public. The most desirable and feasible station locations will be identified during the alternatives analysis.

3.1.3 Existing Transit Modes Serving the Area

The north-central area of Puerto Rico does not have an organized or formal transit system with large vehicles such as buses. The only existing system of this type in the island is administered by the Metropolitan Bus Authority (or by its initials in Spanish, *AMA*). The system is operated by the Department of Transportation and Public Works of Puerto Rico, and runs mostly within the metropolitan area, reaching only two of the municipalities that are being evaluated within the study corridor (Toa Baja and Bayamón). The extent of the AMA bus routes is shown in **Figure 5**.





Figure 5 AMA Transit Routes¹

The AMA is one of three major public transportation systems serving the Metropolitan San Juan area, along with Tren Urbano--the heavy rail transit service—and the Cataño Ferry, which operates a boat service between San Juan and Cataño. Both AMA and Tren Urbano (TU) services are accessible to each other, and several TU stations have connections with a major AMA transit center. AMA is also the only public transit system in the area that serves Old San Juan. However, there is no connection of any of these services with the north-central region of the island.

The AMA bus network consists of 30 routes and 277 buses. 28 of these routes use traditional buses, two express routes use bus rapid transit (BRT) and four routes use Metrobus. The ridership is estimated at 112,000 passengers on work days. In addition, the AMA provides service for handicapped persons with physical limitations known as Call and Travel (*Llame y Viaje* in Spanish), which consists of 54 paratransit vans.

Unlike San Juan, in the north-central area only public cars (*publicos* in Spanish) and public vans (*vanes* in Spanish), are responsible for providing the service. *Publicos* and *vanes* are privately owned vehicles franchised by the government, consisting of a fixed-route transit service that has provided extensive

¹Base Year 2005 New San Juan Metro Travel Demand Model

mobility throughout the island. They reach urban and rural areas where other systems cannot access due to existing road or terrain conditions.

Vanes also travel between towns and cities, thus providing short-trip connections between neighboring cities. For many residents, they are the only mode of transportation providing access to employment, medical care, shopping centers, schools and many essential needs. These modes are an inexpensive transportation alternative for the users.

The *publico* system is overseen by the Public Service Commission (PSC). These cars generate their trips from a public terminal and the routes and times of operation are based on the needs of the residents of each municipality they serve. As shown in **Figure 6**, there are several existing public routes which connect to the PR-2 and PR-22 corridors. These *publicos* will serve as feeders to the proposed transit corridor, providing additional ridership from more remote locations.



Figure 6 Publico (Public Car) Routes

3.1.4 Special generators

Some of the major activity centers along the proposed transit corridor (or with access to it via the local *publico* transportation system) include: Ruben Rodriguez Coliseum, Juan Ramon Loubriel Baseball Stadium, Santa Rosa Mall, Science Park, Plaza del Sol Commercial Center, Interamerican University, University of Puerto Rico (Utuado), Caribbean University, Punta Salina Beach, Plantation Village, Dorado Beach, National Park of Vega Alta, Los Tubos Beach, Prime Outlets of Barceloneta, Luis

Rodriguez Olmos Baseball Stadium, Petaca Iguina Coliseum, Plaza del Atlantico Mall, Arecibo Observatory, and Camuy Caves. The location of major activity centers along the study corridor is shown in **Figure 7**.



Figure 7Activity Centers

Currently, the island's major mass transportation system, the Tren Urbano (TU), lacks a reliable feeder system to transport passengers from the north and central areas of the island to the metropolitan region. Besides supporting greater employment opportunities, this lack of interconnectivity also affects tourism. A new system will efficiently interlace the north and metropolitan areas, taking advantage of the points of interests found throughout the region (**Figure 7**), thus promoting domestic tourism.

3.1.5 Lack of Connectivity with Existing Tren Urbano

The TU is a 10.7 mile long heavy rail transit system linking Bayamón and Santurce, near Old San Juan. Phase 1 of TU was designed to bring a new mode of transportation to the most congested sections of the San Juan Metropolitan area. Phase 1 operates 18 hours a day, with trains running every eight minutes during morning and afternoon peak hours. The daily ridership on the TU is estimated to be 40,000 passengers per day. Although trains have on-board operators, the system is completely automated, with a double-track guideway. The Puerto Rico Department of Transit and Public Works (DTPW) is already planning future phases of Tren Urbano. Next phases include plans to build "TU Conexión", a medium capacity transit system that will go into service along Roosevelt Avenue. Additional future Tren Urbano lines will extend the Tren Urbano system to the Isla Verde airport, the city of Caguas, and eventually to Old San Juan, thus providing access to all major activity centers of the metropolitan region. **Figure 8** shows the Master Plan for the extension of the Mass Transit system in Puerto Rico.



Figure 8 Master Plan for the extension of the Mass Transit System in Puerto Rico

The existing TU system is mostly used during weekdays and its use is associated with the working sector and universities in the metropolitan area. A feeder system from the north will allow residents from the north-central region of Puerto Rico to access the existing TU facilities for home-base work or other purposes (education, recreation, shopping, etc.).Vice versa, the system will also allow residents of the metropolitan area to access via transit the north area of the island. This synergy between regions will augment the train ridership not only on weekdays but also during weekends.

The proposed transit corridor from Hatillo to Bayamon, in conjunction with the construction of lanes for "Bus Rapid Transit (BRT) and High Occupancy Toll Lane (HOT Lane)" from the Toa Baja Toll Plaza to the existing Tren Urbano Bayamón station—currently being proposed by the Puerto Rico Highways and Transportation Authority (PRHTA)—will extend Puerto Rico's mass transit system westward. This latter system being proposed between Toa Baja Toll Plaza and Bayamon will consist of exclusives lanes through the state highways PR-22 and PR-5. This project will also include the construction of a parking and transfer station in an area adjacent to the Toa Baja Toll Plaza. These projects will provide an alternative to move a greater number of people and reduce their travel time along the corridor.

3.2 Insufficient access to transportation for economically disadvantaged markets

The north-central area of Puerto Rico has a significant number of families below the poverty level, and over 18% of the households within the study area do not own a personal vehicle. In addition, the only available transit services (vans or jitneys and public cars) are constrained by the congestion existing along the service routes. Combined, these conditions severely restrict mobility within the region.

Island-wide, there are about 660,000 riders who use transit services daily (vans or cars or, in Spanish: *vanes* and *publicos*), and about 42% of the total trips are between the metropolitan area and the rest of the island. Specifically within the study area, most services of vans and public cars use the highly congested PR-2. Vans caught in traffic congestion provide unreliable service and passengers often experience overcrowding and extended waiting times between vans, as well as slower operating speeds and increased travel times.

Moreover, the service hours of public transport are not at par with regular work schedules since most transport operations end as early as 1:00 or 3:00 in the afternoon.

Overall, the existing transit service for this area is insufficient and primarily affects, as explained, the captive market of the economically disadvantaged.

3.2.1 Poverty Status of Families located in the Corridor Study Municipalities

Poverty level is a socioeconomic indicator that helps to identify the captive market sector for a transit system, since there is a high likelihood that families under the poverty do not have any other means of transportation.

According to 2000 Census data, about 219,000 families with very low income were identified within the municipalities encroached by the study area. As shown in **Table 3**, the majority of these families are located in the municipalities of Arecibo, Bayamón and Toa Baja, in which 44%, 28%, and 33% of the households, respectively, are below the poverty line. Furthermore, in 12 of the 16 municipalities previously listed, more than 40% of the families are reported to be below poverty level.

Geography	Total Families	Families at or above Poverty Level	Percentage of Families at or above Poverty Level	Families below Poverty Level	Percentage of Families below Poverty Level
Arecibo	23,588	13,113	56%	10,475	44%
Barceloneta	6,130	3,352	55%	2,778	45%
Bayamón	54,414	39,287	72%	15,127	28%
Camuy	8,292	4,182	50%	4,110	50%
Ciales	4,814	2,168	45%	2,646	55%
Corozal	8,756	3,847	44%	4,909	56%
Dorado	8,959	6,249	70%	2,710	30%
Florida	2,963	1,469	50%	1,494	50%
Hatillo	9,913	4,932	50%	4,981	50%
Manatí	10,914	6,112	56%	4,802	44%
Morovis	7,562	3,203	42%	4,359	58%
Toa Alta	17,796	11,383	64%	6,413	36%
Toa Baja	22,494	15,024	67%	7,470	33%
Utuado	7,780	3,547	46%	4,233	54%
Vega Alta	9,325	5,145	55%	4,180	45%
Vega Baja	15,006	8,061	54%	6,945	46%
Study Area Total	218,706	131,074	60%	87,632	40%
Puerto Rico Total	911,899	534,367	59%	377,532	41%
United States Total	75,082,471	67,677,189	90%	7,405,282	10%

Table 3 Families below Poverty Level

Poverty Status in the last 12 months

Data Set: 2005-2009 American Community Survey 5-Year Estimates

Survey: Puerto Rico Community Survey

3.2.2 Housing Units and Vehicle Available per Housing Units

Normally, the private car is the main mean of transportation used for home-based work trips, trips to colleges and universities (home-based school) and other desired destinations (home-base other and non-home based). The number of vehicles per housing unit was evaluated based on 2000 US Census data. **Table 4** lists the number of zero-car households within each municipality. There are approximately 281,000 housing units within the 16 municipalities of the study area. According to the census data collected, over 18% (or 51,800) of these households do not own a car.

Figures 9 and **10** illustrate the number of households and the average number of available vehicles per household in each census block for Year 2000. As shown in Figure 10, there is an average of less than one vehicle available per household throughout most of the study area.

Geography	Total Occupied Housing Units	Occupied Housing Units with No vehicle available	% of Occupied Housing Units with No Vehicle Available
Arecibo	31,304	6,349	20.3%
Barceloneta	7,761	1,456	18.8%
Bayamón	71,275	11,321	15.9%
Camuy	10,439	2,007	19.2%
Ciales	5,796	1,214	20.9%
Corozal	10,900	2,078	19.1%
Dorado	11,672	2,115	18.1%
Florida	3,871	666	17.2%
Hatillo	12,352	1,947	15.8%
Manatí	15,002	4,012	26.7%
Morovis	8,700	1,814	20.9%
Toa Alta	21,252	2,783	13.1%
Toa Baja	30,214	4,988	16.5%
Utuado	9,944	2,310	23.2%
Vega Alta	11,989	2,427	20.2%
Vega Baja	18,680	4,253	22.8%
Study Area Total	281,151	51,740	18.4%
Puerto Rico Total	1,213,939	251,222	20.7%
United States Total	112,611,029	9,909,977	8.8%

Table 4 Zero Car Households

Data Set: 2005-2009 American Community Survey 5-Year Estimates Survey: Puerto Rico Community Survey



Figure 9 Year 2000 Households



Figure 10 Average Number of Available Vehicles per Household²

3.2.3 Available Transit Services

Currently, the primary means of public transportation (transit) serving the study corridor are the public cars (*publicos* in Spanish) and public buses or jitneys or vans (*vanes*, in Spanish). These services are run by private operators and work on a demand basis.

As shown in **Table 5**, transportation in Puerto Rico is heavily dependent on the automobile. According to the 2000 US Census only about 3% of workers in the island uses public transportation as a means to travel to and from work. This is particularly true for the north-central area were the percentage of workers utilizing transit is only 2.5%. This is primarily attributed to the lack of available transit service throughout Puerto Rico. Nevertheless, the government has increased the investment in public transportation in an attempt to decrease vehicle dependency and road congestion.

²Data Set: 2005-2009 American Community Survey 5-Year Estimates Survey: Puerto Rico Community Survey

Geography	Total Workers	Car, truck, or van - drove alone	Percentage	Public transportation	Percentage
Arecibo	25,694	20,513	79.8%	362	1.4%
Barceloneta	5,820	3,939	67.7%	97	1.7%
Bayamón	72,243	53,132	73.5%	3,492	4.8%
Camuy	9,799	8,785	89.7%	29	0.3%
Ciales	4,753	3,340	70.3%	47	1.0%
Corozal	9,137	7,671	84.0%	101	1.1%
Dorado	12,175	9,911	81.4%	144	1.2%
Florida	4,014	2,532	63.1%	0	0.0%
Hatillo	11,388	10,073	88.5%	99	0.9%
Manatí	13,083	10,514	80.4%	278	2.1%
Morovis	7,037	5,806	82.5%	23	0.3%
Toa Alta	24,367	20,467	84.0%	437	1.8%
Toa Baja	33,378	24,453	73.3%	1,089	3.3%
Utuado	7,824	5,370	68.6%	34	0.4%
Vega Alta	10,325	7,886	76.4%	138	1.3%
Vega Baja	15,834	13,129	82.9%	325	2.1%
Study Area Total	266,871	207,521	77.8%	6,695	2.5%
Puerto Rico Total	1,163,126	884,820	76.1%	38,348	3.3%
United States Total	138,541,405	105,185,519	75.9%	6,859,705	5.0%

Table 5 Select Modes of Travel to Work

1) Estimates for Workers 16 Years and Over

2) Public Transport excluding taxicab

Data Set: 2005-2009 American Community Survey 5-Year Estimates

Survey: Puerto Rico Community Survey

The following **Table 6** shows a relation among some of the previously discussed indicators. Namely, it summarizes side-by-side the percentage of households below poverty level, the percentage of households without a vehicle, the use of transit services for home-based work trips, and the unemployment percentage of each municipality. Furthermore, the table is organized in decreasing order of poverty levels.

It can be generally observed—as expected—that the poorer the municipality, the less access to personal vehicles of their inhabitants and, and therefore the higher the unemployment. However, it is also noticeable the very low level of use of transit in those cases. This latter fact could be attributable to the lack of sufficient transit services or options for those economically disadvantaged, who are—by de facto—captive transit riders. This project, along with the implementation of a supporting feeder system from the farther areas to the corridor itself is expected to act as a catalyst to improve the economic conditions of the most underprivileged populations.

Geography	% of Families below Poverty Level ¹	% of Occupied Housing Units with No Vehicle ²	% of Transit Riders/Users ³	% of Unemployed Workers ⁴
Morovis	58%	20.90%	0.30%	23%
Corozal	56%	19.10%	1.10%	10%
Ciales	55%	20.90%	1.00%	25%
Utuado	54%	23.20%	0.40%	28%
Camuy	50%	19.20%	0.30%	23%
Florida	50%	17.20%	0.00%	15%
Hatillo	50%	15.80%	0.90%	25%
Vega Baja	46%	22.80%	2.10%	18%
Barceloneta	45%	18.80%	1.70%	18%
Vega Alta	45%	20.20%	1.30%	18%
Arecibo	44%	20.30%	1.40%	17%
Manatí	44%	26.70%	2.10%	23%
Toa Alta	36%	13.10%	1.80%	10%
Toa Baja	33%	16.50%	3.30%	13%
Dorado	30%	18.10%	1.20%	14%
Bayamón	28%	15.90%	4.80%	16%

Table 6 Relationship between Socio-economic Indicators

(1) Data from Table 3

(2) Data from Table 4(3) Data from Table 5

(3) Data from Table 3(4) Data from Table 2

3.3 Increased Transportation Demand

Between 1970 and 2000, the population along the study corridor has grown almost 60%, compared with a 40% of the entire island. Furthermore, the region is expected to continue growing another 13% from 2000 to 2025, also above the overall 10% estimated for the island. The historical population growth from 1970 to 2000 is shown in **Table 7** and the future population projections prepared by the Puerto Rico Planning Board are shown in **Table 8**. **Figures 11** and **12** provide a graphical representation of the data summarized in Tables 7 and 8, respectively.

Table / Instorical I opulation	Table 7	/ Historical	Population
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Geography	1970	1980	Change (1970- 1980)	% Change (1970- 1980)	1990	Change (1980- 1990)	% Change (1980- 1990)	1995	2000	Change (1990- 2000)	% Change (1990- 2000)	Change (1970- 2000)	% Change (1970- 2000)
Arceibo	73,468	86,766	13,298	18%	93,385	6,619	8%	100,131	100,131	6,746	7%	26,663	36%
Barceloneta	20,792	18,910	-1,882	-9%	19,409	499	3%	20,219	22,322	2,913	15%	1,530	7%
Bayamon	156,192	196,026	39,834	26%	220,262	24,236	12%	231,334	224,044	3,782	2%	67,852	43%
Camuy	19,922	24,884	4,962	25%	28,917	4,033	16%	321,891	35,244	6,327	22%	15,322	77%
Ciales	15,595	16,211	616	4%	18,084	1,873	12%	18,474	19,811	1,727	10%	4,216	27%
Corozal	24,545	28,221	3,676	15%	33,095	4,874	17%	35,812	36,867	3,772	11%	12,322	50%
Dorado	17,254	25,514	8,260	48%	30,759	5,245	21%	32,121	34,017	3,258	11%	16,763	97%
Florida		7,232			8,689	1,457	20%	8,744	12,367	3,678	42%	5,135	71%
Hatillo	21,913	28,958	7,045	32%	32,703	3,745	13%	38,122	38,925	6,222	19%	17,012	78%
Manati	30,559	36,562	6,003	20%	38,692	2,130	6%	39,770	45,409	6,717	17%	14,850	49%
Morovis	19,059	21,142	2,083	11%	25,288	4,146	20%	32,272	29,965	4,677	18%	10,906	57%
Toa Alta	18,964	31,910	12,946	68%	44,101	12,191	38%	55,338	63,929	19,828	45%	44,965	237%
Toa Baja	46,384	78,426	32,042	69%	89,454	11,028	14%	91,144	94,085	4,631	5%	47,701	103%
Utuado	35,494	34,505	-989	-3%	34,980	475	1%	35,299	35,336	356	1%	-158	0%
Vega Alta	22,810	28,696	5,886	26%	34,559	5,863	20%	36,084	37,910	3,351	10%	15,100	66%
Vega Baja	35,237	47,115	11,878	34%	55,997	8,882	19%	60,320	61,929	5,932	11%	26,692	76%
Study Area Total	558,188	703,846	145,658	26%	808,374	97,296	14%	1,157,075	892,291	83,917	10%	326,871	59%
Puerto Rico Total	2,711,899	3,196,523	484,624	18%	3,522,037	325,514	10%	3,735,127	3,808,610	286,573	8%	1,096,711	40%

Population for Year 1970 is not available for Florida, as Florida was not declared a municipality until 1971. The land and population prior to 1971 were under the jurisdiction of Barceloneta

Corridor Total change and % change in population (1970-1980 does not include Florida.

Puerto Rico 2030 Long Range Transportation Plan (August 2005), 2000 US Census

Geography	2000	2015	Change (2000- 2015)	% Change (2000- 2015)	2020	Change (2015- 2020)	% Change (2015- 2020)	2025	Change (2020- 2025)	% Change (2020- 2025)	change 2000- 2025	% change 2000- 2025
Arecibo	100,131	106,301	6,170	6%	107,093	792	1%	107,348	255	0%	7,217	7%
Barceloneta	22,322	23,769	1,447	6%	24,080	311	1%	24,434	354	1%	2,112	9%
Bayamón	224,044	228,746	4,702	2%	228,889	143	0%	230,171	1,282	1%	6,127	3%
Camuy	35,244	41,216	5,972	17%	42,763	1,547	4%	43,258	495	1%	8,014	23%
Ciales	19,811	21,578	1,767	9%	22,007	429	2%	22,382	375	2%	2,571	13%
Corozal	36,867	41,113	4,246	12%	42,070	957	2%	42,778	708	2%	5,911	16%
Dorado	34,017	37,456	3,439	10%	38,116	660	2%	38,502	386	1%	4,485	13%
Florida	12,367	16,115	3,748	30%	17,212	1,097	7%	17,414	202	1%	5,047	41%
Hatillo	38,925	45,529	6,604	17%	47,182	1,653	4%	47,800	618	1%	8,875	23%
Manatí	45,409	51,530	6,121	13%	52,893	1,363	3%	53,333	440	1%	7,924	17%
Morovis	29,965	34,803	4,838	16%	36,170	1,367	4%	37,157	987	3%	7,192	24%
Toa Alta	63,929	85,516	21,587	34%	92,109	6,593	8%	94,409	2,300	2%	30,480	48%
Toa Baja	94,085	100,515	6,430	7%	101,488	973	1%	102,927	1,439	1%	8,842	9%
Utuado	35,336	36,156	820	2%	36,166	10	0%	36,458	292	1%	1,122	3%
Vega Alta	37,910	41,979	4,069	11%	42,847	868	2%	43,527	680	2%	5,617	15%
Vega Baja	61,929	67,694	5,765	9%	68,853	1,159	2%	69,645	792	1%	7,716	12%
Study Area Total	892,291	980,016	87,725	10%	999,938	19,922	2%	1,011,543	11,605	1%	119,252	13%
Puerto Rico Total	3,808,610	4,095,642	287,032	8%	4,149,291	53,649	1%	4,177,077	27,786	1%	368,467	10%

Puerto Rico Planning Board. Population Projections 1990-2025



Figure 11 Study Area Historical Percentage Change in Population (1970-2000)³

³Puerto Rico 2030 Long Range Transportation Plan (August 2005), 2000 US Census



Figure 12 Study Area Projected Percentage Change in Population (2000-2025)⁴

3.4 Roadway Congestion

Roadway improvements have not kept pace with transportation demand resulting in increased congestion, delay, and business costs. The PR-2/ PR-22 corridor serves as the primary east-west link between north-eastern and north-western Puerto Rico, and both roadways are already experiencing major congestions nowadays.

Congested corridors also restrict transit capacity and usage. An efficient transit system will provide reduced travel times, which will in turn save costs and improve quality of life.

Mass Transit System

⁴Puerto Rico Planning Board. Population Projections 1990-2025

3.4.1 Over Capacity Roadway Facilities

Several roadway segments along PR-2 and PR-22 are currently operating over capacity (volume over capacity ratio or $V/C \ge 1$) and will continue to operate poorly into the future without the implementation of additional roadway and/or multi-modal improvements. Year 2000 and Year 2030 (Existing plus Committed Network) volume to capacity (V/C) ratios documented in the Year 2030 Puerto Rico Long Range Transportation Plan (LRTP) indicate this situation, which is also depicted in the maps provided as **Figures 13** and **14**, respectively.



Figure 13Year 2000 Volume to Capacity (V/C) Ratios⁵

⁵Source: Puerto Rico Year 2030 Long Range Transportation Plan



Figure 14 Year 2030 (Existing + Committed) Volume to Capacity (V/C) Ratios⁶

3.4.2 Travel Times

During the morning rush hours, traffic congestion on PR-2 and PR-22 occurs in the eastbound direction from Hatillo towards the San Juan metropolitan area. In the afternoon, congestion is evident in the opposite direction (westbound), from San Juan to Arecibo.

Travel times along PR-2 and PR-22 were collected and have been summarized in **Table 9**. Based upon this field data, it takes between an hour and 15 minutes to an hour and 45 minutes to travel from one end of the study corridor to the other along PR-22 depending on the peak period, which is about twice as long as it would take traveling at the posted speed limit of 65 mph. Likewise, it takes approximately two hours to travel PR-2 between Hatillo and Bayamon during the peak periods, which is also twice as long as it

⁶Source: Puerto Rico Year 2030 Long Range Transportation Plan

would take to make the trip maintaining the posted speed limit along the corridor (note that the posted speed limit along PR-2 varies considerably based upon location, ranging from 25 to 50 mph).

	AM Peak Period (minutes)	PM Peak Period (minutes)
PR-22 (48.8 miles)		
Eastbound (Hatillo to Bayamon)	105	55
Westbound (Bayamon to Hatillo)	54	75
PR-2 (50 miles)		
Eastbound (Hatillo to Bayamon)	125	99
Westbound (Bayamon to Hatillo)	94	119

Table 9 Corridor Total Travel Times

Moreover, travel times collected along PR-2 and PR-22 during the peak periods indicate that the eastern half of the study corridor (the closest to Metropolitan San Juan) experiences the heaviest congestion. Travel speeds in this portion of the PR-22 corridor fall considerably below the posted speed limit of 65 mph, with motorists traveling at average speeds of approximately 30 mph or less along the easternmost nine miles.

PR-2 experiences congestion along the entire length of the corridor, with average travel speeds reaching at most 80% of the posted speed in the peak direction during the peak periods, with the exception of two short segments where the posted speed limit is 25 mph. Moreover, travel speeds in the eastern portion of the PR-2 corridor were found to be only 20% to 60% of the posted speed in the eastbound direction during the AM peak period and 20% to 80% of the posted speed in the westbound direction during the PM peak period.

The average travel speed observed during the peak periods in the eastbound and westbound direction along PR-2 and PR-22 have been graphically illustrated in **Figures 15** through **18**.



Figure 15 PR-22 Average Travel Speed (Eastbound) AM Peak Period



Figure 16 PR-22 Average Travel Speed (Westbound) PM Peak Period



Figure 17 PR-2 Travel Speed (Eastbound) AM Peak Period



Figure 18 PR-2 Travel Speed (Westbound) PM Peak Period

3.4.3 Lack of Future Roadway Improvements and Alternate Routes

As previously mentioned, the existing PR-2 is heavily traveled and lined with roadside development for much of the corridor, making it difficult to upgrade it to expressway standards. For this same reason, further widening of PR-22 is also unlikely due to the physical constraints. Furthermore, the topography surrounding the PR-2/PR-22 corridor consists of environmentally sensitive limestone karst and mountainous areas to the south, and wetland areas along the northern coast. These topographical features create obstacles in indentifying a feasible route for an alternate east-west corridor.

There are three roadway improvement projects to PR-2 and PR-22 within the study area identified in the Year 2030 Long Range Transportation Plans (LRTP) for Puerto Rico (Island-wide) and Puerto Rico's North Transportation Planning Region and its Urbanized Areas (Arecibo, Barceloneta, Bajadero, Florida). The LRTP roadway projects are summarized in **Table 10**.

There are two short term projects to rehabilitate the pavement and provide safety enhancements to the existing PR-22 roadway facility. In addition, according to the Puerto Rico Island-wide and North Transportation Planning Region 2030 LRTPs, there are some mid-term plans for a potential extension of PR-22 from Hatillo to Aguadilla, either running roughly parallel to PR-2 or by upgrading PR-2 itself (or a combination of both options). However, there are several environmental issues that could impact this project. There are no long term roadway projects identified in either LRTP for PR-2 and PR-22.

Term	Municipality	Roadway	Project Description
Short	Arecibo / Barceloneta	PR-22	Pavement Rehabilitation
Short	Arecibo / San Juan	PR-22	Safety Improvements and Rehabilitation of Ramps
Intermediate	Aguadilla / Hatillo via Moca, Isabella, Quebradillos, and Camuy	PR-2/22	New six-lane toll road

Table 10 Year 2030 LRTP Projects

The Long Range Transportation Plan for the North Transportation Planning Region (March 2006) Puerto Rico Year 2030 Long Range Transportation Plan (August 2005)

4 EVALUATION MEASURES

4.1 Methodology

The evaluation framework for the MTSHB Alternative Analysis Study will be based on a set of goals and objectives and will address several important factors such as:

- Environmental impacts
- Transportation Impacts
- Cost effectiveness
- Potential for economic growth
- Community support

Understanding the transportation problem will enable stakeholders to move forward with the process of defining and refining the potential alternatives. This process included:

- Reviewing previous planning and engineering studies related to the project.
- Establish a set of goals and objectives and evaluation measures that address the purpose and needs.
- Identify a universe of initial alignments and transit technology alternatives.

4.2 **Project Goals and Objectives**

Based on the issues discussed in the Problem Statement, eight goals were established for the study. These goals will be used in the planning, development, screening, and evaluation of alternatives, and are as follows:

- Improve the mobility and connectivity within the north-central region;
- Improve inter-regional access;
- Provide a major expansion to the capacity of the public transit service;
- Improve the public transit service efficiency, convenience, and reliability;
- Minimize the impacts on the environment;
- Support the economic growth in the north-central region;
- Reduce roadway congestion;
- Serve as a feeder system to the existing Tren Urbano

In order to evaluate the alternatives in a qualitative form, these goals were further formulated as a set of objectives. Using these objectives, the alternative's ability to meet the study's goals would be assessed. The objectives were then assigned a set of measures of effectiveness (MOEs) that would allow the quantitative assessment of each alternative. **Table11** presents these goals, objectives, and evaluation measures to be used as part of the analysis and screening of alternatives.

Although each stage of the study will have its specific metrics, all stages will be tied back to this set of goals and objectives that defines what the recommended alternative should accomplish in the Alternative Analysis.

Table 11 Goa	ls, Objectives,	and Evaluation	Measures
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Goals	Objectives	Evaluation Measures
1. Improve the mobility and connectivity within the North Central Area	 To provide a better connectivity between the municipalities. To provide better access to major employment, educational, recreational and cultural activities within the area. To improve access for students and transit-dependent populations. To improve the mobility along the municipalities within the area. 	 Population & employment Concentrations Served Transit Dependent Populations Served Average Transit Trip Length and Duration
2. Improve the regional access	 To provide a faster access to a variety of locations within the region through an alternative system, other than the use of private cars. To integrate the multi-modal system on a local and regional level. 	Number of High Activity Centers ServedService TimesUser Benefits
3. Provide a major expansion in the capacity of the public transit service	 To significantly expand and improve the public transportation services for all people, particularly the disabled and mass transit dependents. Attract new riders to the proposed transit system. 	Passengers per HourSystem CapacityNew riders
4. Improve the public transit service efficiency, convenience, and reliability	 To provide service at a competitive travel time and cost. To provide an efficient transport system; a convenient and reliable way in which users can reach their destinations in a real travel time. To integrate the system to the transportation services in the area. 	 Directness of Route Trip Travel Times Park and Ride Capacity/Availability System Linkages/Integration
5. Minimize the impact on the environment	 To provide a cost-effective transportation thus reducing dependency on automobiles and improving the air quality. To provide a transit solution that minimizes adverse impacts. To minimize the impact to historic, archaeological, cultural places, parklands, wetlands and other sensitive areas. To meet or exceed all environmental requirements established by the regulatory and permitting agencies. 	 Air quality impacts Environmental impacts Impacts on historic, archaeological, cultural, parklands, wetlands and other sensitive areas
6. Support the economic growth in the North Central Area	 To provide more transportation capacity to support the economic growth of the area. To provide the construction industry with an economic stimulus and support a long-term economic renewal in urban centers. To attract new industries and businesses to settle in the area. 	 Land Uses that support Transit Consistency with Present and Future Area development Plans System capacity Service Times
7. Reduce roadway congestion.	 To provide a travel option that avoids roadway congestion in the area. To reduce traffic congestion along PR-22 and PR-2. 	 Use of existing Infrastructure Cost per Rider Trip travel Times
8. Serve as a feeder system to the existing Tren Urbano	 To improve accessibility to Tren Urbano To increase ridership on the Tren Urbano and other connecting mass transit services. 	Tren Urbano increased ridership

5 CONCEPTUAL ALTERNATIVES

This section provides an overview of the alternatives that will be considered, including the alignments and transit technologies to be developed and evaluated as part of the Hatillo-Bayamón corridor. For each alternative, the location of the stations will be determined by the following factors:

- Land Availability
- Vehicular and Pedestrian Access
- Compatibility with adjacent Land Use and Plans
- Local traffic Characteristics
- Local Environmental Characteristics
- Degree of Community Acceptance

5.1 Summary of Conceptual Alternatives

A series of alternatives will be evaluated as part of this Alternatives Analysis, including a No Build (or Baseline) alternative, Transportation System Management (TSM) alternative, and three potential alignments (Build) alternatives. As part of the Alternatives Analysis, the alternatives will be further defined as part of the *Conceptual Definition of Alternatives Report*. Notwithstanding, a brief summary is provided below.

5.1.1 No Build and Baseline Alternatives

For comparison purpose to potential build alternatives, a No Build Alternative (NBA) will be developed. The NBA includes the existing transportation network and the roadway improvements as per the Long Range Transportation Plan for Puerto Rico (2030). It will also reflect future conditions if no new actions are taken to assist the objectives of the proposed project.

5.1.2 Transportation System Management (TSM)

The Transportation System Management alternative consists of a bus service in mixed traffic.One alternative will begin in the municipality of Hatillo, being the first one along state road PR-2 while the second one will be along the José de Diego Expressway (PR-22) until it reaches the municipality of Bayamón. In these alternatives, transit services will be integrated with the existing Tren Urbano system at the Bayamón Station. The buses will be similar to those used for general transit service.

The TSM Alternatives involves the construction of transfer stations and a "Storage and Maintenance Facility". Transportation infrastructure for the system will not be considered.

5.1.3 Build Alternative - PR-2 Alignment

For the PR-2 Alternative, the alignment begins in the town of Hatillo and runs along state road PR-2 through the municipalities of Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja and

Bayamón as shown in **Figure 19**. The alternative will be connected through a transfer station in the town of Bayamón near the existing Tren Urbano's Bayamón Station.

The PR-2 Alternative involves the construction of new major transportation infrastructure for the system, including transfer stations and a Storage and Maintenance Facility.

5.1.4 Build Alternative - PR-22 Alignment

The alignment will run along the median strip of state road PR-22 beginning in the town of Hatillo, throughout the municipalities of Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, and Bayamón as shown in **Figure 19**. This alternative will be connected by means of a transfer station in the town of Bayamón near to the existing Bayamón Station of the Tren Urbano.

The PR-22 Alternative involves the construction of new major transportation infrastructure for the system, including stations and a Storage and Maintenance Facility.

5.1.5 Build Alternative - Intermediate Alignment

The proposed alignment for this alternative will begin in the town of Hatillo and goes eastward through the municipalities of Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, until it reaches the municipality of Bayamón. This alignment will run along PR-2, PR-22 and a combination of both.

Intermediate Alternative involves the construction of complete new major transportation infrastructure for the system, including stations and a Storage and Maintenance Facility.

Figure19 Conceptual Alternatives



5.2 Potential Transit Technologies

Possible transit technologies to be considered in the Hatillo-Bayamón corridor include: Bus Rapid Transit, Light Rail Transit and Heavy Rail Transit. The traditional Bus Transit service of fixed route buses will be only included as part of the TSM Alternative:

5.2.1 Bus Rapid Transit (BRT)

A Bus Rapid Transit is a bus service with rubber tires that connects major activity centers. The purpose of the system is to serve a geographic area with a high frequency of service through a simple route on a street lane reserved for the exclusive use of the BRT. These are low-floor cars and have multiple doors exit/entry to facilitate boarding. The BRT can accommodate approximately 80 passengers and can use intelligent transportation system technology, traffic signal priority and rapid fare collection to optimize the operation of the bus system.



5.2.1.1 Bus Rapid Transit Alternative at PR-2

The BRT Alternative along PR-2 will consider a bus rapid transit technology system utilizing rubber tire rapid transit. The alignment is anticipated to operate on a new exclusive lane for the entire length of the route.

5.2.1.2 Bus Rapid Transit Alternative at PR-22

The BRT Alternative along PR-22 will consider a bus rapid transit technology system utilizing rubber tire rapid transit. The alignment is anticipated to operate on a new exclusive lane for the entire length of the route through the median strip of PR-22.

5.2.1.3 Bus Rapid Transit Intermediate Alternative

The BRT Alternative will consider a bus rapid transit technology system utilizing rubber tire rapid transit. The alignment is anticipated to operate on an elevated/street running exclusive lane for the entire length of the route.

5.2.2 Light Rail Transit (LRT)

Light Rail Transit (LRT) is a very flexible rail transit solution that can be applied in a wide range of situations from exclusive right-of-way to the simpler street-running solutions on rails embedded in pavement. Vehicles can be equipped with low floors to allow street-level boarding



depending upon the required application.

A LRT is designed for low speed and light loads, and can accommodate approximately 120 passengers.

5.2.2.1 Light Rail Transit Alternative at PR-2

The LRT Alternative will consider a light rail transit system operating in an exclusive right-of-way. Elevated sections will be considered in major intersections. The at-grade section will be operated in a separated lane.

5.2.2.2 Light Rail Transit Alternative at PR-22

The LRT Alternative will consider an elevated/street running light rail transit system operating in an exclusive right-of-way through the median strip of PR-22.

5.2.2.3 Light Rail Transit Intermediate Alternative

The LRT Alternative will consider an elevated/street running light rail transit system operating in an exclusive right-of-way.

5.2.3 Heavy Rail Transit (HRT)

Heavy rail is defined as an intra-city train transport system which runs on dedicated tracks which have a separate right of way. Because heavy rail tracks run on a separate right of way, the train rarely has to deal with vehicle traffic. A HRT can accommodate approximately 190 passengers and runs at regularly scheduled times.



5.2.3.1 Heavy Rail Transit Alternative at PR-2

This HRT Alternative will consider an elevated Heavy Rail Transit (HRT) system operating in an exclusive right-of-way.

5.2.3.2 Heavy Rail Transit Alternative at PR-22

The HRT Alternative will consider an elevated/street running Heavy Rail Transit (HRT) system operating in an exclusive right-of-way running through the median strip of PR-22.

5.2.3.3 Heavy Rail Transit Intermediate Alternative

The HRT Alternative will consider an elevated/street running Heavy Rail Transit (HRT) system operating in an exclusive right-of-way.

6 NEXT STEPS

Early coordination with FTA and regional stakeholders will occur to gather input to perform the study. The primary tasks associated with the early study phases include the following:

- Project Management Plan
- Public Engagement Plan
- Initial Data Collection
- Establishing Goals and Development of the Universe of Alternatives
- Developing a Preliminary Purpose and Need

6.1 Project Management Plan

A complete and accurate plan will be customized for this specific project and will be followed to ensure that the project is conducted in accordance with Client's standards. The plan will define the roles and responsibilities of all parties involved, including the individual members of the consultant team and their commitment to the job.

6.2 Public Engagement Plan

Public participation is based on the belief that people who are affected by planning decisions of a transport system have the right to participate in the decision-making process. The direct participation of citizens in this process promotes the successful resolution of problems and promotes the participation of diverse voices, thus providing with new ideas, giving the public a sense of ownership of the developed solutions. An extensive Public Engagement Plan (PEP) will be conducted as part of this study and will include input from the general public and project stakeholders (e.g., adjacent neighborhoods, business owners, etc.) and local, regional, state and federal agencies. The purpose of this PEP is to inform the community about the study's progress and to actively seek and incorporate input from the public into the decision-making process to assure that the project meets the needs of the community.

6.3 Initial Data Collection

This task will involve the development of the study area boundaries, as well as research all available documentation and reports.

6.4 Establishing Goals and Developing a Preliminary Purpose and Need

This task involves the development of the goals and objectives, culminating in the drafting of a preliminary Purpose and Need Statement. The Purpose and Need Statement will guide the refinement and development of alternatives and provide documentation for inclusion in the AAin accordance with federal and Commonwealth requirements.

6.5 Development of the Universe of Alternatives

Developing a universe of potential alternatives, which will be later narrowed into the set of alternatives carried into the Tier 1 screening phase of the project.

If you have any questions or would like follow-up information, please contact:

Mrs. Esther Ruiz

Municipality of Barceloneta