An Assessment of Acuaexpreso: The Urban Ferry System in San Juan

by

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Submitted to the Department of Civil and Environmental Engineering
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Abstract

The island of Old San Juan (Puerto Rico) is facing severe traffic congestion in the next decade as travel demand and auto use increase. The bridges to the island are of limited capacity, and also need to be reconstructed due to age. The construction of a tunnel and the extension of *Tren Urbano,* a heavy rail system now under construction in the city, are probable long term solutions, while in the short term the bus system is being reorganized and other policies are being followed to encourage travelers to switch to modes other than the automobile. These strategies will have some effect, but are still limited by the capacity of the road and bridge network.

An alternative to these land-based systems is *Acuaexpreso,* an urban ferry system connecting Old San Juan with the rest of the city. While this system has been experiencing declining ridership and increasing costs, the need to provide alternate means of transportation to Old San Juan offers the system an opportunity to play a greater role in the urban transportation network. In addition, the first phase of *Tren Urbano* and the reorganization of the San Juan transit services will lead to better integration of all the public transit modes, potentially increasing ferry ridership as one of the first phase rail stations will be immediately adjacent to an *Acuaexpreso* terminal.

Acuaexpreso currently operates two routes, and analysis of the ridership market and service cost comparison indicate that retention of the Cataño - Old San Juan ferry route is clearly justified, however the continued operation of the Hato Rey - Old San Juan route is questionable due to its poor performance and level of service compared to other transit options. Based on a review of other urban ferry systems, the performance of both systems could be improved by means of service changes and increased integration with other modes. Changes in the schedule of operation for both routes are analyzed, increasing frequency to increase service attractiveness or in the case of the Hato Rey route reducing service to peak period operation only or suspending operation entirely. Schedule and fare integration with other modes is recommended for the system, especially after the inauguration of *Tren Urbano*. Strategic options for *Acuaexpreso* also include the sale of some of its currently underutilized fleet, and the purchase of smaller replacements that might improve the efficiency of the fleet. A timeline of recommendations is provided, including near term service changes and long term strategies for implementation following the completion of the first phase of *Tren Urbano*. Finally, possible contracted private operation for *Acuaexpreso* is considered, as well as a different organizational arrangement to provide needed expertise and increase transit integration.

The ultimate objective is to provide information that will be of benefit to transportation planners in San Juan, and that will lead to better transportation service in San Juan.

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Glossary

Acuaexpreso	The urban ferry system in San Juan, Puerto Rico
ACT	The Puerto Rico Highway and Transportation Authority Autoridad de Carreteras y Transportación
ADA	American Disabilities Act
AMA	Metropolitan Bus Authority Autoridad Metropolitana de Autobuses
BHCS	Boston Harbor Commuter Services, an urban ferry company in Boston, MA.
CSP	The Público Service Commission Comision de Servicio Público
DTOP	The Puerto Rico Department of Transportation and Public Works Departamento de Transportación y Obras Públicas
FTA	The Federal Transit Administration, formerly known as the Urban Mass Transit Administration (UMTA)
MBTA	Massachusetts Bay Transit Authority
NYCDOT	New York City Department of Transportation
POF	Passenger-Only Ferry
RVH, RVM	Revenue Vehicle Hours, Revenue Vehicle Miles
SJMA	San Juan Metropolitan Area
WSF	Washington State Ferry

1. Introduction

The purpose of this thesis is to analyze transportation service to and from the island of Old San Juan. In particular, the efficiency and effectiveness of the San Juan ferry system, *Acuaexpreso* will be examined, offering as it does an alternative to the geographically limited land routes. Analysis will concentrate on (1) identifying features of the present day transportation alternatives, (2) comparing *Acuaexpreso* with other transportation systems in San Juan, both in the short run and after the completion of *Tren Urbano*, the rail system now under construction, (3) examining similar aspects of other urban ferry systems in North America, and (4) using the information to assess potential futures for *Acuaexpreso*. The ultimate objective is to provide information that will be of benefit to transportation planners in San Juan, and that will lead to better transportation service in San Juan.

1.1 Problem Definition

1.1.1 The Context

San Juan is the largest city on the island of Puerto Rico, located on the northern coast, and contains roughly 37% of the 3.5 million inhabitants of the entire island. The greater San Juan Metropolitan Area (SJMA) is experiencing population and employment growth, resulting in increasing demand for transportation. While part of this increased demand has been met through highway construction, this is no longer an option within the developed portions of the city, placing a limit on road capacity. In addition, rapid growth in car ownership and use has lead to increasing congestion within the city, generating a need for other solutions.

In response to the need for transportation alternatives in San Juan, the government of Puerto Rico has begun construction of *Tren Urbano*, a heavy rail system providing mass transit within the metropolitan area. The first phase of *Tren Urbano* is scheduled for completion in 2001, and the introduction of the rail system presents San Juan with the

opportunity to restructure its overall transportation network. The integration of existing transit modes with *Tren Urbano* has the potential to significantly improve urban travel conditions in the SJMA, increasing accessibility and providing greater personal mobility.

Three extensions for *Tren Urbano* are being planned which, when complete, will provide a rapid mass transit system covering the major municipalities of the SJMA. One of these extensions will eventually provide service to the small island (or islet) of San Juan. However, this extension of the rail system is still a considerable time in the future, and there is need for improved transportation in the meantime.

The islet of San Juan, the Isleta de San Juan, lies north-west of the center of the city, protecting the bay and harbor to its south. The Isleta is approximately two miles long and three-quarters of a mile wide, stretching from east to west. The original fortified city of Old San Juan occupies the western end of the Isleta and marks the colony established by the Spanish. Old San Juan is a major attraction for the tourist industry, which provides a major source of revenue to Puerto Rico as a whole. The rest of the Isleta is occupied by government offices, hotels, parks, and residential areas.

As an island, the Isleta is naturally limited by geography in terms of access from the rest of the city. Land access to the Isleta is limited to three bridges, all located at the south-east corner, forming a bottleneck through which all road traffic to and from the Isleta must move.

The Isleta is facing two major transportation problems in the near future. As a tourist and government center, the daily traffic to the Isleta and Old San Juan is expected to grow by close to 50% over the next decade.[1] Already a source of congestion and delay, current traffic predictions estimate that the bottleneck formed by the three bridges to the city will become hopelessly congested with automobile traffic by 2003.

The second problem the Isleta faces is that these three bridges will all need major reconstruction work within the next decade. The reconstruction or replacement of these bridges threatens to create additional major delays for traffic to and from the Isleta.

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[1] Steer, Davies & Gleave. *El Triángulo Dorado: Phase II - Final Report*. Executive Summary. From a 1996 base, [] development suggests traffic demand will increase by 46% by the year 2005 and 113% by 2015. [...] Projections indicate that between 2002 and 2005 the existing configuration will fail.

The capacity of the bridges and the adjoining road network being limited, the Puerto Rico Department of Transportation and Public Works (DTOP) is studying the possibility of expanding capacity by constructing a fully grade-separated tunnel to the Isleta. While this may be a satisfactory solution, construction is still some time in the future, and other more immediate strategies have focused on attempting to reduce demand by offering alternatives to automobile use. In addition, policies such as stricter parking ordinances have also been introduced to influence auto use, but with only limited effectiveness.

Currently, however, the major focus for alleviating congestion at the bridge bottleneck is on improving the bus network, which is being reorganized in support of the future introduction of *Tren Urbano*. The buses operate on exclusive bus lanes and offer some potential of reducing the demand on the road network, but are still confined to the same roads as automobile traffic at every cross street and also while traversing the bridges. They thus face many of the same delays as auto users, and the necessary bridge reconstruction poses particular problems.

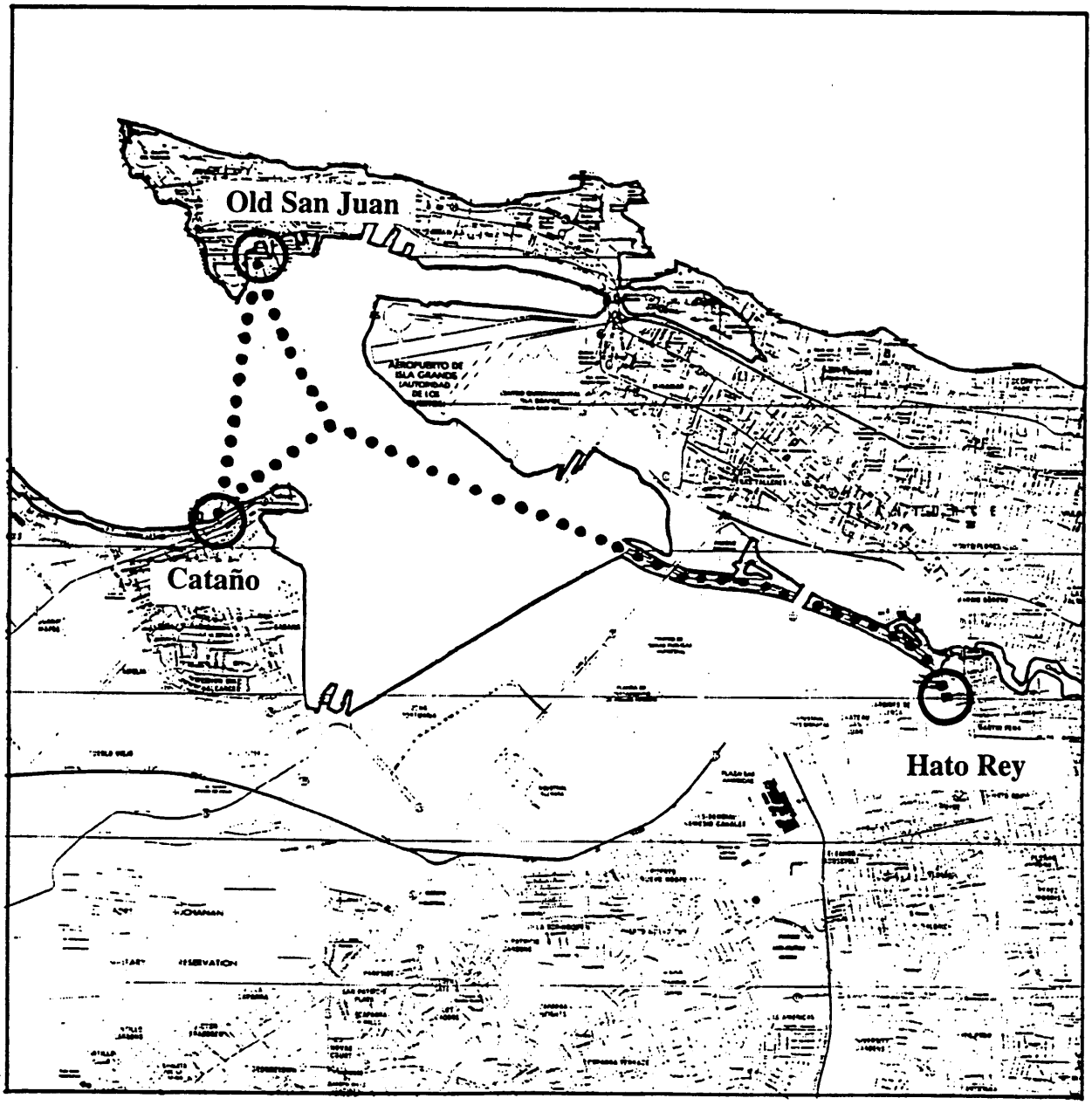
An alternative to both the automobile and road based mass transit systems is the local ferry system, *Acuaexpreso*. This modern urban ferry system provides service between Old San Juan and two other areas of the city, Cataño and Hato Rey. Not dependent on bridges and already in service, *Acuaexpreso* would appear to offer a real alternative for transportation to the Isleta. The water transportation alternative to road congestion has been discovered in several cities in the United States, leading to a resurgence in urban ferry service, often in the context of mitigation for the traffic disruption caused by infrastructure reconstruction.

1.1.2 *Acuaexpreso*

Why Look at *Acuaexpreso*?

Within the existing transportation network of the SJMA, *Acuaexpreso* plays a very minor role. This will always be the case, due to the geographic layout of San Juan and the availability of other means of transport. However, as an island at the end of a peninsula the Isleta de San Juan is, and will continue to be, connected by a limited

Map 1-1 *Acuaexpreso* Ferry System

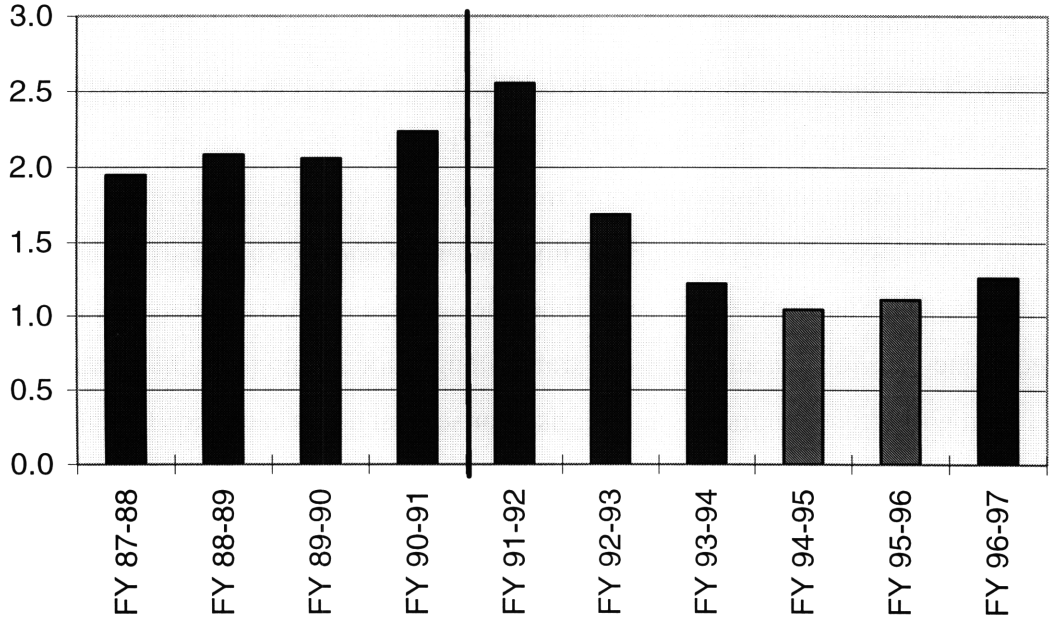


Source: *Assessment of Ferries as Alternatives to Land-Based Transportation*. Figure 2-25.

number of roads to the rest of the city, leading to the probability of severe congestion for auto and bus transportation. Taking advantage of the open water routes between the Isleta and other parts of the city, *Acuaexpreso* offers an alternative to congestion and the expense and disruption posed by both new construction and the necessary reconstruction of the bridges (See Map 1-1). If travelers can be attracted to the service, demand on the bridge network will be reduced, increasing the benefits for all concerned.

Unfortunately, to date the success of *Acuaexpreso* at attracting travelers has been disappointing. Throughout the 1980's, the old ferry system between Old San Juan and Cataño averaged over 5,000 passengers a day. It was hoped that the inauguration of *Acuaexpreso* in March 1991, with new high-speed catamarans, terminals, and new routes from Cataño and Old San Juan to the business center of Hato Rey, would add a significant number of riders to the system. This has not been the case, and *Acuaexpreso* ridership has decreased significantly from pre-system levels. Figure 1-1 illustrates the decline in ferry ridership, showing that ridership has fallen below the previous levels recorded on the old ferry system, only recently returning to 1.3 million a year.

Figure 1-1 San Juan Ferry Annual Ridership (millions per fiscal year)[2]



**The vertical line marks the introduction of the Acuaexpreso system (March 1991).*
***FY 94-95 and 95-96 affected by Hato Rey - Old San Juan route closing (Jan - Sep 1995).*

[2] Puerto Rico Port Authority. *Statistical Summary.* August 1996. p.16.

Ridership has been affected by service cutbacks and disruptions in recent years. Regular service between Cataño and Hato Rey was eliminated in December 1993 due to low ridership. In 1995, the Hato Rey - Old San Juan route was shutdown from January to September while the Martin Peña canal was dredged and the boats and facilities were repaired. The route was shutdown again in October 1997 due to dredging work on the eastern branch of the waterway, to be reopened in January 1998.

For these and other reasons, the route between Hato Rey and Old San Juan, when operating, frequently has a daily ridership of less than a hundred. At the same time, ridership on the traditional Cataño - Old San Juan route has declined to an average of 3,300 a day. Besides the decline in ridership, *Acuaexpreso* has also seen its costs increase over the same period, both operational expenditures and the need to pay off depreciation. While operational expenses have stabilized, the transportation provided is underutilized, making the system's cost per passenger the highest of any transit system in San Juan. As a whole then, *Acuaexpreso* is a transportation service in trouble, and its continued existence has been the subject of debate.

The Future

The construction of *Tren Urbano,* and the reorganization of the SJMA transit services which will integrate the bus and *público* networks with that system, offers a new opportunity for *Acuaexpreso*. The Nuevo Centro station of *Tren Urbano* will be immediately adjacent to the *Acuaexpreso* terminal at Hato Rey, creating an easy intermodal link between the services. From this station, *Acuaexpreso* already offers direct ferry service to Old San Juan. At the same time, the demand on the road network is projected to increase to such an extent that traffic congestion to and from the Isleta and Old San Juan will affect commuters and tourists for several hours each day. Congestion and delay will also be a by-product of the reconstruction work that must be done on the three bridges linking Old San Juan to the city.

Therefore, with the transportation demands to and from the Isleta and the tie-in with the *Tren Urbano* rail system, the opportunity exists in the next decade to redirect a portion of the traffic between Old San Juan and the rest of the metropolitan area onto the ferry system. Together, these developments offer the potential of increasing ridership and

the role of *Acuaexpreso*. An analysis of the *Acuaexpreso* ferry service, the other transportation services to the Isleta de San Juan, and a review of other urban ferry systems for comparative purposes would therefore provide potentially valuable information for transportation planners and government officials in the San Juan Metropolitan Area.

1.2 Research Objectives

The goal of this thesis is to reexamine *Acuaexpreso* in view of the increasing traffic and congestion in San Juan and the need for effective transportation alternatives. There is clearly a potential for *Acuaexpreso* to play a much greater role in the urban transportation system given the introduction of *Tren Urbano*, projected travel demand, and reconstruction of the Isleta de San Juan bridges. Though the record to date of *Acuaexpreso* as a transportation provider has been disappointing, by comparing *Acuaexpreso* with the other San Juan transit systems and other North American urban ferry systems this performance can be better analyzed and understood. By identifying and evaluating possible changes for *Acuaexpreso* based on the lessons of other ferry systems, recommendations for improving *Acuaexpreso's* value as a transportation alternative in San Juan can be made.

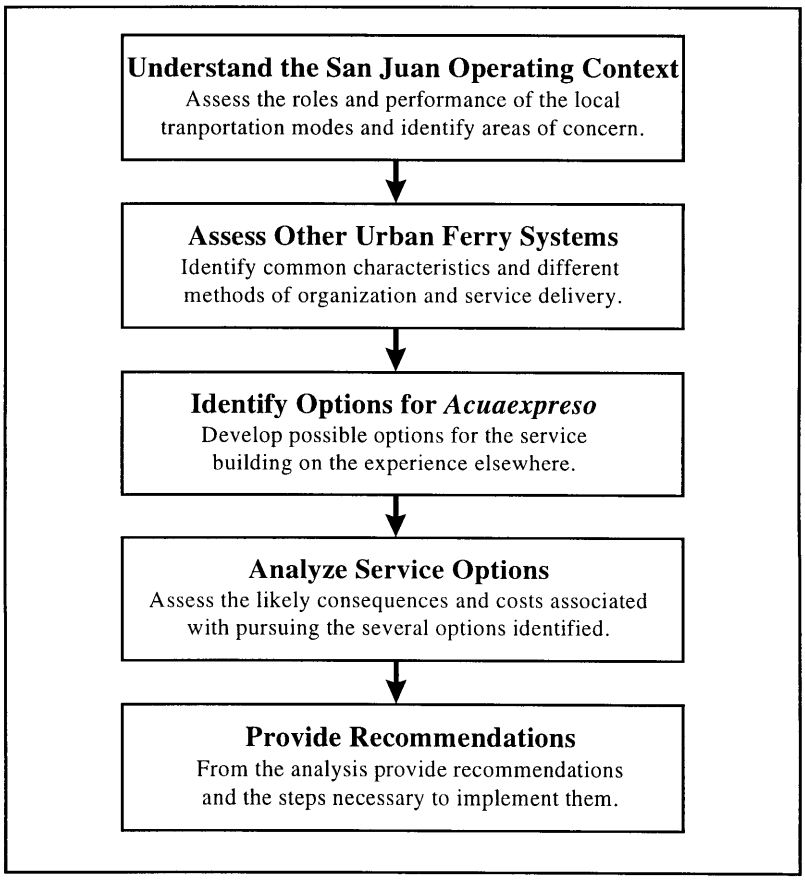
1.3 Research Methodology

The basic approach of this thesis is to analyze the *Acuaexpreso* system in the context of the range of transportation alternatives in San Juan. By comparing it with the other transportation alternatives, current and potential future roles for *Acuaexpreso* can be identified. Other North American urban ferry systems are examined to see if some of the characteristics or experiences of these other systems can be adapted to, or are in some other way relevant to *Acuaexpreso*. The information is then used to develop, discuss, and analyze potential strategies for *Acuaexpreso*.

This research process can be divided into five steps. The first step is the assessment of the local situation in San Juan, including a review of the performance of *Acuaexpreso* and the other transportation services. This provides an understanding of the current role of *Acuaexpreso,* and allows comparisons with the other alternatives. These

comparisons allow the identification of areas for possible improvement as well as identifying potential future roles for *Acuaexpreso*. The second step is an assessment of other North American urban ferry systems to provide comparative information. This information can then be used to identify possible strategies for application to *Acuaexpreso*. Analysis of the San Juan and ferry system information then begins with the third step, in which possible options for *Acuaexpreso* are defined given the potential roles and the strategies identified through comparative review. The fourth step of the process is the analysis of the various options, assessing the possible outcomes and costs associated with possible changes in *Acuaexpreso*. The fifth and final step is then to produce recommendations on the basis of the analyses conducted. A summary of the five steps is shown in Figure 1-2.

Figure 1-2 Research Methodology



1.4 Thesis Organization

The remainder of the thesis is divided into four chapters which cover the research methodology given above.

Chapter Two examines the San Juan context in detail, including the road network and the transit alternatives for non-auto users: the AMA bus system, *Metrobus, públicos*, and *Acuaexpreso*. The three regions of the San Juan Metropolitan Area that are connected by *Acuaexpreso* are discussed, and the service provided by the various transit alternatives to these areas examined.

Chapter Three surveys the urban ferry systems of Boston, New York City, Seattle, San Francisco, and Vancouver (Canada). The historical development of each system and some of each systems' characteristics: routes, capital assets, level of service, and ridership, are reviewed. In addition, each system has particular characteristics or has experienced special problems that provide possible lessons for application to *Acuaexpreso*. This review sets the stage for developing possible options for *Acuaexpreso.*

Chapter Four pulls together the information in the preceding chapters, reviewing the characteristics of the various urban ferry systems and emphasizing the common features of all the ferry systems. The chapter then goes on to estimate and compare the costs and effectiveness of operation for the Hato Rey and Cataño routes for application in the following chapter. The chapter concludes by presenting and comparing the performance measures associated with both the San Juan transit systems and the urban ferry systems.

Chapter Five is the major part of the thesis. The Cataño - Old San Juan route and the Hato Rey ferry services are examined separately. The future customer market is examined, and the ferry level of service is compared to other transportation modes. Recommendations focus on service improvements and increased integration with other modes. Recommendations for both services are then combined into a timeline of implementation for the various proposed options. The chapter concludes by examining possible organizational arrangements for *Acuaexpreso.*

The thesis concludes with Chapter Six, which summarizes the main points of the thesis and the basic recommendations.

2. Transportation Systems in San Juan

This chapter examines the transportation systems in San Juan, placing *Acuaexpreso* in context with the other modes. The regions served by *Acuaexpreso* are described, along with the bridge network and the transit alternatives for non-auto users: the AMA bus system, *Metrobus, públicos*, and *Acuaexpreso*. Discussion of the bridge connections concentrates on access to the Isleta de San Juan, while routes, ridership, and the level of service attributes are covered for the transit services.

2.1 San Juan Area Description

The urban areas adjacent to the ferry terminals are the primary generators of ridership for *Acuaexpreso*. While there is some ferry traffic generated simply by the excursion opportunity of traveling across San Juan harbor on a ferry, most passengers are traveling to one of the areas and are using the ferry as a preferred transportation alternative. A description of the three urban areas connected by *Acuaexpreso*: Hato Rey, Old San Juan, and Cataño, therefore provides information on transportation patterns as a whole, including some of the reasons for ferry ridership.

2.1.1. Hato Rey

One of the major urban business areas of the SJMA, Hato Rey occupies the urban area immediately south of the Martin Peña canal, stretching from the Báhia de San Juan to the Laguna San José. While a significant residential area, its major role lies in the many financial institutions and other businesses located in Hato Rey. These make the area a major source of employment and thus a major travel destination for commuters from throughout the San Juan Metropolitan Area,

As one of the major business districts, as well as due to its central location in San Juan, Hato Rey is served by numerous transit routes. In addition, *Tren Urbano* will provide service to Hato Rey when complete. The Nuevo Centro station, second from the northern end of the line, is to be built immediately adjacent to the *Acuaexpreso* terminal.

2.1.2 Cataño

The municipality of Cataño lies to the southwest of the Isleta de San Juan, across the Bahía de San Juan. The area is largely residential, though with a few industrial sites including the Bacardi factory, a popular tourist destination. The *Acuaexpreso* terminal is located in the town of Cataño at the eastern end of the municipality, which is adjoined by the towns of Vietnam, Sabana, and Amelia, all in the neighboring municipality of Guaynabo. This developed section, approximately a mile square, has the bay on its north and east sides while the landward sides are undeveloped, making the section somewhat self-contained.

The town of Cataño is served by several land-based transit routes. However, it is not part of the major transit network, though it has good road connections with the city of Bayamón to the south-west.

2.1.3 Old San Juan

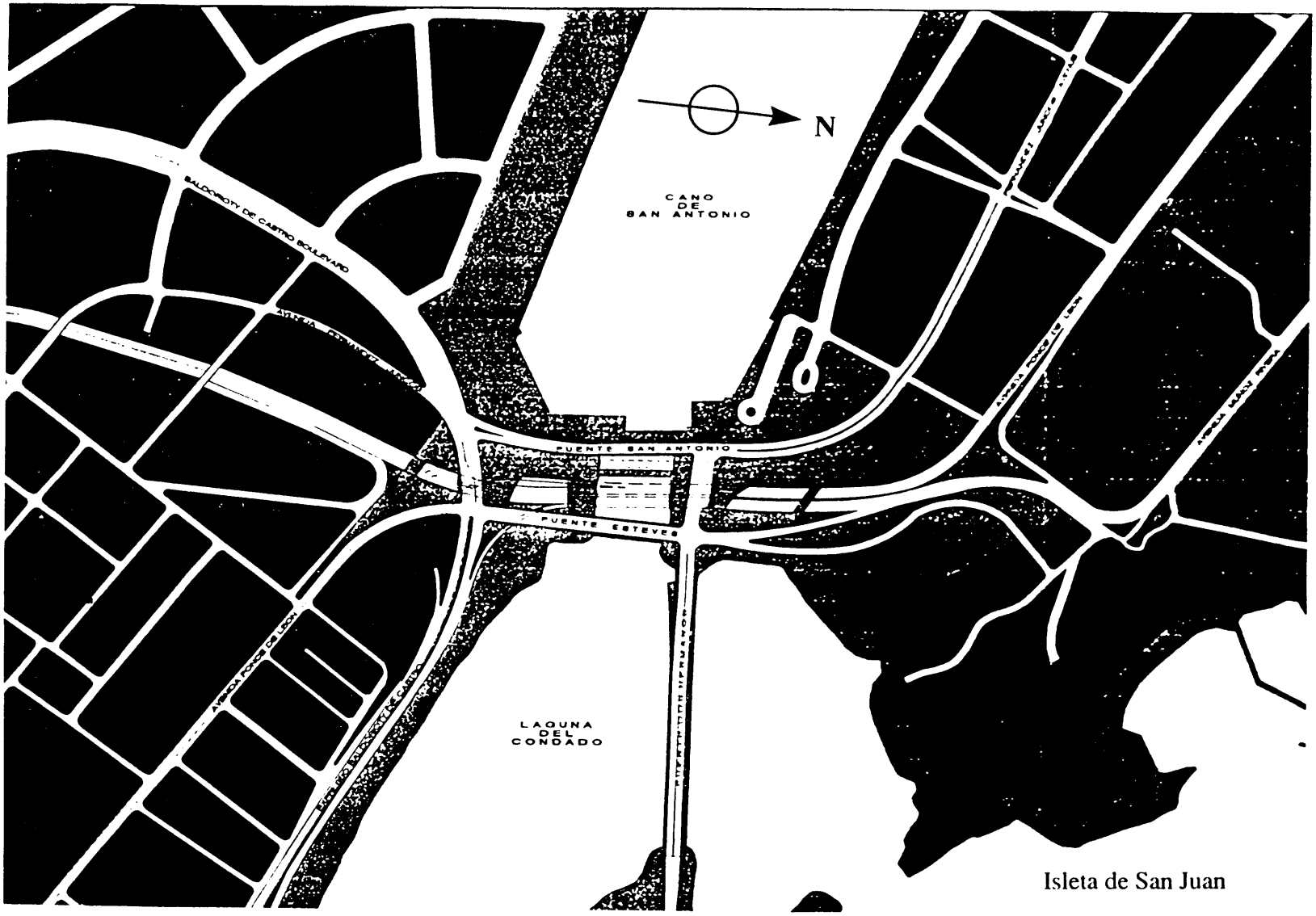
Old San Juan is a major tourist area, filled with restaurants, boutiques, and museums, as well as the signature fortress of Castillo del Morro. The old part of the city, characterized by narrow streets and three to four story buildings, occupies the western third of the Isleta of San Juan. The Isleta also has a significant residential area and numerous public offices. The Government House is situated roughly in the center of the Isleta, while around it are located other government buildings. There is also development taking place throughout the Isleta, with a major hotel having recently been completed near the old city.

Transportation is difficult within the old city, given the narrow streets and little parking available. Bus services run to the Covadonga bus terminal adjacent to the old city, but do not extend into the city. However, Old San Juan is reasonably conducive to walking, and there is a trolley service which circulates through the district.

2.2 The Road Network, Bridges, and Auto Traffic

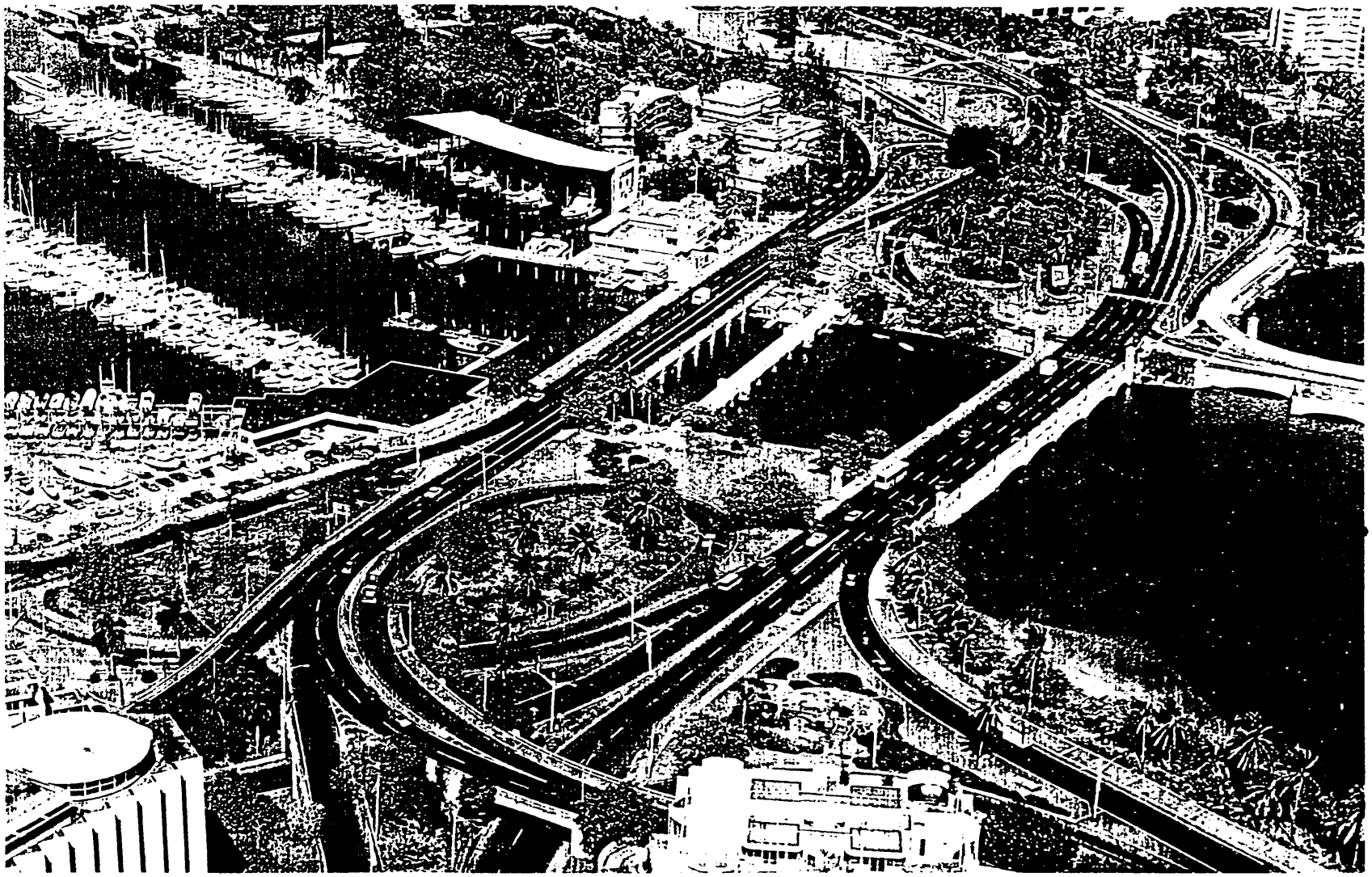
The Isleta de San Juan is connected to the rest of Puerto Rico only by bridges at its south-east end. As all the land-based transportation systems now in use rely on these

Map 2-1 Overhead View of the Bridges to the Isleta de San Juan



Source: Steer, Davies & Gleave. *El Triángulo Dorado: Phase II - Final Report*. Figure 5.10.

Map 2-2 Photographic View of the Bridges to the Isleta de San Juan



Source: Steer, Davies & Gleave. *El Triángulo Dorado: Phase II - Final Report.* Figure 5.6

bridges, an understanding of the geographic constraint imposed on those systems by this connection is important before examining the modes of transportation to the island.

The Isleta de San Juan is linked to the rest of the city by three bridges, all located immediately adjacent to each other. The two main bridges are the Puente Esteves, carrying the Avenida Ponce de León, four lanes of one-way traffic onto the Isleta, and the Puente San Antonio, carrying the Avenida Fernández Juncos, four lanes of traffic off the Isleta. Two expressways to the east, the Muñoz Rivera and the Baldorioty de Castro, serve as the primary access routes to the area, intersecting the two avenues just to the east of the bridges. (See Maps 2-1 and 2-2).

The third bridge, Puente de Dos Hermanos, intersects the Puente Esteves at the Isleta abutment, and links Old San Juan to the Condado strip, a major resort area along the coastline. The bridge itself is two lanes in each direction, but once in Condado the street, Avenida Dr. Ashford, is only one lane in each direction, serving the resort area but making it a poor traffic arterial. Therefore, the majority of the car and bus traffic to and from Old San Juan travels over the two main bridges.

The triangular link formed by the three regions of the city the bridges connect, Old San Juan, Condado, and Isla Grande, is referred to as "El Triángulo Dorado", the Golden Triangle. Development efforts of the last several years have been focused on this area, and the construction of a major conference center in Isla Grande in 2003 and the development of other sites to attract more tourism and business to San Juan are planned. This development contributes significantly to the large expected increase in traffic through the area and especially over the bridges.

2.2.1 Congestion

Given the constraints, it is not surprising that peak period congestion frequently adds several minutes to the travel time required to move the quarter mile between the expressway and the point on the Isleta where the island's roads spread out. Traffic analyses for 1996 give the Puente Esteves an overall arterial Level Of Service of D, with the expressway approaches having a peak hour LOS of F, indicating practical standstill.[1]

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[1] Steer, Davies & Gleave. *El Triángulo Dorado: Phase II - Final Report*. p.10. Table 3.1: Average Travel Speeds.

A consulting firm was hired to prepare a report on improving capacity through the bridge bottleneck. Their model of the expected traffic demand forecast that volumes for 2005 would be beyond the present capacity of the bridges to handle at an acceptable level of service.

2.2.2. Capacity Expansion and Reconstruction

It has been recognized that the bridges to the Isleta are insufficient to carry the present as well as forecast traffic. The Puerto Rico Highway and Transportation Authority (ACT) is examining the need for greater capacity, and has commissioned several studies on methods to improve capacity through the area.

An initial design approach followed by the primary consultant was to analyze the effects of a redesign of the road network to improve traffic flow at a relatively low cost. However, when traffic flow was modeled, unacceptable traffic congestion was still predicted. The second phase of the consultant's study therefore focused on the possibility of constructing a tunnel to provide extra capacity.

The analysis of possible tunnel designs produced two main options: a full scale tunnel, and a minimum build tunnel. The full tunnel design would carry the Muñoz Rivera expressway through the tunnel, with ramps to the other expressway, Baldorioty, linking to both the major avenues on the Isleta. The initial cost estimate for a full tunnel was $338 million.[2] At the time, further exploration of this proposal was ruled out by the ACT as cost prohibitive, and attention was shifted towards examining less expensive solutions. However, the full tunnel option is still under consideration, as it does offer the greatest capacity increase for road traffic to and from the Isleta.

The minimum tunnel design is very similar to that for the full tunnel, but carries traffic only to and from the Avenida Fernández Juncos on the Isleta. The cost estimate for this design was $191 million, and further analysis was carried out, primarily involving coordination with transit options.[3]

Besides the expense of building the tunnel, there is also the complicating effect of the construction of the tunnel on travel. The consultant estimates that building the tunnel

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[2] *Ibid.* p. 24. Table 5.1.
[3] *Ibid.* p. 25. Table 5.2.

will require closing off the Muñoz Rivera expressway to traffic for the last 18 months of what would be a four year project.[4] Traffic would have to be diverted to a temporary road, and onto local streets. The congestion effect of the construction can therefore be expected to be severe for at least a year and a half.

In addition to the need for capacity expansion, the Puente Esteves and the Puente San Antonio date from the 1920's, and both require rebuilding in the near future. One possibility is to rebuild them with a greater capacity, though to be effective this would require rebuilding of the linking road network and be of limited value in meeting additional capacity needs. A decision on how and when to rebuild the bridges is still pending, and will probably not be made for several years. Currently, discussion involves the aesthetics of replacement designs, as the image presented by the bridges as the gateway to the Isleta and the effect on nearby tourist locations is considered important. In any case though, the bridge reconstruction is sure to add delays and reduce road access to and from the Isleta for several months at a minimum sometime in the future.

2.3 Transit Systems in San Juan

The three suppliers of road based public transit in the San Juan Metropolitan Area are the Metropolitan Bus Authority (AMA), *Metrobus*, and the *públicos*. In preparation for the introduction of the *Tren Urbano* rail system a great deal of work has been done in the last few years to reorganize the public transit system around centers linked by high frequency bus service. This service is meant to correct some of the shortcomings of the current bus service as well as to mold transportation patterns to support *Tren Urbano* when completed. As the new transit center plan is in the process of implementation, discussion of the transit systems will concentrate on this plan and the service that will be provided to the areas served by *Acuaexpreso*.

2.3.1 The Metropolitan Bus Authority System

Traditionally, AMA has been the operator of the city's bus service, and comes under the direction of the Puerto Rico Department of Transportation and Public Works

[4] *Ibid.* p. 26. Section 5.4.3.

(DTOP). AMA service is concentrated in the denser urban area, mostly connecting the rest of the city to the major north-south employment and transportation spine that runs from Río Piedras through Hato Rey and Santurce before turning west to extend to Old San Juan. The majority of bus routes therefore run through or connect to the Hato Rey area.

The introduction of the transit center system will reorganize the bus system around key terminals such as Parada 18 (Stop 18) in Santurce and Capetillo in Río Piedras. Beginning in December 1997, trunk routes will connect the centers and provide transportation along the most heavily used routes, while passengers from lower demand areas can transfer at the centers to and from the local buses. Bus service is planned for the following frequencies, though full implementation will not take place for some time due to fleet size restrictions.

Table 2-1 Planned AMA Route Headways (minutes)[5]

	Weekday	Evening/Saturday	Sunday
Trunk	10	15	20
Local	20	30	60

AMA fares are set at $0.25 for all routes. Currently, there is no provision for reduced fare transfers within the system, though this option is under review. However, the transit center system will coordinate bus movements such that a transfer is fairly easy to accomplish except for the fare payment.

Under the transit center plan AMA will provide bus service to and from the Covadonga bus terminal adjacent to Old San Juan over four routes:

#5 Iturregui	via Santurce and Isla Verde
#8 San Patricio	via Santurce
#9 Río Piedras	via Santurce, Barrio Obrero, and Cantera
#21 Plaza Las Americas	via Condado and Santurce

The #5 and #9 buses will be trunk routes, operating at headways of ten minutes, while the #8 and #21 local buses will run less frequently.

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[5] Multisystems. *Short Range Transit Center Plan.* (Cambridge, MA. May 1, 1996.) p.37. Table 4-4: Transit Center Plan Service Levels.

In addition, a fifth local bus, #10 Hato Rey to Parada 18, along the mid-portion of its route will travel over the bridges at the corner of the Isleta. There are also four express routes: #30, #32, #91, and #92, which will travel from Santiago Iglesias, Guaynabo, Santa Juanita, and Magnolia Gardens respectively to Hato Rey and then on to Old San Juan. These express routes are designated as peak-period only routes with one or two buses during each period. They are not intended as high-speed, limited-stop routes but instead provide continuous, one-fare service between more distant areas where demand warrants; during the off-peak passengers will have to transfer to make the same journeys.

On selected routes throughout the city, buses are able to take advantage of reserved rights of way for faster travel. On the Isleta, the busway runs the length of the Isleta to the Covadonga bus terminal (built over the old railway tracks), and allows faster service to and from the Covadonga terminal for those routes that do not circulate through the Isleta, #5, #8 , and #9. Unfortunately for the speed of bus service, there is no reserved link between the bus lanes on the Isleta and those in the rest of the city. Instead, both terminate as the road network approaches the bridges to and from the Isleta. This puts the buses back into the main traffic flow, reducing their speed and adding to overall congestion of the bridge network.

The AMA routes serving Cataño will be the #3 trunk route to Río Piedras via San Patricio and Hato Rey, which will run every 10 minutes, and the #37 local route. The latter will circulate through the Cataño municipality and part of the adjacent town of Levittown before traveling to Bayamón. Note that there will be no direct bus service between the town of Cataño and the city of Bayamón to the south-west, even though the P.R. 5 highway directly connects the two. Instead passengers between the two will have to transfer at the San Patricio center or take the circuitous #37 route.

At Hato Rey, AMA routes #10, #11, #15, #16, #17, and #41 stop at the *Acuaexpreso* terminal. Routes #10, #11, and #41 will have an initial service frequency of 30 minutes on weekdays, while the others are planned to meet the new local frequency standard of every 20 minutes. All of these routes circulate throughout the local area, none of them providing through service to Old San Juan. Other bus routes, though, operate to and from the Isleta over routes that pass within a few blocks of the terminal.

2.3.2 The *Metrobus* System

In 1991, the DTOP decided to contract out the operation of a major bus route as a means of improving service and reducing operational costs. Currently service on this major bus route in San Juan is provided by a private operator under contract to ACT. This service and route, known as *Metrobus Route 1*, has been very successful, and carries 23,000 passengers a day, almost a third of all daily bus passengers in the SJMA. A second contracted route, *Metrobus II*, was awarded to AMA in 1995.

Metrobus Route 1 provides high frequency service to Old San Juan, connecting it to the other major commercial areas of the SJMA: Río Piedras, Hato Rey, and Santurce. Service quality is high, with headways of four minutes during the peak periods, and five to ten minutes the rest of the day. However, *Metrobus* does have a higher fare than the AMA bus system, costing $0.50 a trip. In addition, there is also a *Metrobus 1* Express that operates every 8 to 10 minutes with a reduced stop schedule.

Bus service along the *Metrobus Route* 1 is aided by the existence of contra-flow bus-only lanes throughout the greater part of the route. However, on the Isleta de San Juan the buses circulate through the streets instead of using the Isleta busway.

Under the transit center plan, *Metrobus Route 1* will remain essentially unchanged, connecting the transit centers of Río Piedras, Hato Rey, Santurce, and Old San Juan. Headways will be four minutes during the peak periods, ten minutes in the off-peak and on weekends, and fifteen minutes in the evenings.

2.3.3 *Públicos*

The third transit system, *públicos*, is the collective term for a fleet of privately owned and operated passenger vans and minibuses that is regulated and licensed by the Public Service Commission (CSP). The *públicos* provide a large portion of the public transit available in the SJMA, as well as the only service available in the rest of Puerto Rico. San Juan ridership in 1994 was estimated at 143,000 trips a day, 65% of all transit trips made within the city.[6]

The fleet of *públicos* is composed of a variety of minibuses and vans, generally capable of carrying up to seventeen passengers. While most vehicles are owned and

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[6] *Ibid.* p.7.

operated by individuals, the routes on which they operate are regulated by license. The system is also loosely regulated as to schedule, with service concentrating on the AM peak, less frequent during the day and PM peak, and sporadic at night.

The CSP is the regulatory authority for the *públicos*, with a board appointed by the Governor. The agency franchises routes and operators, inspects vehicles, and sets fares. As the assignor of routes, the CSP works with AMA to set routes in the central region of the city, where AMA is protected by law from *público* competition without the Authority's formal permission.

Público service within the SJMA is concentrated in those areas outside the AMA and *Metrobus* routes that service the high density regions of the city. The urban areas of Bayamón to the west, Carolina to the east, and Río Piedras in the center serve as the main terminals for the *públicos* operating either as collectors or as arterial transport to and from the major employment districts. Hato Rey is also an important travel point for *públicos*, and several dozen routes carry thousands of passengers a day to this central district.

Público service is important for Cataño, as the municipality has only limited bus service at present, as shown in Table 2-2 for 1994.

Table 2-2 1994 Section 15 data on *Público* Routes serving Cataño[7]

Route Number	Route Code	Description	Daily Passengers
202	I-11-17	Cataño to Bayamón	2,984
208	I-62-17	Cataño to Río Piedras	2,325
259	L-17-01	Cataño to Barrio Palmas	958
683	L-17-02	Cataño to Buchanan	170
200	L-17-03	Cataño to Levittown (1-4)	1,701
271	L-17-05	Cataño to Levittown (5-8)	940

Route #202 is one of the 34 high frequency routes in the SJMA, with an average headway of 6.4 minutes. However, ridership on this route has fallen, as a 1991 survey listed it as carrying 12,338 passengers a day, the second highest of all the *público* routes. In 1994 it was ranked as sixteenth in daily ridership in the metropolitan area. Another high-frequency *público* route is #200; this local route provides service between Cataño

[7] *Ibid.* Appendix H.

and Levittown to the west. Both these routes serve the new Cataño *público* terminal completed in 1994.

Público service for the Isleta de San Juan is much less significant than it is for other parts of the city, given the frequent bus service. On the Isleta, *público* service is primarily oriented towards serving several low-income residential areas. Of the 34 high-frequency *público* routes, only #303, the I-63-13 Intercity route, operates to and from the Isleta, running down through Hato Rey to the suburb of Caguas just over eight miles to the south. In 1994, this route was estimated to carry 2,883 passengers a day, though how many of these use the service all the way to the Isleta is not known.[8]

2.3.4 *Tren Urbano*

The introduction of *Tren Urbano* will significantly affect the other transit systems. The first phase of the rail system, now under construction, is scheduled to open for service in November, 2001, operating between Bayamón and Santurce, with stations at the Medical Center complex, the University of Puerto Rico campus in Río Piedras, and Hato Rey. Once the approximately ten miles of track and sixteen stations are functioning, the bus transit network is expected to be restructured to operate effectively as a feeder system for *Tren Urbano*. The rail system will thus not only offer a transit alternative along its corridor, but will also serve as a link in transit trips to and from other areas.

The first phase of the *Tren Urbano* alignment is shown in Map 2-3. As mentioned, the Nuevo Centro station will be immediately adjacent to the *Acuaexpreso* Hato Rey terminal, offering the possibility of increased ridership on the ferry service from passengers on *Tren Urbano* (shown in Map 2-4). Further planned phases of the system will extend to Carolina, the Isleta de San Juan, and the Luis Muñoz Marin International Airport, however completion of these extensions is a considerable time in the future, and such aspects as alignment, funding, and schedule are still tentative.

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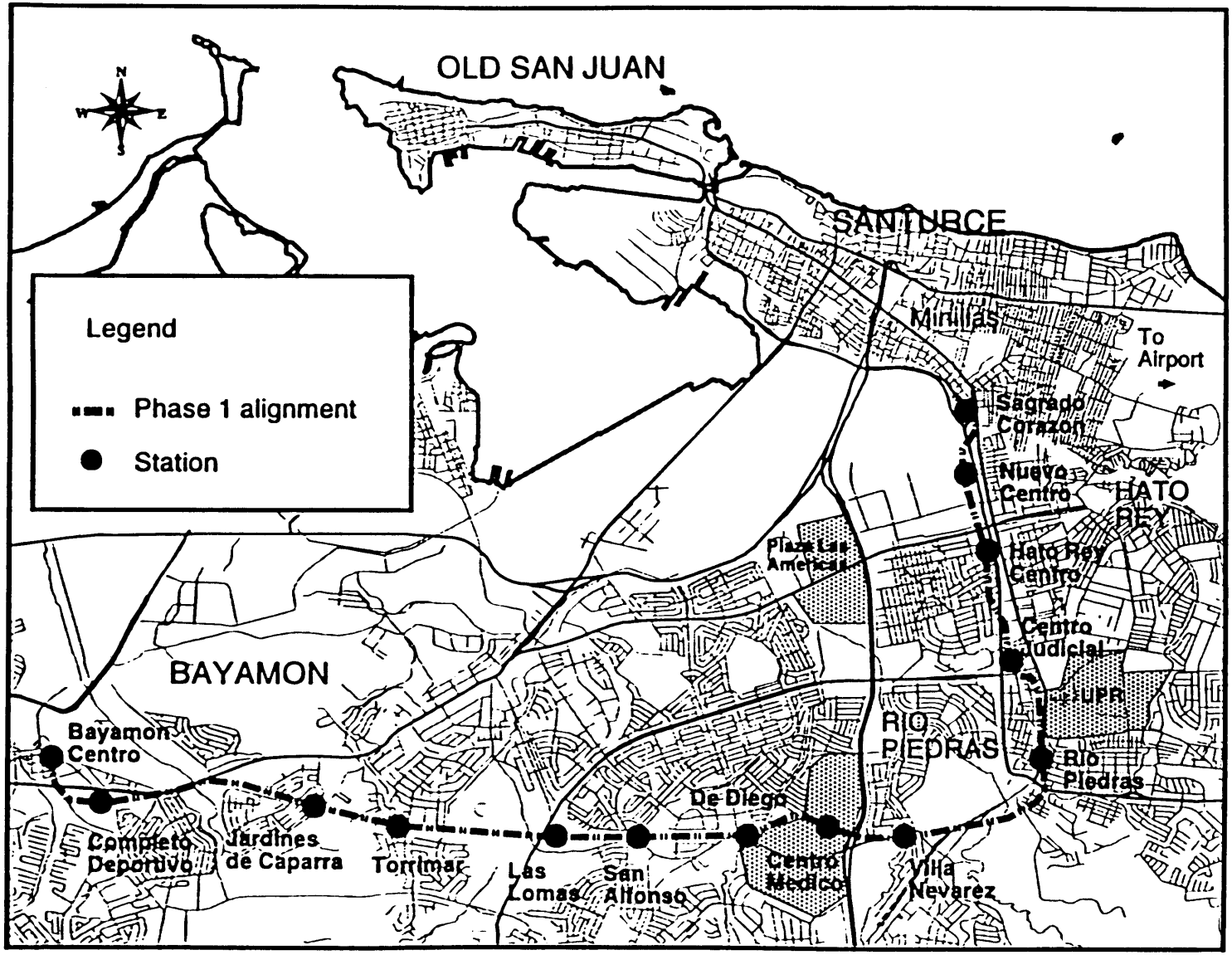
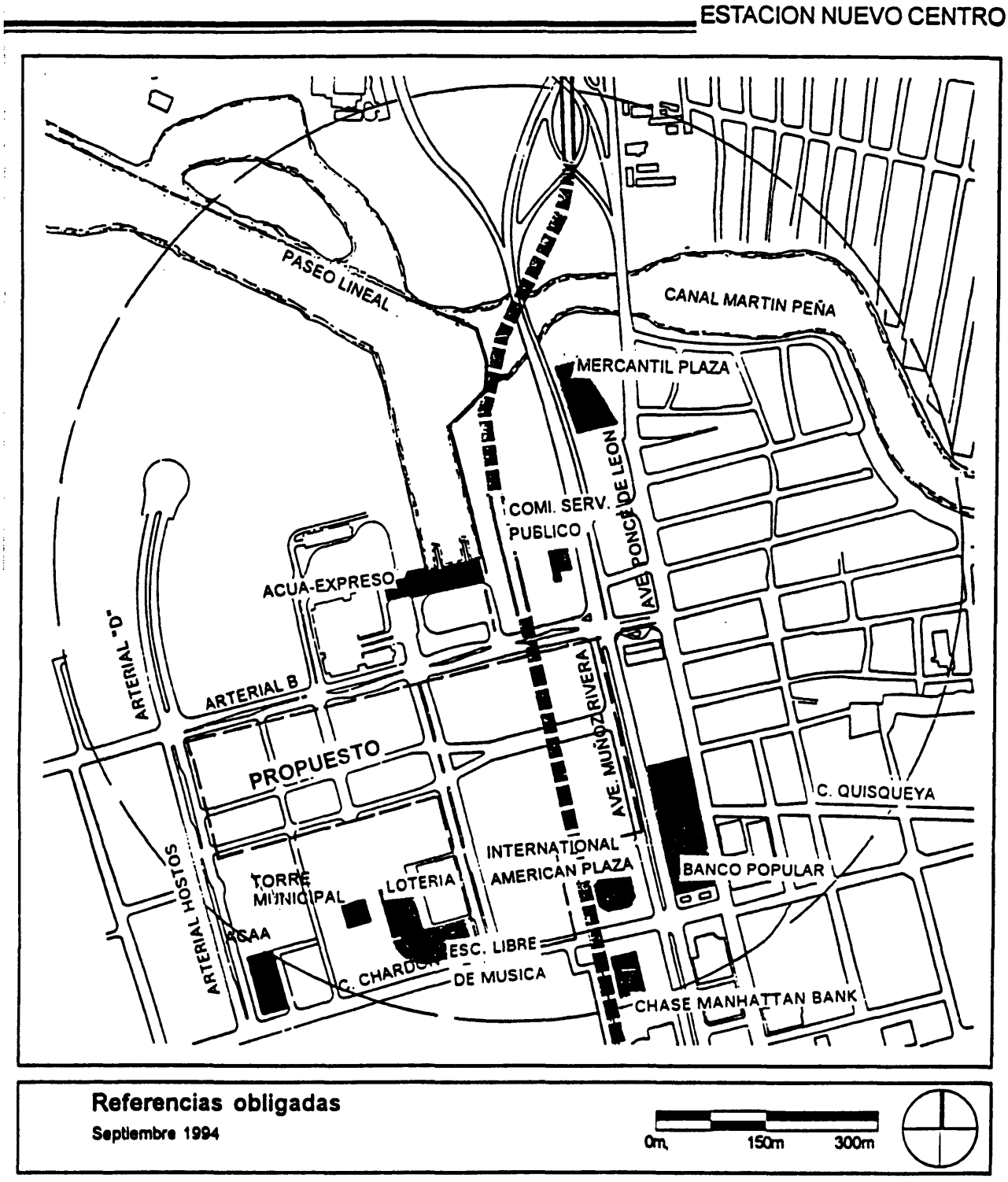
[8] Multisystems *FY 1994 San Juan Público Section 15 Data Collection*. (Cambridge, MA. December 21, 1994) Appendix H: Route-Level Summary Data.

Map 2-3 *Tren Urbano* Phase I Alignment



Source: GMAEC - *Tren Urbano* Office

Map 2-4 *Tren Urbano* Nuevo Centro Station Plan



Source: GMAEC - *Tren Urbano* Office

2.4 The Acuaexpreso System

2.4.1 Historical Background

Ferry service in San Juan dates back to the middle of the 19th century, when a private developer built the town of Cataño, across the bay from Old San Juan, using the ferry service to attract residents. The service was taken over by the government in 1919, and continued in operation until replaced by the *Acuaexpreso* system.

Acuaexpreso is publicly owned and operated by the Puerto Rico Port Authority. The system consists of nine vessels, which since March 30, 1991 have been providing service between the three terminals at Cataño, Old San Juan and Hato Rey. The system currently operates two routes: Cataño - Old San Juan and Hato Rey - Old San Juan. Regular service on the Cataño - Hato Rey route was discontinued due to declining ridership.

The Creation of *Acuaexpreso*

In 1981, the Puerto Rico Department of Transportation and Public Works (DTOP) applied to what was then the Urban Mass Transit Administration (UMTA) for preliminary engineering funds to expand the existing ferry system. The proposed expansion of the waterborne service was a component of a plan called the San Juan Urban Core Transit proposal, designed to provide improvements in transit to the Nuevo Centro area of Hato Rey, the urban region adjoining the south side of the Martin Peña canal.

The initial Transportation Improvement Program was approved September 15, 1981, and UMTA funds in the amount of $536,000, an eighty percent share, were granted in March of 1982. In addition, another $224,000 from a previous rail system alternatives study was redirected to the project. The funds were used to complete an Environmental Impact Statement (EIS), to develop specifications for new ferry boats, and to support the dredging and reconstruction of the Martin Peña canal by the U.S. Army Corps of Engineers.

A major portion of the funds was dedicated to the relocation of the residents of Barrio Tokio, a community of squatters that was occupying a portion of the land around

the proposed terminal location in Hato Rey. The planning and execution of this relocation eventually consumed approximately 35% of the UMTA Section 3 funding allocated to the project, an arrangement being made with the Department of Housing and Urban Development by which UMTA paid for the relocation.

The next disbursement of Federal funds occurred in the fall of 1983, consisting of two additional amendments to the grant. The first was for $780,000 to complete the planning for the previous projects and also to conduct preliminary engineering and design for new terminal facilities. Within a month, a grant for $16,359,472 followed to carry out the relocation plan and the reconstruction of the canal.

The next step was the construction of the terminals, the completion of the canal reconstruction, and the purchase of three new ferry vessels. The funding for this came in September 1984 with an amendment of $9,999,999, now being matched by 25% local funds (versus the previous one-fifth share).

The last portion of Federal funding under Section 3 was approved in August 1986 to complete the above projects and provide funding for an additional three ferry vessels. The final amendment, also matched 25% locally, was for $3,801,000, before being closed out on January 15, 1987. A summary of the Section 3 funding is provided in Table 2-3.

Table 2-3 Section 3 Federal Funding for *Acuaexpreso* - By Category

Purpose	**Federal Funding**
Initial EIS & Planning	$760,000
Preliminary Design	$780,000
Canal Reconstruction	$14,215,799
Urban Relocation	$8,801,120
Terminal Construction	$1,266,000
Vessel Purchase	$4,426,500
Project Admin & Misc	$1,227,052
Total	$31,476,471

Section 3 grants were not the only source of Federal funding for *Acuaexpreso*. In addition to those funds, over $13 million of Section 9 funding was also assigned to *Acuaexpreso*. The total Federal funding for the project was thus almost $45 million.

In addition, the Puerto Rico Department of Transportation and Public Works spent over $9 million in matching funds for the Section 3 grants. With additional funding

from other local sources, total expenditures on the project, both Federal and local, were approximately $80 million.

2.4.2 Capital Assets

Ferry Boats

Three of the *Acuaexpreso* ferries are of 300 passenger capacity, dating from 1975, and operating only on the route between Cataño and San Juan. These vessels are double decked, with the upper deck open, half covered by an awning.

The other six ferries were built directly for the *Acuaexpreso* project. All six were constructed by Nichols Brothers Boatbuilding, three in 1989 and three in 1990. They are of modern catamaran design, and are capable of speeds up to 25 knots with capacity for 149 passengers. While these vessels are primarily intended for the routes to and from Hato Rey, they also supplement the Cataño - Old San Juan route service. These vessels have a single, totally enclosed deck, and are air-conditioned. All of these vessels have also completed a six month overhaul within the last few years, improving their serviceability. (Information on the *Acuaexpreso* fleet is included in Appendix A.)

Terminals

All three terminals date from the UMTA grant, the original terminals of Old San Juan and Cataño having been completely rebuilt. The terminals were constructed using common features and decoration, though differing somewhat in layout. Besides ticket booths, waiting areas, and the piers, all three also have space for between two and six concession stores, though these are vacant at the Hato Rey terminal.

1. Hato Rey

The Hato Rey terminal is located on the southern side of the Martin Peña Canal, just to the west of the Nuevo Centro district of Hato Rey, the core of the urban area. The largest of the three terminals, it stretches along the south side of an artificial inlet constructed for the piers.

Adjacent to the terminal to the east is an entrance to the Parque Lineal, a linear park that crosses over the canal and then continues along the northern bank for close to a

kilometer before turning inland and joining up with the Parque Central. This path is used by bicyclists and for other recreational activities.

When the terminal was constructed, a bus terminal was built adjacent to the ferry terminal to the west. However, the fumes and noise generated by the buses were protested by the local residents in an adjoining apartment complex, and use of the bus terminal was discontinued. Several AMA routes still service the terminal, which is fronted by a bus waiting area. However, there is no integration of schedules or fares with *Acuaexpreso.*

Beyond the entrance to the terminal and stretching to the south are expansive parking lots for the nearby financial and business buildings; the closest buildings in use are thus several hundred feet from the terminal. The central avenues of Fernández Juncos and Ponce de León pass several hundred meters to the east of the *Acuaexpreso* station, and it is along these streets that most of the transit services through Hato Rey operate.

2. Cataño

The terminal at Cataño is located in the middle of the waterfront of the town of Cataño, southwest of the Isleta de San Juan across the bay. The terminal is smaller than that at Hato Rey, and arranged perpendicular to the waterfront. The terminal's walkway extends through a parking lot of approximately 150 spaces (depending on the creativity of the drivers) immediately in front of it, and then lets out onto a narrow street. On the other side of the street begins the residential area, consisting of detached two or three story dwelling units for low to middle income families. There are some modest businesses located along the waterfront.

There is a bus stop in front of the terminal walkway for AMA buses to stop at, but no space for waiting or multiple buses. A former bus terminal nearby was taken over by the municipality for development. A new *público* terminal for the town was completed in 1994, several hundred feet from the *Acuaexpreso* terminal. The location of this terminal has been criticized, as the old terminal allowed buses and *públicos* to stop immediately adjacent to the ferry terminal.[9]

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[9] Barton-Aschmann Associates, Inc. *Integration of San Juan Metropolitan Region Público and Private Bus Routes into the Metrobus Transportation System.* (Ft. Lauderdale, FL. September 1992.) p. 121.

3. Old San Juan

The terminal for Old San Juan is located on the south side of the Isleta de San Juan, fronting the Bahía de San Juan. Comparable in size to the Cataño terminal, the terminal faces onto a collector road running along the waterfront. Immediately across from the terminal, construction of several new buildings is taking place, and a major hotel has recently been completed. To the east along the waterfront are the piers for cruise liners, and to the west is the Coast Guard base. Across from these the old city begins.

No bus service is provided at the terminal, however the old part of the city is within easy walking distance, and the free trolley service has a terminus roughly a hundred meters away. The waterfront walk is pleasant, with street vendors and small shops.

Other Assets

Acuaexpreso is in the process of completing a new maintenance facility, at a cost of $7.2 million. Once the facility is complete, it is planned to convert the old maintenance yard in Cataño into a parking garage, with up to several hundred spaces. This will provide additional parking for ferry riders from the township.

For several years the Port Authority also operated four 47-passenger buses along a route between the Hato Rey terminal and the Plaza las Americas shopping center, a major destination. The expectation was that by linking this attraction with the ferry service by means of the buses, ridership on *Acuaexpreso* would be increased. The buses were timed to match the ferry schedule, and the fare was $0.25, but after several years, this service was discontinued due to low use.

2.4.3 Level of Service Variables

Travel Time

Travel times are between six and eight minutes for the Cataño - San Juan route, depending upon the vessel in use as well as traffic and time of day. The Hato Rey - San Juan route averages fifteen minutes, while the Cataño - Hato Rey route averages sixteen

and a half minutes.[10] These times include both cruising time and the time required for docking and undocking, the latter taking about two minutes. Speed is limited on the trips to and from Hato Rey due to concern over the effect of vessel wakes on waterfront activities and the mangrove swamps along the Martin Peña Canal.

Service Frequency

Acuaexpreso operates daily throughout the year. Regular service is offered between Cataño and Old San Juan and between Hato Rey and Old San Juan (See Figure 2-1). Service frequency is differentiated by peak and off-peak periods, the AM peak period being 6:00 to 9:00 AM, and the PM peak 4:30 to 7:00 PM. The normal service frequencies are given in Table 2-4 for service throughout the week.

Table 2-4 *Acuaexpreso* Service Frequency

	Peak Period	Off-Peak	Hours of Operation	Daily Trips
Cataño - San Juan	15	30	6 AM to 10 PM	87
Hato Rey - San Juan	30	60	6 AM to 7 PM	58

In addition, though routine service from Cataño to Hato Rey was terminated in December 1993, four trips during the AM peak and four in the afternoon peak are scheduled as stopping at all three terminals. In the morning the ferry follows the route Cataño - Hato Rey - Old San Juan, reversing in the PM to Hato Rey - Cataño - Old San Juan.

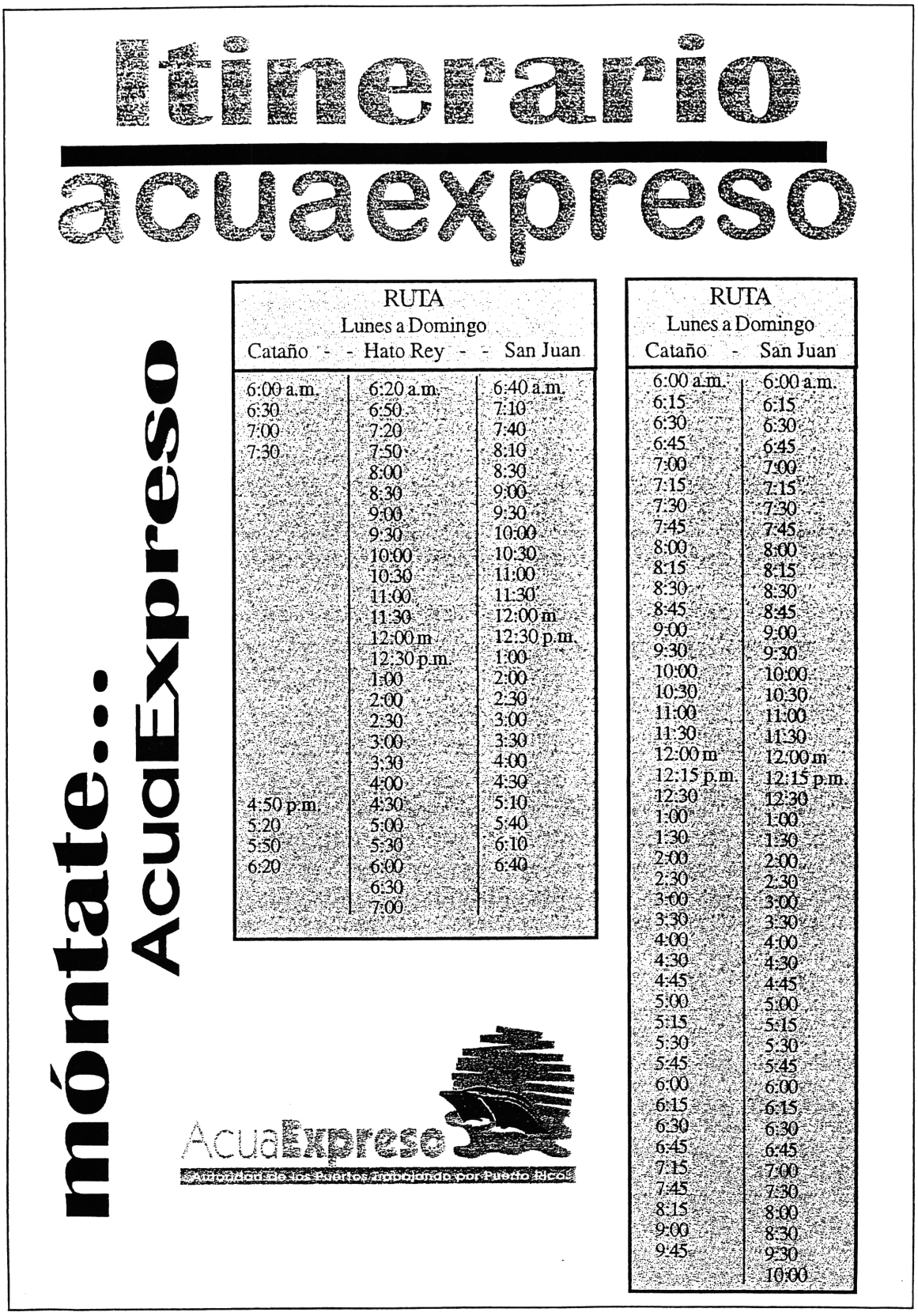
The daily schedule followed by *Acuaexpreso* has been in a continuing state of change over the last several years due to service changes and disruptions. In addition, the service has been plagued by reliability problems, leading to missed or late trips. The actual schedule is not always consistent for these reasons, and may differ from the printed schedule.

Fares

The fare is 50 cents between Cataño and San Juan, and 75 cents for trips to and from Hato Rey. As with the other San Juan transit services, *Acuaexpreso* is a completely

[10] Vazques, Reynaldo. *Análisis de Algunos Aspectos Operacionales del Sistema Acuaexpreso*. (May, 1993). p. 19.

Figure 2-1 *Acuaexpreso* Schedule



stand-alone system with no transfers or other forms of fare integration with other modes. Elderly and passengers with disabilities can purchase tickets at a discount, 35 cents and 50 cents for the two routes respectively.

Service Quality

The catamaran ferries are air-conditioned, which is very important in the hot, humid climate of San Juan. The entire passenger compartment is an enclosed bay with seats for all with large windows along the sides, but only small ones to the front. Unfortunately, this design for both the seating arrangement and to preserve the air conditioning prevents passengers from enjoying a breeze or enjoying much of a view.

The older Cataño ferries have two levels, with the upper deck open, making it more popular for tourists and as excursions. This may also be due to the fact that the Cataño trip crosses the San Juan bay. The portion of the Hato Rey trip which traverses the Martin Peña canal is not particularly pleasant, lined with mangrove swamps on both sides, with occasional litter and an unpleasant odor.

2.4.4 Ridership

Annual Ridership

Ridership on *Acuaexpreso* has not fulfilled the original expectations of the service, which was for up to five million passengers a year. Annual ridership figures since fiscal year 1991-1992, the first year of complete service, are shown in Table 2-5.

Table 2-5 *Acuaexpreso* Annual Ridership (by Fiscal Year starting July 1st)

Fiscal Year	San Juan-Hato Rey	San Juan-Cataño	Hato Rey-Cataño	Total
1991-92	689,433	1,618,708	149,146	2,457,287
1992-93	372,254	1,283,019	34,127	1,689,400
1993-94	113,832	1,105,210	4,371*	1,223,423
1994-95	6,826*	1,049,938	0	1,049,938
1995-96	48,678*	1,054,893	0	1,103,571
1996-97	53,738	1,208,980	0	1,262,718

** service disruption or change*

Annual ridership has been in a steady decline up to the past two years. The highest ridership was in the first full service year, F.Y. 1991-1992. In part this was probably due to the novelty of *Acuaexpreso*. Another significant influence was the Great Columbus Regatta during the summer of 1992, a tall ship festival celebrating the 500th anniversary of the discovery of the New World. During the ten days of the festival, from June 5th to the 14th, *Acuaexpreso* carried over 500,000 riders. This event naturally focused attention on the waterfront, and many riders utilized the service for excursion purposes.

In the succeeding year the total number of riders fell by over 750,000, or approximately 30%. Ridership declined further in F.Y. 1993-1994 by 450,000 riders, or roughly 25%.

The decrease in the number of riders was most dramatic on the Hato Rey routes. For trips between Hato Rey and Cataño, ridership in F.Y. 1992-1993 was barely a fifth that of the previous year, while ridership between Old San Juan and Hato Rey fell by almost half. Direct, regular service on the Cataño - Hato Rey route was canceled in December of 1993, daily ridership having fallen from a weekday average of over 500 to only a handful in the three years of operation of this route, with monthly ridership for the last five months of operation averaging below 900. Under the current schedule limited peak service is offered between the two terminals as part of a triangular route, however numbers are not tracked separately for this service. Ridership also declined between Hato Rey and Old San Juan, falling below 24,000 in calendar year 1994, a number barely half of the 42,000 moved in the month of July in the previous year alone.

In January 1995, service to Hato Rey was discontinued for eight months. Reasons for the shutdown were the need to dredge the Martín Peña canal due to silt build-up and the severe mechanical problems being experienced by the catamaran vessels. The Hato Rey - Old San Juan route was reopened on September 15, 1995 after dredging of the waterway and overhaul of three of the catamarans. Although ridership was better than it had been in 1994, in the following ten months barely five percent of the total passengers (48,000 out of 915,000) used the Hato Rey-San Juan route. Fiscal years 1994-95 and 1995-96 were clearly affected by this service disruption, with annual ridership steady at 1.1 million. While ridership on the service was clearly falling prior to the canal closing,

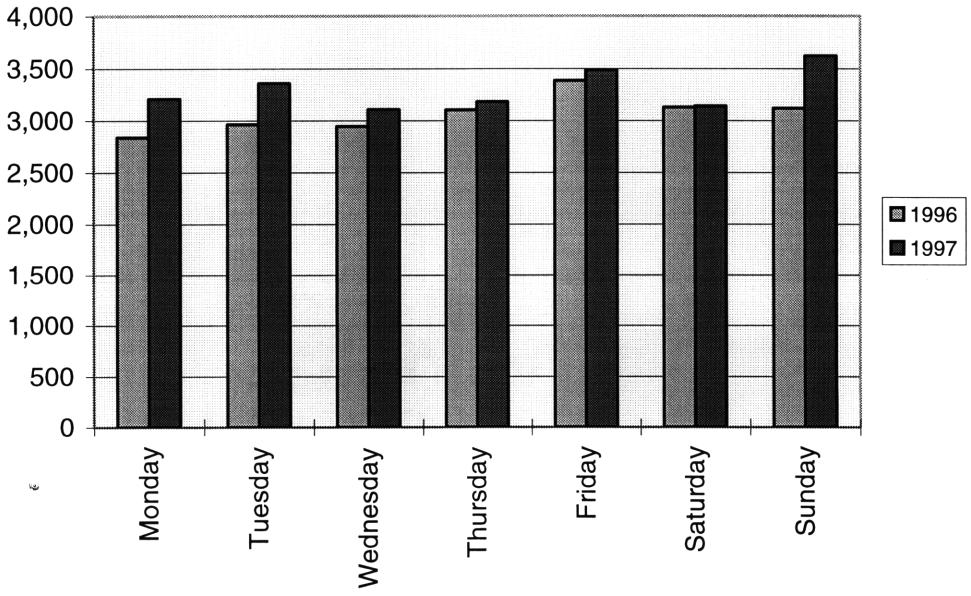
the cessation of service surely reduced confidence in the system and caused regular users to shift to other means of transportation.

In the most recent fiscal year ridership has improved, the Cataño - Old San Juan ridership having improved by almost 15%. Ridership on the Hato Rey route also improved slightly with a full year of service. Unfortunately, the Hato Rey service was shutdown again in October 1997 for more dredging, in support of flood control efforts on the Porto Nuevo channel to the east. Resumption of service is expected in January 1998, in conjunction with a $150,000 ad campaign.

Daily Ridership

Historically, over 5,000 passengers a day used the old ferry system to travel between Cataño and Old San Juan. With the introduction of the *Acuaexpreso*, daily ridership was expected to increase significantly, projections ranging as high as 15,000 to 19,000 a day.[11] During the first summer of operation, ridership levels did average over 7,000 a day. During the Great Columbus Regatta in 1992, *Acuaexpreso* moved its greatest number of passengers ever, transporting 75,720 on the twelfth of June alone.

Figure 2-2 Average Daily Ridership Cataño - Old San Juan (February - July)[12]



[11] Letter from Secretary Faría, Department of Transportation and Public Works to Mr. James O'Conner, UMTA Regional Administrator, July 22, 1983.

[12] Puerto Rico Port Authority monthly ridership figures.

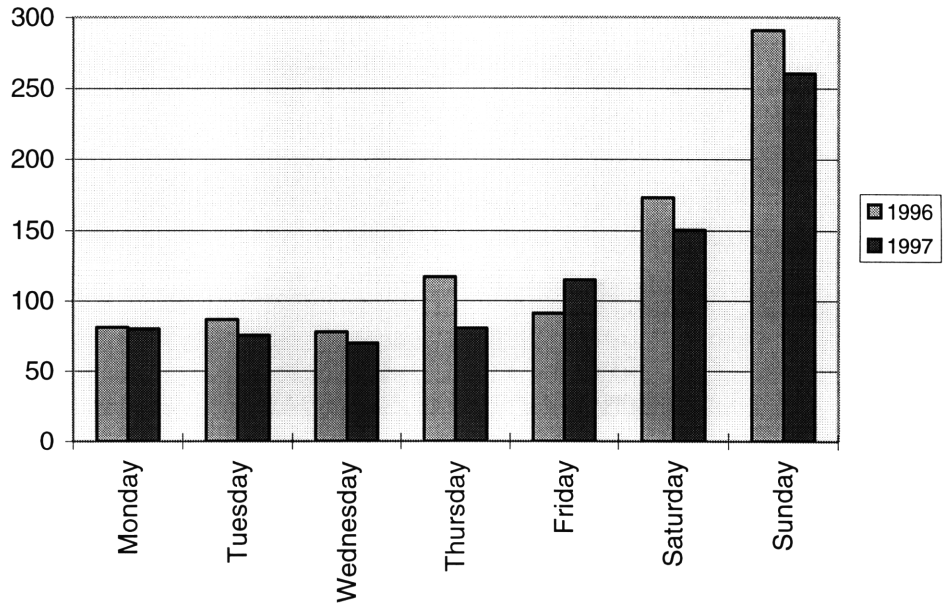
Since then, daily ridership numbers have matched the decline in the annual total. Figure 2-2 shows the daily ridership for the Cataño - Old San Juan route by day of week, for the six months between February and July (inclusive) for 1996 and 1997. Daily ridership during these six month periods averaged 3,100 passengers a day in 1996, 3,300 in 1997, with slightly higher ridership on the weekends.

Daily ridership on the Hato Rey - Old San Juan route is much lower than that of the Cataño - Old San Juan route , as shown in Figure 2-3. On weekdays the performance of this ferry route is usually dismal, averaging only ninety passengers and with a day's ridership of less than fifty not uncommon, an average of less than one passenger per trip. However, ridership more than doubles on the weekends, especially on Sunday. Several reasons are suggested for the higher weekend ridership, including:

a) higher recreational demand for travel to the Isleta on the weekend, e.g. more trips for excursion purposes;

b) poorer service by other transit systems on the weekend and a lack of parking make *Acuaexpreso* a more attractive transportation alternative.

Figure 2-3 Average Daily Ridership Hato Rey - Old San Juan (February - July)[13]



[13] Puerto Rico Port Authority monthly ridership figures (excluding March 23 and May 19, 1996).

The variability of daily ridership is considerable, especially for the Hato Rey - Old San Juan route. The month of January in particular has large swings in ridership due to the attraction of various festivals and holiday events in Old San Juan. For instance, on January 19, 1997 (a Sunday), 4,389 riders were carried on this route, compared to just 11 on the Monday two weeks previous. The ridership on this exceptional day alone was greater than total ridership in the subsequent month. Table 2-6 includes the average and standard deviation of daily ridership for the six month periods graphed above, as well as maximum and minimum ridership observed.

Table 2-6 Daily Ridership Statistical Summary

	Cataño - Old San Juan		Hato Rey - Old San Juan	
	Average	Standard Deviation	Average	Standard Deviation
1997 (February-July)				
Overall	3,299	456	119	83
Weekday	3,266	379	83	45
Weekend	3,381	602	205	93
Maximum	4,864		488	
Minimum	2,129		22	
1996 (February-July)				
Overall	3,067	658	131	123
Weekday	3,067	492	90	84
Weekend	3,184	959	236	142
Maximum	7,175		884	
Minimum	940		13	

Maximum ridership was always observed on a weekend, minimum ridership on a weekday.

2.4.5 Costs and Productivity

Cost of Service

Acuaexpreso is experiencing a common difficulty for all transit systems: increasing costs. Between 1991 and 1992, operating costs rose from $5.7 million to $7.9 million, roughly 57%. This was aside from the depreciation costs for the ferryboats, payments for which began in 1992, with an initial charge of $3.1 million. Added to operational expenses, this meant that total costs almost doubled between 1991 and 1992. Costs have stabilized since the 1992 jump, however the falling ridership and the

Table 2-7 *Acuaexpreso* Operating Funds & Expenditures (Fiscal Year)[14]

	1991-92	1992-93	1993-94	1994-95	1995-96
Total Expenses	$7,728,576	$7,346,239	$8,129,274	$6,146,496	$7,430,000*
Salaries/Wages/ Benefits	$5,111,846	$4,942,129	$4,984,137	$4,611,635	$6.0 million
Materials & Supplies	$531,116	$386,988	$245,871	$242,621	$250,619
Other Expenses	$2,085,614	$2,017,122	$2,899,266	$1,291,940	$1,177,842

* Based on rounded expenses of $3.7 M for salaries and wages, $2.3 M for benefits.

Table 2-8 *Acuaexpreso* Estimated Expenditure F.Y. 1996-97[15]

	Total Annual	Cataño 51%	Hato Rey 49%	Total Monthly	Cataño 51%	Hato Rey 49%
Operational Labor & Fringe Benefits	$2,793,804	$1,424,840	$1,368,964	$232,817	$126,409	$106,408
Maintenance Labor & Fringe Benefits	$1,797,036	$916,488	$880,548	$149,753	$76,373	$73,380
Maintenance Repairs	$644,259	$328,572	$315,687	$53,688	$27,381	$26,307
Diesel and Fuel Expenses	$348,166	$177,565	$170,607	$29,014	$14,797	$14,217
Police Services	$229,497	$117,043	$112,454	$19,125	$9,754	$9,371
Professional Services	$154,314	$78,700	$75,614	$12,860	$6,559	$6,301
Materials & Supplies	$78,706	$40,140	$38,566	$6,559	$3,345	$3,214
Telephone Expenses	$39,617	$20,205	$19,412	$3,301	$1,684	$1,617
Heat, Light, & Power	$70,369	$35,888	$34,481	$5,864	$2,991	$2,873
Water & Sewer Expenses	$47,717	$24,337	$23,382	$3,976	$2,028	$1,949
Insurance Expenses	$280,636	$143,124	$137,512	$23,386	$11,927	$11,459
Litigation Expenses	$315,000	$160,650	$154,350	$26,250	$13,388	$12,862
Sub-Total	$6,799,121	$3,467,552	$3,331,577	$566,593	$296,635	$269,958
Depreciation	$1,380,369	$703,988	$676,381	$115,031	$58,666	$56,365
Amortization	$146,665	$74,799	$71,866	$12,222	$6,233	$5,989
Total	$8,326,155	$4,246,339	$4,079,824	$693,847	$361,534	$332,312

[14] Data for first four fiscal years taken from National Transit Database Reports. F.Y. 1995-96 data taken from Puerto Rico Port Authority presentation, salaries and fringe benefits rounded off to nearest hundred thousand.

[15] Data from Port Rico Port Authority report to FTA Project Management Oversight Services.

reduction in Federal assistance have increased the deficit that must be made up by the Port Authority.

The operating expenses of the system for the first five years of operation are given in Table 2-7. Costs have been variable in the last several years due to the closing of the Martin Peña canal and the eight month cessation of service to Hato Rey. Estimated annual expenditures for F.Y. 1996-97 are given in Table 2-8, showing both the annual totals as well as monthly expenditures for both the overall system and allocated between the two routes. The F.Y. 1996-97 estimate includes depreciation and amortization, which are not included in the expenses listed in Table 2-7. Removal of these expenses lowers overall estimated annual expenses to $6.8 million, as shown under the sub-total row.

Service Productivity

Besides reducing revenue, the reduction in ridership has also caused the principal performance measures of the *Acuaexpreso* service to decline, until the most recent year's increasing ridership. Unfortunately, the performance measures for *Acuaexpreso* in the National Transit Database for the fiscal years 1992 through 1995 have significant errors, requiring estimation of the correct performance measures. Based on known ridership and costs, and estimating revenue vehicle miles and hours based on fuel consumption and schedule requirements, estimated performance measures for the system are presented in Table 2-9.

The table shows that all cost-based measures have deteriorated, especially in 1995 when the interruption in Hato Rey service reduced vehicle miles and hours of operations sharply, while costs remained high. The estimates for F.Y. 1996-97 are improved, representing an entire year of full service, as well as cost reduction from the high in F.Y. 1992-93.

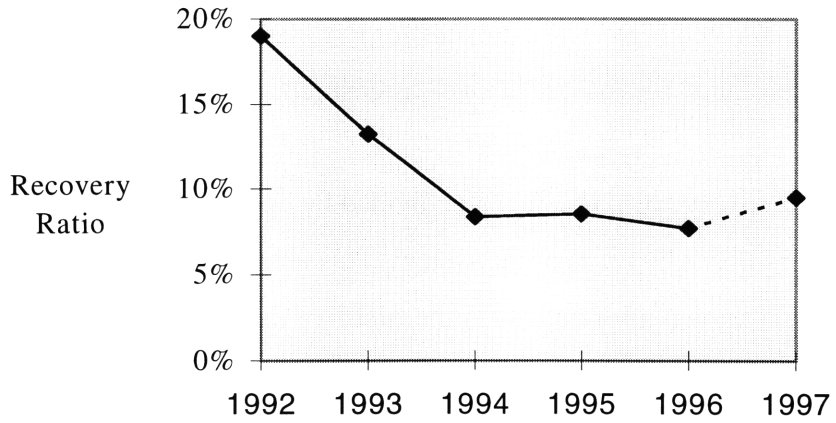
The farebox recovery ratio, fare revenue divided by operating expenses, measures the percentage of costs borne by users of the system. This measure is shown graphically in Figure 2-4, based on known information for the first five fiscal years and estimated information for the most recent fiscal year.

Table 2-9 Estimated Performance Measures for *Acuaexpreso* (Fiscal Year)

	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
Service Efficiency						
Operating Expense/ Revenue Vehicle Mile	$34.35	$49.02	$123.06	$94.06	$66.48	$52.14
Operating Expense/ Revenue Vehicle Hour	$181.85	$259.54	$651.49	$497.99	$543.61	$335.63
Cost Effectiveness						
Operating Expense/ Passenger Mile	$1.37	$2.20	$4.31	$4.58	$4.87	$3.91
Operating Expense/ Unlinked Passenger Trip	$3.15	$4.35	$6.64	$5.82	$6.73	$5.38
Service Effectiveness						
Unlinked Passenger Trips/ Revenue Vehicle Mile	10.92	11.27	18.52	16.17	9.87	9.68
Unlinked Passenger Trips/ Revenue Vehicle Hour	57.82	59.69	98.05	85.62	80.74	62.33
Passenger Miles/ Revenue Vehicle Mile	25.00	22.29	28.53	20.53	13.65	13.34
Farebox Recovery Ratio	19.02%	13.22%	8.33%	8.51%	7.68%	9.48%
Estimated Service Data						
Passenger Trips	2,457,287	1,689,400	1,223,413	1,056,764	1,103,571	1,262,718
Revenue Vehicle Miles	*225,000*	*149,850*	*66,060*	*65,340*	*111,759*	*130,396*
Revenue Vehicle Hours	*42,500*	*28,305*	*12,478*	*12,342*	*13,668*	*20,258*
Passenger Miles	*5,624,632*	*3,339,425*	*1,884,968*	*1,341,433*	*1,525,498*	*1,739,612*
Operating Expense	$7,728,576	$7,346,239	$8,129,274	$6,146,196	$7,430,000	*$6,799,121*
Passenger Revenue	$1,469,865	$970,858	$676,979	$523,067	$570,366	*$644,794*

** italicized figures are estimates, based on other information. (See Appendix B).*

Figure 2-4 Farebox Recovery Ratio for *Acuaexpreso*



Passenger Fares as a percentage of Operating Expenses
(Fiscal Year ending in year indicated)

However, despite recent performance improvements, *Acuaexpreso* remains a service that in terms of productivity is relatively inefficient and expensive to operate compared with other transit operations in the SJMA.

2.4.6 Service Operation

As discussed in the section on frequency of service, operation of the *Acuaexpreso* system has been variable, with published information, human sources, and actual operation disagreeing. Even ridership numbers differ, depending upon the source. In part, this is due to the service disruptions and changes that have taken place, as well as occasional breakdowns and other problems. Nor is it to be expected that operation of the service should have been consistent over the past six years.

These changes in operation will affect the results of an overall cost estimate for *Acuaexpreso* in Chapter Four, based on the information available for the system and using methods from several studies. In addition, cost estimates for the two routes operated by *Acuaexpreso* will be calculated, allowing an allocation of the known costs between the routes. These route cost allocations will then be used for performance comparison in Chapter Four and service comparison in Chapter Five.

Due to the changes in operation, there will be a degree of error in the estimated costs for the service, as well as the usual uncertainties associated with cost allocation. Nevertheless, it is evident that the history of *Acuaexpreso* has not been positive in terms of service effectiveness or efficiency, in particular the Hato Rey - Old San Juan route. This will be evident in the performance comparisons of Chapter Four, and in the review of other North American urban ferry systems in the next chapter, the majority of which have been relatively successful.

3. Comparative Ferry Systems

This chapter discusses several North American urban ferry systems. A brief review of the historical development of each system is presented, as well as a service description and any unique features associated with the system. The information from these case studies will be used to provide ideas and examples for possible changes for application to *Acuaexpreso*, which will be presented and analyzed in the following chapters.

3.1 Introduction

3.1.1 Historical Development

There are over 150 ferry systems in the United States, carrying roughly 70 million passengers a year on over 250 routes.[1] These ferries carry both passengers and vehicles across harbors, rivers, and the ocean. Many of these routes are substitutes for road networks, operating in lieu of bridges or across significant stretches of water. In Puerto Rico, the ferries to the islands of Vieques and Culebra are examples of these conventional ferry systems. However, the last two decades have seen the reappearance of a once common sight, the urban ferry, operating as a complement to other transportation alternatives.

Historically, most urban ferry services in American cities disappeared during the first half of the twentieth century. The explosion in car ownership, and the construction of bridges, tunnels, and highways, eliminated all but the strongest of ferry services in most cities. Only those ferries that operated in lieu of a bridge survived. The prime example of this is the Staten Island ferry in New York City, the largest-volume passenger ferry route in the United States. Though driving is possible between Staten Island and Manhattan, the route is long and circuitous and the ferry service has remained a preferred alternative for many commuters. Similarly, in the state of Washington local government decided against

[1] Urban Harbors Institute, UMASS-Boston. *National Ferry Database* (Boston, MA. 1994). p.1.

a plan to build multiple bridges across the Puget Sound, given both the cost and the impact on the waterway. The existing ferry services were maintained and improved, and continue to serve as the main transportation links between Seattle and the islands and towns across the Sound that comprise some of that city's suburbs.

However, ferry services that offered a means of transportation in direct competition to other modes disappeared. Ferry trips were unappealing, with the disadvantages common to most public transit services of waiting time and low quality, along with the unpleasantness of trips across frequently polluted harbors. The question posed regarding urban ferry service was: 'Why would anyone take a ferry, unless to get to an island that they could not drive to?' The answer of course is congestion, as the number of vehicle trips into cities, and therefore the average commute time and cost of parking, rose. While growth in suburb to city traffic has been only modest, the overall growth of urban traffic has been great, choking highways and creating enormous public demand for alternatives.

Starting in the late 1960's, interest in ferries as alternative commuter modes of transportation reappeared in the US. The first instance was in San Francisco, where the Golden Gate Bridge had put several ferry services out of business when built in the 1930's. The growth of the region and automobile use increased sharply in the next two decades, however, to the point where peak demand exceeded the capacity of the bridge. With the bridge jammed with traffic every day, the city and state studied the cost and impacts of building another span or a complete new bridge to supply the needed capacity. Eventually, the various proposals were rejected, due to both the economics and the aesthetics of building an additional span. Instead, transit services were improved, including both express bus service over the bridge and a modern commuter ferry.

This reemergence of the commuter ferry spread to other US cities, leading to developments in vessel technology; the high speed catamaran ferries that *Acuaexpreso* uses being one example. Commuter ferry services now exist in New York City, Boston, San Francisco, and Seattle, all major port cities. It is the development of these new commuter ferry systems that prompted the introduction of the *Acuaexpreso* ferry service concept in the mid-1980's.

Ferry systems can thus be categorized as providing one of three types of service, as outlined in a study prepared for the FTA, *Assessment of Ferries as Alternatives to Land-Based Transportation*. These are:

1. Ferry routes that serve as the only means of surface transportation, e.g. to and from an island. Examples include routes to islands like Nantucket and Martha's Vineyard off the coast of Massachusetts, or in the case of Puerto Rico the ferry routes to the islands of Culebra and Vieques.
2. Ferry routes that replace a bridge or tunnel. In this case, while a tunnel or bridge is technically feasible, the cost or other negative effects, e.g. choking off a waterway or destruction of the urban fabric, have kept ferries as the preferred alternative. The Staten Island system in New York City is an example of this, or in the Puerto Rican case, this description applies to the case of the Cataño - Old San Juan route served by *Acuaexpreso*, the cost and impacts of a bridge or tunnel linking those two areas being prohibitive.
3. Ferry routes that serve as complementary transportation modes to other land based modes. In this case, the ferries are competing directly with a road network or other public transit service. These routes typically serve as either excursion routes, meant to serve as an amusement, or more recently, as commuter routes, using the freedom of the waterway to avoid the peak hour congestion found in most large cities. This latter explains the introduction of such ferry systems as New York Waterway in New York City, the Hingham commuter boat in Boston, and, potentially, the Hato Rey - Old San Juan route of *Acuaexpreso*.

There is some overlap among the three categories of ferry service. The second category, where service is provided in lieu of a bridge or tunnel, can also be considered as acting in competition with land-based transportation alternatives. Again, the Staten Island ferry is an example of this, as it is possible to travel by car from the island to Manhattan. However, the savings in travel time on the ferry is usually so much greater that the land based alternative is attractive only for those commuters for whom the importance of an

alternative is large, e.g. the attractiveness of the automobile outweighs any other consideration.

Still, ferry travel in the United States and in Canada is a pale shadow of that existing elsewhere. It is estimated that there are as many daily passengers on the ferry system in Lisbon, Portugal as there are on all the systems in the entire United States.[2] In addition, in Europe, the Far East, and Australia, there have been major investments in ferry systems and technology, concepts from the latter having since been incorporated into US vessels. Of course, there are many factors affecting such use, including higher population densities and lower car ownership compared with North America. Nonetheless, these systems are examples of what is possible for urban ferry systems.

3.1.2 Ferry System Case Study Methodology

The *Acuaexpreso* service opened in 1991. It is therefore a fairly modern service. Nonetheless, there have been many developments in ferry service in the United States and elsewhere that offer potential lessons for, and comparisons with, *Acuaexpr*eso. A review of other major ferry systems offers innovations in organization, management, marketing, and other fields that may be applicable to *Acuaexpreso*. This is particularly important with respect to intermodalism, which has been one of the main recent transit initiatives. Concentration will be on the third type of ferry systems discusses above, urban ferry systems that act as alternatives to road-based transportation systems.

Case studies of several ferry systems will present different methods of operation, as well as a number of marketing techniques for attracting riders and other innovations. While there are certainly commonalities among the systems, for instance developments in vessel technology have spread quickly, most ferry systems grew and are operated in different ways. Therefore, each case study will include information (where available) on:

- a description of each system, both boats and routes;
- ridership, both total and as a mode share;
- integration with other transit systems, including intermodal access, scheduling, and fares;

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[2] Pacific Transit Management Corp. *Regional Ferry Plan San Francisco Bay Area.* Final Report, September 1992. p.4.

- institutional/organizational arrangements;
- technology;
- operating costs and revenue, total and per capita;

and in particular will focus on unique features and solutions to past problems.

The major United States urban ferry systems, located in the cities of Boston, New York City, San Francisco, and Seattle, will be reviewed, as well as the SeaBus ferry system in Vancouver, Canada. The information from these case studies will be used to provide comparisons and concepts for recommendations of changes for *Acuaexpreso*.

3.2 The Boston Ferry System

3.2.1 System Description

The Boston ferry system consists of a variety of both private and contracted ferry services, operated by a number of private companies who own and operate their own vessels. Two state agencies in Boston, the Massachusetts Port Authority (Massport) and the Massachusetts Bay Transit Authority (MBTA), are the agencies most heavily involved, though a number of others play minor roles. The MBTA subsidizes four ferry routes based on contract agreements. Massport does not directly subsidize ferry operating costs, but indirectly supports several routes in conjunction with other state or local agencies as well as local businesses by providing parking, advertising, and shuttle bus service. Terminal facilities are provided by various agencies, and a nominal landing fee is charged to the companies.

Most ferry routes in the area operate to and from downtown Boston, landing at either Rowes Wharf or Long Wharf, both located on the waterfront approximately a quarter-mile apart. These piers are within walking distance of a large part of the downtown area as well as connections to the MBTA transit rail and bus system. Boston ferry routes include the following:

1. Rowes Wharf (Boston) - Hingham Shipyard
2. Long Wharf (Boston) - Charlestown Navy Yard
3. Long Wharf - Hull
4. Long Wharf - Quincy Shipyard

5. Long Wharf - Logan Airport Dock
6. Rowes Wharf - Logan Airport Dock
7. North Station - World Trade Center (South Boston)
8. City Water Taxi (service between 12 locations on demand)

The two largest ferry routes in terms of ridership are the Charlestown and Hingham routes, both contracted and subsidized by the MBTA. The other ferry routes are much smaller, carrying only a few hundred passengers a day at most.

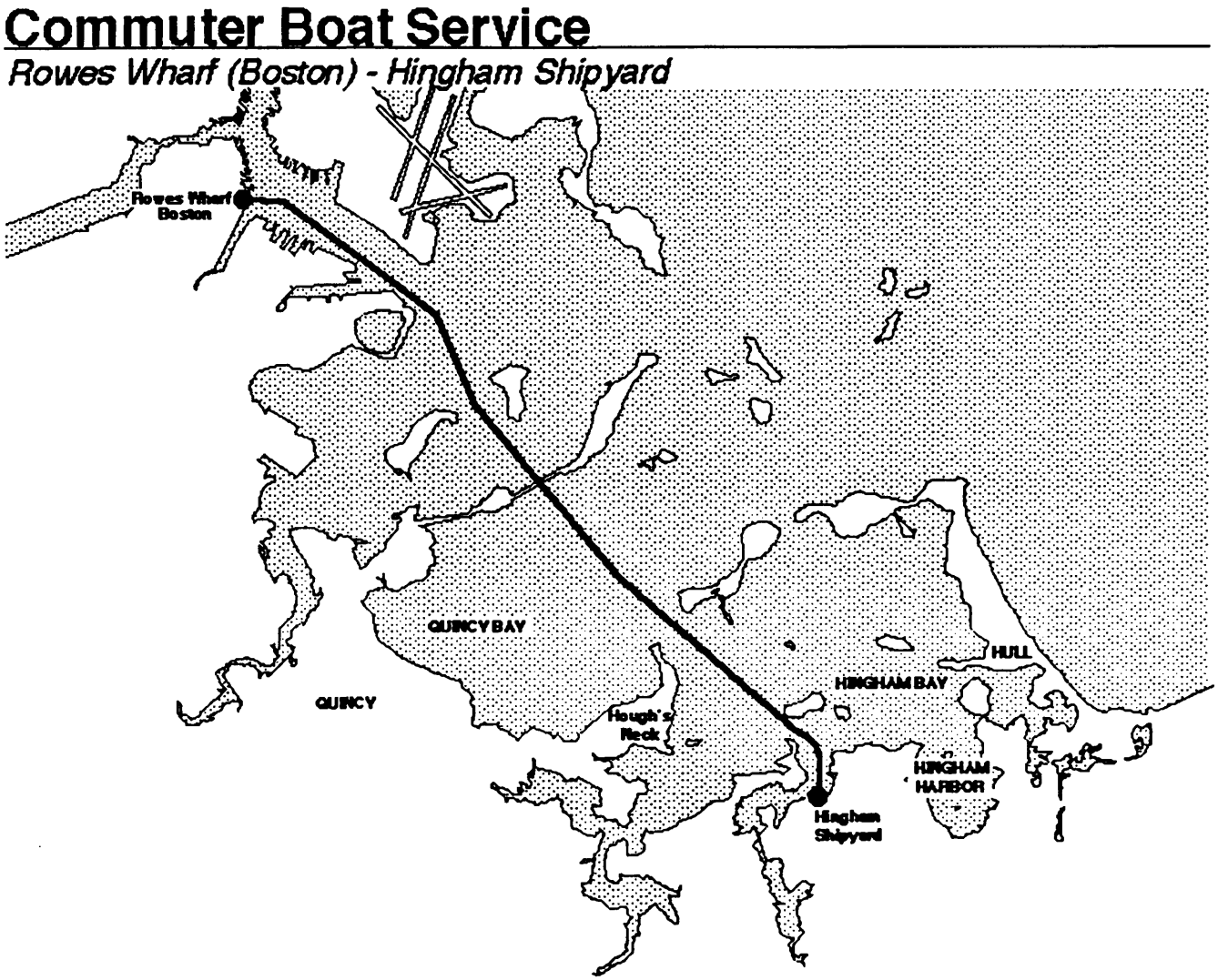
3.2.2 Hingham Commuter Boat

The Hingham Commuter Boat ferry service provides weekday commuter service from a suburb on the South Shore, the coastal area south-east of Boston, to Rowes Wharf downtown (Map 2-1). The operators of the service concentrate on offering a high-quality service, complete with food and newspaper sales, to attract potential customers. The high level of service, along with competitive travel times to Boston compared to other modes, continues to attract a strong and growing ridership.

Ferry service between Hingham and Boston has strong historical antecedents, dating from the early 19th century. However, the growth of the automobile and the post-World War Two construction of the road network had lead to the disappearance of this and many other ferry systems. By the 1970's it was recognized that increasing road congestion was becoming a problem, and in 1975 an agreement was reached to introduce unsubsidized service between Boston and Hingham. However, the route failed to be profitable, and the attempt ended in 1977. In the following year, under the leadership of the Executive Office of Transportation and Construction (EOTC), a high speed hovercraft route was introduced as a transportation experiment. Unfortunately, although providing comparatively quick travel times, the service had several problems due to the expense of the high-speed vessel and the limitation of having only one vessel. Random factors also played a part, as when the vessel ran aground on its second day of service. The service was terminated in 1979.

Public agency involvement occurred again in 1984, when it became apparent that the Southeast Expressway would be seriously affected by reconstruction. As a mitigation measure for the expected congestion and delay, the Massachusetts Highway Department,

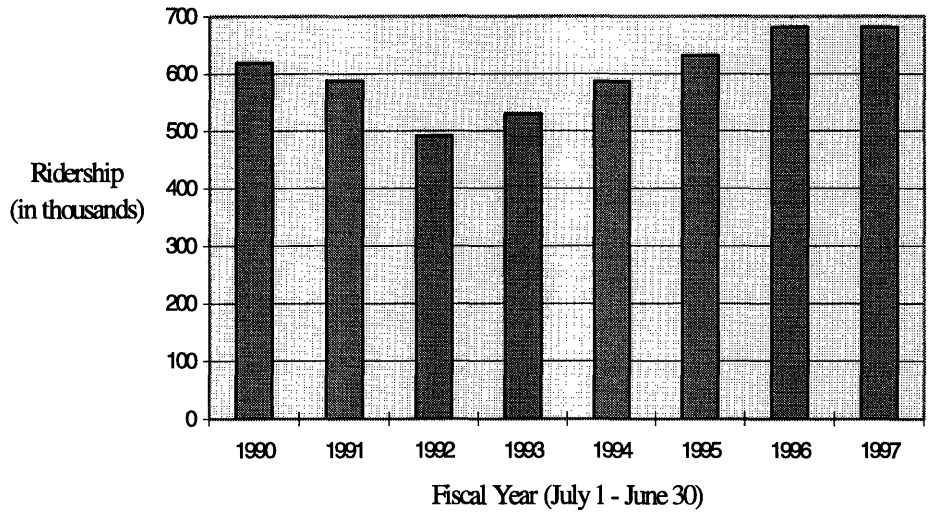
Map 3-1 Hingham Commuter Boat Route



Source: MBTA

the MBTA, and the Executive Office of Transportation and Construction decided to subsidize ferry service as an alternative to the auto commute. With the experience gained during the first operation, this time a contract was put up for bid to operators with multiple vessels for a fixed maximum subsidy. Even though reconstruction was completed within two years, the ferry proved popular enough that the MBTA continued to provide funding. Since 1984, the service has continued on a regular basis with growing ridership, especially over the past several years which have seen annual increases of 30,000 to 50,000 passengers a year since 1992 (Figure 3-1). Currently the Hingham service averages about 3,000 passengers per day, for a total of 681,536 during the 1997 fiscal year (July 1, 1996 to June 30, 1997).[3]

Figure 3-1 Hingham Commuter Boat Ridership



Level Of Service

Schedule: Peak hour service only: 6 to 10:30AM and 2:30 to 7:30 PM.
Departures every 15 minutes in the AM period.
Departures every 20 minutes (approximately) in the PM period.
Operates Monday - Friday, with 34 daily one-way trips.

Fares: $4.00 one-way. $34 for ten ride ticket. $136 for monthly pass.
MBTA pass is valid for a reduction, but no other transfers are available.

Travel Time: 35 minutes

[3] Ridership figures supplied by the Massport Port Planning and Development Department.

Terminals

The Hingham end of the service relies strongly on riders arriving by automobile. According to a 1992 passenger survey, only 35% of the passengers come from Hingham itself. Present parking space at the terminal is now close to 1300 spaces, and the MBTA recently paid for paving the lot and a 200 space expansion.

Cost

The service costs the MBTA approximately $1.3 million per year, depending upon the ridership. This figure consists of an operating subsidy of approximately one million dollars, and another $300,000 for terminal support. The MBTA also provides marketing and advertising for the service.

Modal Comparison

A comparison of travel times for the different modes of travel between the South Shore and Boston, including the Hingham service and the two other one-trip ferry services offered to Hull and Quincy, are presented in Table 3-1 below:

Table 3-1 South Shore Travel Time Comparisons (AM Peak)[4]

Mode:	Walk	Wait	Ferry	Bus	Rail	Auto	Total
Hingham - Boston (~9% of commuters utilize transit)							
Ferry	9	7	35	-	-	7	58
Auto	7	-	-	-	-	48	55
Bus & Rail	12	7	-	25	20	-	64
Hull - Boston (~8% of commuters utilize transit)							
Ferry	12	n/a*	45	-	-	8	65
Auto	7	-	-	-	-	52	57
Bus & Rail	12	10	-	45	20	-	87
Quincy - Boston (~18% of commuters utilize transit)							
Ferry	13	n/a*	17	-	-	13	43
Auto	7	-	-	-	-	29	36
Rail	12	2	-	-	20	-	34

*The Hull and Quincy routes have only one round trip a day.

[4] Schoon, J., P. Furth, and R. Lieb. *The Potential for Supplemental Freight Services in Ferry Planning and Operations: A Case Study and Planning Guideline*. (August 1989.) Figure 2.4, p. 58. Updated to reflect new ferry travel times. The travel times are based upon travel times between major street intersections in the local towns and Boston. Bus and/or rail transit combinations are based upon the major transit centers, with people accessing them by walking. For the ferry terminals, it is assumed that they are accessed by car, due to the high numbers of commuters parking or being dropped-off. All travelers are assumed to walk some distance in Boston, with the ferry terminals being slightly more distant from the major employment centers.

In contrast to the 3,000 passengers a day utilizing the ferry service, only about 340 people a day take bus #220 from Hingham to Quincy where there is access to the Red Line rapid transit rail line to the city.[5] It is apparent that the large majority of Hingham and Hull transit commuters to the city rely on ferry service as the transit mode of choice instead of rail or bus service.

The comparisons of travel times shows that the ferry does not have a significant advantage over auto travel in terms of total travel time, though it is faster than other transit alternatives from Hingham and Hull. Instead, it is the quality and convenience of ferry service that attracts riders, while the high cost and difficulty of parking in Boston and the congestion of the roadways discourage commuters from automobile use. From passenger surveys, the reasons for traveling on the ferries predominantly include preference for the quality and comfort of the service, including: the scenery, food & beverage service, and the opportunity to do work or another activity instead of driving. The fares for the service are high, especially compared other transit modes, but comparable to typical parking fees in downtown Boston which can exceed $10 a day.

3.2.3 Charlestown Water Shuttle

The Charlestown Water Shuttle provides ferry service from downtown Boston to a combined residential and tourist area immediately north of Boston. The Charlestown ferry therefore attracts both commuters and tourists, leading to two to three times as many passengers during the summer months. The service has a daily ridership between 400 and 1,000 passengers, and carried 245,000 last year, a figure which has been increasing by approximately 20,000 passengers a year since 1990 (Figure 3-2).[6]

The Charlestown Water Shuttle was introduced in the late 1980's as a mitigation measure in support of highway work on the Central Artery, the major highway running through the city center. The original Central Artery/North Area (CA/NA) work lead into the current Central Artery Project, and with the encouragement of the Massachusetts Highway Department, the ferry service is subsidized by the MBTA.

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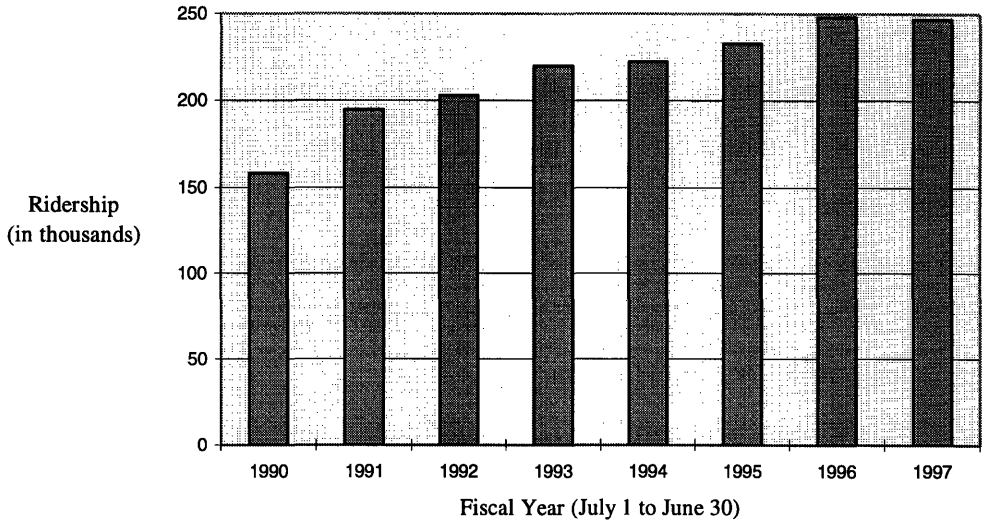
[5] MBTA Planning Division. *1997 Ridership & Service Statistics.* (July 1997.) p. 2-21.
[6] Ridership figures supplied by the Massport Port Planning and Development Department.

Figure 3-2 Charlestown Water Shuttle Annual Ridership[7]



Level Of Service

Schedule: Weekday Service operates from 6:30 AM to 8:15 PM.

Departures every 15 minutes during peak periods. (6:30 - 9:00 AM 3:30 - 6:30 PM)

Weekend Service operates from 10:00 AM to 6:15 PM

Departures every 30 minutes.

Fares: $1.00 one-way. No other tickets. The MBTA "T" monthly combo pass is valid. No other transfers available.

Travel Time: 10 minutes

Terminals

The Long Wharf terminal is immediately adjacent to the New England Aquarium. From there, the boat sails to the Charlestown Navy Yard, where the historic USS Constitution is moored. In addition, there is a free shuttle bus operating in the Navy Yard, contracted by the MBTA. The shuttle bus schedule is timed to match ferry arrivals, with the route serving the USS Constitution tourist attraction and a parking garage.

Cost

The subsidy for the service was roughly $150,000 in fiscal year 1996. While the service is contracted by the MBTA, funding comes from the Massachusetts Highway Department as a mitigation measure for the Central Artery construction project.

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[7] *Ibid.*

3.2.4 Other Ferry Services in Boston

The other ferry services operated in Boston are of a smaller scale, generally consisting of small one-ferry boat routes served by owner-operators.

East Boston

This ferry service ceased operation in November of 1997. Contracted by the MBTA, the ferry operated between East Boston and Long Wharf every 20 minutes during the AM and PM peak, with periodic service during the mid-day and on weekends. The service had been in operation since September 1995, and, failing to meet ridership expectations, had been heavily criticized for its high cost per passenger. A small scale operation, daily ridership was projected to be 150 a day, which was the ridership the first month of operation. Although by June, 1996, the end of its first fiscal year of operation, over 14,000 riders had been carried, ridership averaged less than 20 passengers per day in January and February. The lack of parking space and the competition of the subway made ridership marginal except during the summer months. In the succeeding summers of 1996 and 1997, ridership grew to over 2,000 in the month of August. However, after September ridership fell to several hundred a month. Without the attraction of a summer excursion-like voyage, the service was simply not competitive.

City Water Taxi

The City Water Taxi seeks to replicate the on-call service provided by auto taxis. A recent introduction to Boston, though a concept that has been implemented in other cities, the service operates on a schedule between Rowes Wharf and the airport landing, but can also be called for pick-up at a half-dozen locations along the downtown waterfront as well as landings at Charlestown, South Boston, and the suburb of Chelsea. These stops are simple gangways and floats, of the simplest construction that the ferry can dock at. The service only operates six months a year, and fares are $5 for travel between all locations except the airport, when they increase to $10, or $8 per person for a group of two or more. The service receives no direct subsidy, but its wharf fees are paid by an alliance of businesses and Boston city agencies.

Harbor Express

Harbor Express is a contracted ferry service, without a direct operating subsidy, operating a triangle route between the South Shore suburb of Quincy, Long Wharf downtown, and the Logan Airport Dock. It thus provides a service for both commuters to downtown and users of the airport. The company is under a contract agreement with Massport to supply the service, through which Massport picks up the non-operating costs, including maintenance of the airport landing. Massport also operates free shuttle bus service from the dock throughout the airport terminals. The company operates two vessels, providing service every 35 to 45 minutes during the weekday peak, with a reduced off-peak and weekend schedule. Between Quincy and Long Wharf the ticket price is only $5, however between Quincy and the airport the fare is $10, while between Long Wharf and the airport, a trip of only a few minutes, the fare is $8. This fare structure reflects the generally higher premium business travelers are willing to pay for transportation to or from the airport; transit connections to the airport being poor while traffic delays can exceed 30 minutes at the bottleneck imposed by the tunnels into downtown Boston.

Airport Water Shuttle

The Airport Water Shuttle is the final link in access to Logan Airport, operating frequent service between Rowes Wharf and the Logan Airport Dock. This service is also under contract agreement with Massport to provide service, though operating costs are not subsidized directly. The service operates on a fifteen minute frequency throughout the work week, thirty minutes on the weekend. The fare is also high, $8 one-way or $14 for a round trip ticket, again reflecting the airport premium. A recent modification of this is an agreement between the MBTA, Massport, and the Airport Water Shuttle to provide a discounted rate for connections between the Shuttle and the Hingham Commuter Boat, with a discount of $2 off the otherwise combined fare of $12.

3.2.5 The MBTA Hingham Commuter Boat Contract

An analysis of the most recent contract signed between the Massachusetts Bay Transit Authority and the operator of the Hingham Commuter Boat ferry service presents

information on both the standard contract for privately operated services, and provides a lesson in the problems in dealing with a changeover in contracted services.

The contract by the MBTA for operation of the Hingham commuter ferry service is a variable cost contract for a five-year term. The service is subsidized to make up the difference between cost of operation and passenger revenues collected. The operator has the entire responsibility for operation and ownership of the vessels, submitting the necessary paperwork concerning seaworthiness and insurance of the vessels as well as certification of the crew.

Besides monitoring performance of the operator, the MBTA continues to perform several other activities. It prints the fare tickets and pays the company for all costs associated with upkeep of the ticketing facilities. The agency also performs the marketing for the service: publishing schedules, printing maps, and advertising the service.

Contract Analysis

The contracted company is paid a subsidy to offset the costs of operation of the service. The maximum amount of subsidy that will be paid by the MBTA is set at the signing of the contract for the service. The bidding companies submit their projected costs and passenger revenues for the five year period, and the MBTA sets maximum compensation for the contract at the lowest bid. However, actual compensation is based on the difference between the cost of operation and fare revenue collected, up to the maximum amount specified by the bid for each fiscal year. Note that this is usually a declining figure, based on projected increases in ridership, and thus fare revenue, over the duration of the contract. If ridership falls below expectations, the operator will be making less than projected for the contract.

In examining the current and the preceding contracts, however, there is a significant difference in the determination of the compensation. In the preceding contract, there was an incentive for the operator based on increases in ridership. Based on the ridership for a base year, the fiscal year prior to the contract, if revenues in any year were higher due to more riders the company gained the revenue from the additional ridership, minus 50% of the increase from the preceding year of operation. For instance, if base year fare revenue was $100K, last FY fare revenue was $120K and this year's fare revenue

was $150K, the operator would collect a bonus of $35K in addition to the subsidy amount calculated from actual expenses minus revenue collected.

Under the current contract, there is no ridership incentive bonus. Instead, the company at a maximum can only gain the subsidy amount it bid. If revenue is greater than predicted, then the subsidy amount decreases proportionally. However, in the newer contract there is an additional step for figuring the maximum subsidy and bid amount. In the calculation, the operator adds a rate of return of eight percent after the subtraction of projected revenue from projected expenses produces an estimated subsidy. This total compensation figure is then used to determine the bid amount for the maximum subsidy the MBTA will provide. The MBTA then pays a monthly subsidy based on actual costs of operation minus actual passenger revenue, plus the eight percent allowed return. However, the eight percent allowed return is also a maximum limit to the profits an operator can make, for in any year the company finds that is has exceeded the eight percent rate from direct operation of the service, the excess must be returned to the MBTA.

There is no provision in the contract for keeping the MBTA informed of the costs and profits of any concession service offered. It is likely that this is a significant portion of the revenue for a company, based on its importance to both passengers and the operator of the vessels.

In most contracted companies, the vessels are owned by the contracted private operator. This increases the risk faced by the operator, for in the event the contract being lost or terminated, the operator is then left with the vessels and little use for them. Given that a vessel lifetime is usually at least fifteen years, an operator must add the risks of vessel ownership to the bid, as well as any associated depreciation.

Monitoring the contract is always difficult. Ridership can be measured using covert surveys over a period of days. Monitoring the revenue actually collected by a company is harder, presuming the fare is differentiated for categories of passengers, or if there are discounts or passes that can be used.

3.2.6 The 1997 Hingham Commuter Boat Operator Transition

On July 1st, 1997, a new operator took over operation of the Hingham to Boston commuter ferry service. This changeover in operator engendered a significant amount of opposition by both the prior operator and by users of the system, who formed a citizen's group to protest the change.

The operator of the Hingham Commuter Boat service for the prior fourteen years was Boston Harbor Commuter Services (BHCS). This company had operated the service since 1984 as part of the mitigation for reconstruction of the Southeast Expressway. During this period of operation, ridership grew from several hundred to 2,800 riders a day. Another company, Massachusetts Bay Lines, had bid for the initial contract in 1984, having operated intermittent service to Hingham in the preceding years. Despite losing the contract, peak demand was sufficient to enable Massachusetts Bay Lines to continue to operate a vessel between Hingham and Boston without subsidy.

As June 30, 1997 approached, the contract for the service was up for renewal or re-bidding. The MBTA sent out its request for bids in early May, and decided among the bidders on June 3rd. The new holder of the contract was Harbor Cruises LLC, a consortium largely supported by a construction company Modern Continental Construction Co., that had been operating several smaller ferry routes in the Boston harbor area. Harbor Cruises won with a bid that significantly undercut that of Boston Harbor Commuter Services, asking for $5,000,000, or some 30% less than the bid by BHCS.

Harbor Cruises LLC began operating the service on July 3rd, in the face of opposition by the owners of BHCS and a citizen's group that had formed. By this time, BHCS had informed riders of the upcoming change, and expressed their concern that Harbor Cruises would be incapable of offering the same level of service as had BHCS. An injunction was sought on June 30th to prevent the change in operator, but was rejected by the court.

The first week of operation, Harbor Cruises did face several problems, as they worked to set up their system. Several boats were delayed as the captains gained

experience with the route, and there were many customer complaints concerning late departures, longer travel times, as well as cleanliness and conditions on the vessels.

In the face of these complaints, the MBTA responded by involving its management and customer relations in the service. Each vessel departing was monitored by an MBTA manager, taking notes and responding to customer concerns. Checksheets were filled out for each voyage, and expert pilots were hired as temporary consultants to monitor the Harbor Cruises' captains and crews in their operation of the vessels. Discrepancies were quickly resolved, and the two weeks for which this program continued saw continuous improvement in the performance of Harbor Cruises, now virtually matching the service offered by BHCS.

At the same time, BHCS acted to maintain its presence. After only four days of operation by Harbor Cruises, BHCS joined forces with Massachusetts Bay Lines, still operating its peak-only unsubsidized service, to continue offering service at the same fares and schedule as under the contract agreement. Use of the pier facilities was permitted by law to any operator of a commuter service, so BHCS could continue to use the same docking spaces. The response was tremendous, as the majority of riders promptly shifted back to riding with BHCS, despite the overcrowding and lengthy waits that were common during the peak period. For the first several weeks after the two services began competing on July 7th, eight out of ten passengers continued to use the BHCS service.

The standoff between the two services continues, though BHCS has had to reduce its service, offering fewer runs and concentrating on peak period operation. Despite the service reduction, roughly 35% of travelers still use BHCS as of December 1997. Harbor Cruises continues to operate under contract, losing revenue due to lower than projected ridership.

Aside from the competition between the routes, the attraction of the ferry service is based on the quality of service provided, heightened by the fact that voyage length is thirty-five minutes. Both operators maintain concession services onboard, selling coffee, pastries, newspapers, and beer. Though Harbor Cruises' initial offering of such amenities was poor compared to BHCS, the service has responded strongly, and has also committed

to a $400,000 upgrade of the ferry seating from plastic chairs to seating of the level of comfort offered by airlines or inter-city buses. More importantly, the company will also take delivery of two new 350 passenger catamaran vessels in July 1998. At an approximate price of $4.1 million apiece, these high speed vessels are expected to complete the current 35 minute trip in under 20 minutes. The effect on traveler service choice is certain to be tremendous, and the company is considering the purchase of an additional pair. The net effect of the dispute therefore has been to focus attention on the market possibilities of commuter urban ferry service, and will prove beneficial to travelers.

3.3 The New York City Ferry System

3.3.1 System Description

The development of commuter ferry systems in New York City is unique. Historically, the Staten Island ferry is the single largest ferry route in the United States, moving 17 million passengers a year. In addition, ferries have continued to function to support other islands in the harbor, namely Governor's, Ellis, and Liberty Island. However, other traditional ferry systems, dating back to the city's early years, fell victim to the construction of the tunnels and bridges across the harbor entrance and the Hudson river, the last ceasing operation in 1967.

The new tunnels and bridges increased the ratio of capacity to demand greatly, but it then began to decrease rapidly as demand grew. By the 1980's congestion was again becoming a major factor in commuter trips. The Port Authority of New York and New Jersey estimated that over 720 buses were crossing the Hudson during the peak hour, at a rate of one every 4 to 5 seconds.[8] The PATH subway headway had been reduced to 90 seconds, and car seating had been reduced to permit more standees. The need for greater transit service across the Hudson River was clear, but expansion of road capacity was prohibitively expensive. This need did not go unnoticed by the private sector, and in 1986 a trucking and real estate entrepreneur reintroduced cross-Hudson commuter ferry service

[8] Phraner, S., and G. Cancro. *New Generation of Private Ferry Services in the New York/New Jersey Harbor, Featuring Proposed LaGuardia-Manhattan High-speed Ferry.* (May 1997.) Page 1-2.

with an unsubsidized route between Weehawken, New Jersey and the West Side of Manhattan.

Since then, the demand for ferry service has grown from roughly 3,000 daily passengers in 1987 to 23,000 in 1996 over a large network of routes (shown in Map 3-2). While ferry service transports only a fraction of the total number of commuters, given the population of New York City region this is still a large number. In 1994, a survey of cross-Hudson River commuters revealed the following modal split.[9]

- 66% Motor Vehicles
- 23% PATH subway
- 6% New Jersey Transit train service
- 3% Ferry
- 2% Amtrak train service

Currently, there are a number of private ferry operators in New York City, operating on over twelve private or contracted routes. However, the largest system is New York Waterway, the original private service, carrying 95% of the passenger ferry traffic apart from the Staten Island ferry. The experience of New York Waterway offers valuable information as to how a private operator service has been able to provide successful ferry service.

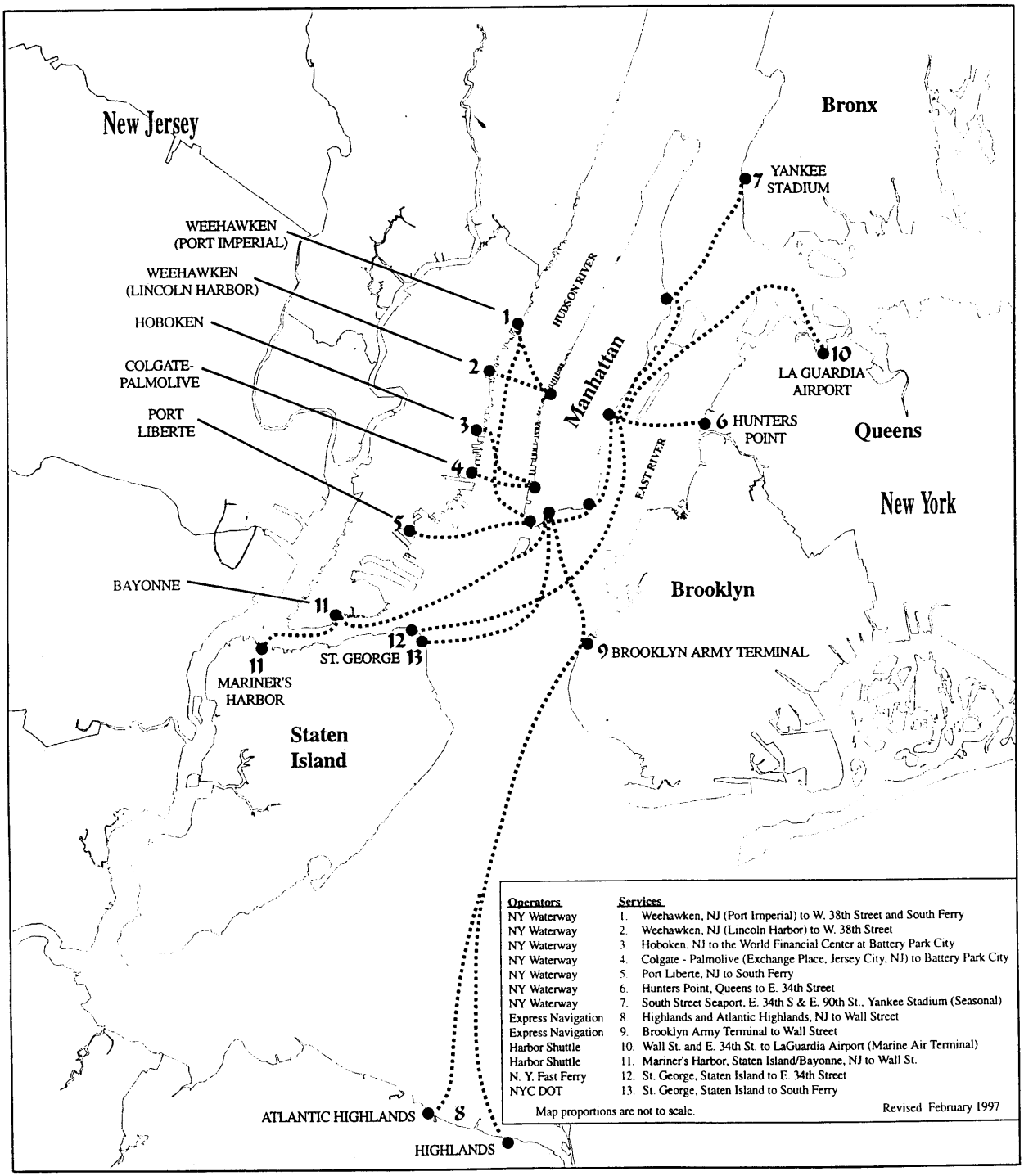
3.3.2 New York Waterway

New York Waterway is a privately owned and operated ferry service. The founder, Arthur Imperatore, was a trucking entrepreneur who was able to purchase a significant amount of former railroad land on both shores of the Hudson river between Weehawken and Upper Manhattan. In 1986, he began a ferry service between the two points, offering a free ride on the first day to a total of 23 passengers.

New York Waterway now operates fourteen vessels on nine routes that serve Manhattan, eight operating from the Jersey shore with one route on the East River from Queens. The service moves roughly 25,000 passengers a day on a combination of peak-only and all day routes, approaching 4% of all mass transit commuters between New

[9] *Ibid.* Figure 3.

Map 3-2 New York City Ferry Systems



Source: Port Authority of New York & New Jersey

Jersey and Manhattan. This despite the fact that the daily fare ranges from $2 to $5, more expensive than the competing PATH subway.

A second important component of New York Waterway's business is supplying excursion and non-work related transportation services. The company uses vessels during the off-peak, mid-day hours for tours along the waterfront and up the Hudson river, offering a range of excursion trips from 45 minute lower harbor cruises to a seven hour trip that stops at several historic sights along the river for guided tours. These trips continue after the PM peak: with starlight tours, trips to evening baseball games at Yankee Stadium, and special shuttle runs for theater-goers.

Though the state and city assist to a small extent in facilitating use of waterfront facilities, much of the service receives no operating subsidy, the one exception to date being a downtown route that receives a subsidy from the local chamber of commerce. However, this is about to change as New York Waterway has now won a contract to start service to LaGuardia airport in 1998.

Level Of Service

Schedule & Travel Times:

New York Waterway concentrates ferry service on the short cross-Hudson River trips. While there are several longer routes, for instance from Weehawken to the lower tip of Manhattan, these routes are typically peak-only. Service on the shorter routes however, with higher passenger numbers, continues throughout the day.

Table 3-2 New York Waterway Frequencies and Travel Times

Ferry Route		Travel Time (minutes)	Weekday Peak Headways (minutes)	Off-Peak Headways (minutes)
1. Weehawken	to Central Manhattan	5	10	15
2. "	to Downtown*	20-30	1 hour	-
3. Lincoln Harbor	to Central Manhattan	5/6	15	15
4. "	to Downtown*	30-20	1 hour	-
5. Hoboken	to Lower Manhattan	6/7	5	20
6. Jersey City	to Lower Manhattan	5/6	15	15
7. Port Liberte, NJ	to Downtown	13	30	-
8. Queens	to East Manhattan	5	15	-

These routes are two legs of a triangular route, reversing direction in the PM peak.

Fares:

As with other transportation systems in New York City, the out-of-pocket costs to ferry travelers tend to be higher than fares in other cities.

Table 3-3 New York Waterway Fares - Adults

Ferry Route		Single	Ten Trip	Monthly
1. Weehawken	to Central Manhattan	$4.50	$43.00	$150.00
2. "	to Downtown	$5.00	$45.00	$156.00
3. Lincoln Harbor	to Central Manhattan	same as #1	"	"
4. "	to Downtown	same as #2	"	"
5. Hoboken	to Lower Manhattan	$2.00	$19.00	$68.00
6. Jersey City	to Lower Manhattan	$2.00	$19.00	$68.00
7. Port Liberte, NJ	to Downtown	$5.00	$45.00	$168.00
8. Queens	to East Manhattan	$3.00	$25.00	$85.00

Reduced single trip fares are available for children and senior citizens, with children under six traveling free. Students pay standard single fares, but can purchase reduced multi-trip passes. New York Waterway also offers parking at the New Jersey terminals, priced at $5.00 a day or $90.00 for a book of twenty passes.

Capital Assets

New York Waterway operates fourteen vessels, all based on a single design. The vessels are capable of 20 knots, and can carry 375 passengers, with seating for 166 on an enclosed lower deck and another 166 on the upper deck. The upper deck is semi-enclosed, offering protection from the elements for commuters, but allowing all passengers to enjoy pleasant weather during the summer months.

All vessels are bow loading, docking at floating ramps and maintaining position by thrusting against a shaped dock with no assistance by a terminal crew.

Ridership

Ridership information is proprietary since it discloses passenger revenue, however, general information provided by New York Waterway is given in Table 3-4. The lower ridership of the peak hours routes (#2,4,7, and 8) is evident.

Table 3-4 New York Waterway Ridership

Ferry Route		Passengers/Month (approximate)
1. Weehawken	to Central Manhattan	194,000
2. "	to Downtown*	6,300
3. Lincoln Harbor	to Central Manhattan	49,000
4. "	to Downtown*	6,300
5. Hoboken	to Lower Manhattan	220,000
6. Jersey City	to Lower Manhattan	60,000
7. Port Liberte, NJ	to Downtown*	9,500
8. Queens	to East Manhattan*	8,000
Total Passengers Carried per Month		553,000

Competition for the New Waterway ferries comes from competing transit services available from New Jersey to Manhattan. These consist of the PATH subway, owned and operated by the New York and New Jersey Port Authority, and a system of express buses that utilize the several land routes available: the George Washington bridge and the Lincoln and Holland tunnels. There are also commuter rail services operated by both New Jersey transit and Amtrak that offer service from more distant suburbs.

Direct competition between New York Waterway and the PATH subway takes place over passengers traveling between Hoboken and Lower Manhattan. PATH travels from Hoboken, where New Jersey Transit buses and trains arrive, to the World Trade Center at a fare of $1.00. Choice between the PATH system and the ferry seems to be based primarily on the comfort and quality of the services. The PATH system dates from 1950, its headways and train sizes are limited by the existing infrastructure and the system therefore has difficulty accommodating current demand levels. As a result, the system suffers from overcrowding and long delays.

A significant event in New York Waterway's service occurred in December of 1992, when a storm flooded the PATH subway. With no other option, commuters lined up for the ferry service. The experience undoubtedly introduced the service to many skeptical commuters, and ridership since the event has been at a much higher level.

New York Waterway Land-side Service

However, the ferry routes are only one half of the New York Waterway transportation network. The company also operates some sixty shuttle buses of various

sizes on a number of short routes from the Manhattan ferry terminals. This additional service is fully integrated, with all the shuttles waiting for each arriving ferry, at no additional cost to the passenger. Several sources attribute the success of New York Waterway to the fleet of buses, an innovation which is unmatched by any other service.

New York Waterway also maintains parking lots at the non-Manhattan terminals, with the headquarters of the company, Port Imperial in Weehawken, offering 2,000 spaces at $5 a day. The New Jersey terminals are also served by NJ Transit, though the bus services and several commuter rail lines that it operates are oriented primarily towards PATH and express bus service into Manhattan.

A major advantage that New York Waterway now enjoys is its size, its fourteen ferry boats and the fleet of shuttle buses giving it a flexibility and resource base unmatched by other operators. The size of the company was apparently a major factor in the company being awarded the contract for the new LaGuardia service, even though another operator already provides service to a pier at one end of the airport. Despite complaints from several operators that the newly planned ferry terminal is expensive and unneeded, the prior success of New York Waterway also undoubtedly contributed to the decision to subsidize a new ferry service to the airport.

Favorable public opinion of ferry service as a whole in New York City is a product of the experience and reliability of New York Waterway. Despite some failed initiatives, ferry service continues to expand, with three other private routes to be opened and new terminals to be built with low interest Federal loans. The construction of a light rail system in New Jersey will also improve land-side access to the ferry terminals on that side of the river, and the owner of New York Waterway has proposed bidding to become the private operator of that system when completed. These events suggest that ferries will be increasingly important players in the overall transportation system of New York City.

3.3.3 Staten Island Ferry

The Staten Island ferry is not a small commuter ferry service like the rest of the systems examined in this chapter. However, a brief review of the system is valuable as a comparative transit route and due to its importance within the transportation network of New York City.

The Staten Island ferry system is publicly owned and operated by the New York City Department of Transportation, and is the highest ridership ferry route in the United States, carrying approximately 70,000 passengers per day. The service also carries vehicles, although recently this part of its service was not available for over a year following a fire in one of the terminals.

The system uses large two thousand-plus passenger ferries to provide frequent service from Staten Island to the southern tip of Manhattan Island. It succeeds largely because alternative modes of transportation are confined to a road and bridge network that is highly circuitous and is frequently highly congested, resulting in long travel times.

On the other hand, the Staten Island ferry is an example of a continuously operated public service that did not expand to fill the potential for greater waterborne transportation. Probable causes for this were the continued construction of bridges and tunnels to Manhattan and the severe financial problems that the city experienced in the 1970's and early 80's. Without an overwhelming need for service expansion as road network transportation growth continued to at least some extent, ferry service stayed static, though planning was carried out for an extensive public network. However, as road congestion exceeded road capacity and vessel technology improved, the private sector responded to the potential for ferry service, leading to the current system.

Recently, a zonal fare structure for all of New York City was implemented. This changed the Staten Island ferry from a stand-alone fare structure costing $0.50 a trip to one integrated with the bus system on the island, allowing free transfer between the two. In practice, with the flow of passengers being so great, fare collection ceased entirely, and eventually it was decided to make it official by making the ferry free. This had the effect of sharply reducing ridership on a high-speed private ferry service that had been introduced between Staten Island and the East Side of Manhattan. The private operator, Harbor Express, attempted reduced service with one vessel instead of two, and then discontinued operation, an example of how a privately operated ferry service can be greatly affected by a change in a public transportation alternative

3.4 The Seattle Ferry System

3.4.1 System Description

The city of Seattle is served by the Washington State Ferry (WSF) system; the largest ferry system in the United States. WSF serves the entire Puget Sound region as an extension of the highway system for cross water travel, with 24 vessels operating over ten routes connecting twenty terminals. In fiscal year 1995, the system carried over 10 million vehicles and 24 million passengers.

The Washington State Ferry system is the successor to a number of private companies that historically supplied water transport in the Puget Sound region. In the post-World War Two period the sole remaining company operating the cross-Sound system was in financial difficulty. The State therefore acquired the system in 1951 and developed it as an extension of the road network, the system being operated by the Washington Toll Bridge Authority and State Highway Commission. While the takeover was initially intended as a temporary solution to be phased out after the construction of several cross-Sound bridges, the various proposals for these highway links were voted down in 1959 as expensive and unappealing. The WSF organization was therefore modernized and expanded, eventually coming under the direction of the Washington State Department of Transportation.

The city of Seattle is the primary beneficiary of these services, as the dominant metropolitan region incorporating most of the eastern shore of the Sound. Constrained by geography and as a major port focused on waterfront activity, Seattle is closely linked with several islands located in the Sound as well as communities on the western shore. In effect, these serve as suburbs for the Seattle metropolitan region. While the focus of the Washington State Ferry system continues to be on motor vehicle transport as an extension of the state highway system, there has been recent interest in the introduction of passenger-only ferries, focused on commuters. Under a federally funded demonstration project, the WSF system acquired a used ferry in 1985 for passenger-only ferry service from the western shore town of Bremerton to downtown Seattle. This project was successful enough for WSF to approach the state legislature for funding to purchase two new vessels. These vessels entered service in 1989, and a new passenger-only route was

introduced between Vashon Island and downtown Seattle. (Passenger-only ferry routes are shown in Map 3-3.)

The decision to introduce passenger-only ferry service was the result of increases in auto travel, adding to traffic problems and congestion in the region. A result of this trend was a slow growth in the number of foot passengers using the auto ferries. Passenger ferries can compete for this market by offering higher speeds than the auto ferries. In addition, the reduced travel times of the passenger-only ferries should encourage more commuters to give up their automobiles.

3.4.2 Washington State Passenger-Only Ferry Operations

Assets:

The oldest vessel of the WSF passenger-only fleet is the Tyee, built in 1985 and carrying up to 319 passengers. The newer vessels, the Skagit and Kalama, were built in 1989, and carry 250 passengers. All three vessels are diesel-powered and capable of speeds up to 25 knots. A fourth vessel is being built, for service starting in 1998.

The terminals of the passenger-only ferries are in tandem with those of the auto ferries, and are based on the requirements of the auto ferries, which can lead to long walking distances for access to the ferries. The Seattle terminal of the passenger-only ferries, at Colman dock, is located on the waterfront of the Seattle central business district. Unfortunately, access to this terminal is subject to congestion along the waterfront, reducing the opportunity for transfers to other modes. However, the vast majority of passengers are going to or coming from points in the downtown area within walking distance of the dock.

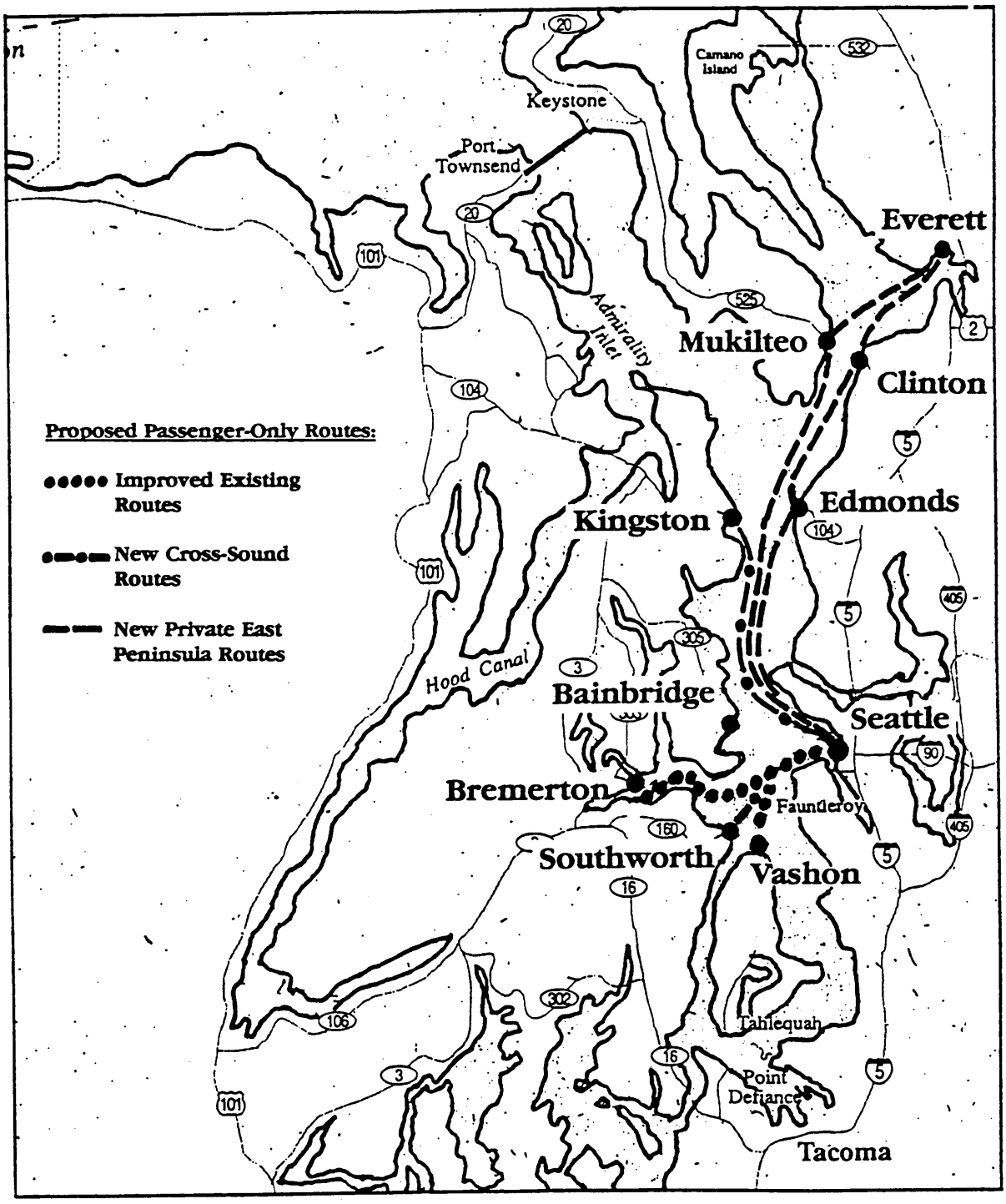
Level Of Service

Route 15 (Seattle-Bremerton): Travel Time 50 minutes

- AM: 5:00 AM to 7:15 AM 2 inbound trips and 1 outbound.
- PM: 4 round trips at 2 to 3 hour intervals except for one after midnight
- Saturday, Sunday and Holiday: five round trips throughout the day at irregular intervals between 11:00 AM and 1:30 AM.

Fare is $3.50, book of 20 for $21.00. Bicycles have a $.50 surcharge.

Map 3-3 Washington State Passenger-Only Ferry System



Source: *Assessment of Ferries as Alternatives to Land-Based Transportation*. Figure 2.13

Auto Ferry (Seattle-Bremerton): Travel Time 60 minutes

- Daily Service: 14 inbound and 15 outbound trips at 1 to 2 ½ hour intervals, slightly adjusted for weekend and holiday service.

Vehicle fares range from $5.90 to $7.10

Route 16 (Seattle-Vashon): Travel Time 25 minutes

- AM peak: 5:00 AM to 9:25 AM 4 inbound trips and 3 outbound at 60 to 90 minute intervals.
- PM peak: 3:05 PM to 8:50 PM 5 round trips at 60 - 90 minute intervals.
- Saturday: six round trips throughout the day at irregular intervals between 9:30 AM and midnight.
- No Sunday Service

Fare is $3.50, book of 20 for $21.00. Bicycles have a $.50 surcharge.

Auto Ferry (Vashon - Fauntleroy/South Seattle) Travel Time 15 minutes

- Daily Service: 35 trips at intervals from 25 minutes to 1 ½ hours with two trips after midnight.

Fare is $2.30 for passengers, between $7.95 and $9.55 for vehicles.

Costs and Ridership

As a publicly owned system, the costs and performance of the WSF system are carefully scrutinized by the state government. As a whole, the commuter ferries are expensive to operate, and while the financial goal of the WSF system is to have user revenue comprise 60% of the operational costs, the farebox recovery ratio achieved for the two passenger-only routes is considerably below this (as shown in tables 3-6 and 3-7).

Table 3-5 WSF Route 15 (Seattle-Bremerton) Summary

	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
Passenger Trips	368,378	377,666	327,806	274,246	261,134	283,848
Total Revenue	604,291	410,646	553,569	283,664	262,448	289,690
Total Expenses	1,982,309	1,932,993	2,296,541	1,977,220	1,770,891	1,931,358
Net	-1,378,018	-1,522,347	-1,742,972	-1,693,556	-1,508,443	-1,641,668
Recovery Ratio	30.48%	21.24%	24.10%	14.35%	14.82%	15.00%

Table 3-6 WSF Route 16 (Seattle-Vashon) Summary

	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
Passenger Trips	188,176	239,622	240,176	246,384	240,754	242,438
Total Revenue	203,448	216,345	223,826	217,636	205,909	203,291
Total Expenses	1,350,613	1,748,161	1,859,509	1,766,410	1,856,628	1,632,095
Net	-1,147,165	-1,531,816	-1,632,683	-1,548,744	-1,650,709	-1,428,804
Recovery Ratio	15.06%	12.38%	12.06%	12.32%	11.09%	12.46%

Operations Problems

The WSF passenger-only ferries have experienced two important difficulties in operation. First, it was found that continued operation of the vessels at maximum speed was causing excessive engine wear leading to engine failure.

The second problem discovered during ferry operation was the effect on the environment of the ferry wakes during operation along the commuter routes. This problem was first discovered during operation of the Tyee ferry, and contract specifications for the succeeding vessels were meant to prevent repetition. Unfortunately, it was found that there were still significant problems of beach erosion caused by the newer vessels' wakes despite the design specification. As a result, the WSF has had to impose a speed limited area of operation for all the ferry boats within certain distances of the shore. Limited to 12 knots near the beach, this speed reduction lengthened the travel times such that service between Bremerton and Seattle, originally meant to be 45 minutes at 25 knots, was lengthened to 55 minutes, only 5 minutes less than the auto ferry.

Future Plans

The implementation program of the Washington State Transportation Committee lays out a detailed plan for future passenger-only ferry vessels as a component of the WSF system. The program recommends ambitious moves in support of the program, including the purchase of eight new vessels in the near future, to be followed by another five vessels in a later expansion. The plan also requires significant expenditures on terminal development. The two phases are estimated at $60 and $50 million respectively, with half the money dedicated to the purchase of the new vessels at approximately $4.9 million apiece. The plan is unlikely to be followed in its entirety, however construction of an additional vessel is now underway, and more may follow soon.

The Commission has strong technical recommendations for the new vessels, in an effort to avoid the difficulties faced by the current vessels. The vessels would be front loading for fast turn around, and would be of catamaran hull construction to increase vessel stability and reduce wake effects. The vessels would be capable of carrying 350 passengers at a speed of 30 knots, at 85% of maximum engine power to avoid the maintenance problems of continued engine operation at maximum power. These specifications for speed, capacity, and design are fast becoming the standard for most urban ferry systems, particularly since the Puget Sound area is the primary location for shipyards capable of and experienced in building ferries. It is noteworthy that, besides the Washington State Ferries, the vessels for San Francisco and for *Acuaexpreso* were also built in Puget Sound.

3.5 The Vancouver Ferry System

3.5.1 System Description

The SeaBus ferry system of the city of Vancouver, in British Columbia, Canada, is one of the most heavily used urban ferry systems in North America. Built around two high-capacity ferries, the ferry system supplements two bridges in providing transportation across Burrard Inlet, an arm of the sea that separates the main city of Vancouver from the suburbs of North and West Vancouver. Though the ferries only travel at 12 knots, the route and frequencies are such as to make them a preferred option for thousands of commuters.

The Seabus ferry was developed in response to congestion on the bridge network connecting North and West Vancouver to the rest of the metropolitan area. Historically, the two parts of the city had been connected by ferries in the early years of the city. However, the construction of bridges over Burrard Inlet, the first in 1938 and the second in 1960, reduced the need for non-automobile transportation and the service was terminated in 1960.

By the early 1970's, the growth in auto traffic lead to increasing congestion on the bridges, and studies were undertaken to analyze the need for and possible type and location of a "Third Crossing". These studies resulted in a proposal to establish a

passenger-only ferry network instead of building a new bridge, and the provincial government moved to provide such a service. The cost of the system included $(Can) 39 million for capital expenditures with another $(Can) 9.4 million for land acquisition.

An important factor in the selection of a ferry system as an additional transportation link was consideration of the effects of building an additional bridge. The necessary road and support infrastructure would have greatly impacted the waterfront area along the north shore of the inlet. The introduction of a ferry system not only avoided such an impact, but served to re-focus development on the urban area surrounding the northern ferry terminal in Lonsdale.

3.5.2 The Seabus Service

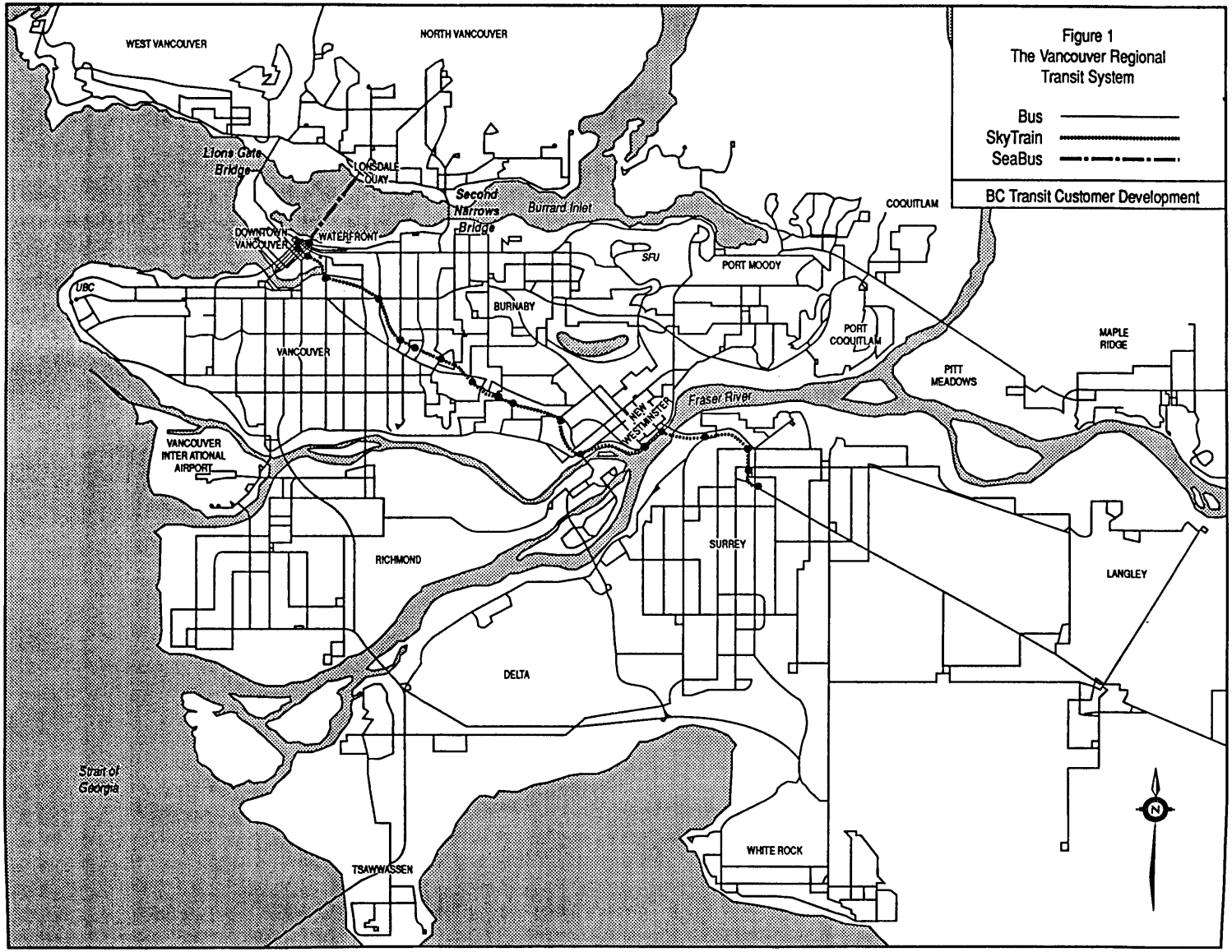
Seabus is a transit service owned and operated by B.C. Transit, and consequently it is closely integrated with the bus and other transit systems in Vancouver. The assets of the Seabus system consist of two large 400-passenger ferries operating on a single route between terminals in North Vancouver and the city of Vancouver proper. (See Map 2-4) The terminal in North Vancouver is the Lonsdale Quay, which has been the focus of efforts aimed at developing the waterfront as a tourism and market center. The ferry terminal in the city of Vancouver, Waterfront Station, is located in the downtown district adjacent to high-density development. The ferry terminal also operates as the major downtown transit center, and is also adjacent to the SkyTrain, a rail system that connects downtown Vancouver to the suburbs of New Westminster and Surrey to the south-west.

The two ferries are catamarans built around the need to load and unload passengers rapidly. The single passenger deck has eight double doors, four on each side. When docking, one side's doors open to allow passengers to disembark, then the doors on the opposite side open to allow passengers to embark. The entire process takes only seconds, and the ferry can start the return trip within three minutes. As all passenger movement is "at-grade", both wheelchairs and bicycles can easily be moved.

Level Of Service

Schedule The system operates throughout the year, starting at 6 AM and running until about midnight. Frequency of service varies based on time and day of the week, as shown in Table 3-7.

Map 3-4 Vancouver Regional Transit System



Source: *The Seabus System in Vancouver, B.C.* Figure 1.

Table 3-7 SeaBus Frequency of Service (minutes)

	Weekdays	Saturday	Sunday/Holidays
AM Peak	15	30	30
Mid-Day	15	15	30 (15)
PM Peak	15	15	30
Evening	30	30	30

As travel time on the route is 12 minutes, one of the ferries can operate the 30 minute headway schedule while both ferries are in service during the 15 minute headway operating periods.

Given the importance of tourism to ridership, the system frequency is changed for the summer season, the Sunday mid-day frequency being increased to a trip every 15 minutes.

Fares System fares are integrated with the rest of the transit system, and make no distinction as to mode of travel (See Table 3-8). During the peak hour, fares are based on zones. As Burrard Inlet is a zone boundary, taking the ferry requires at least a two-zone ticket. However, transfers can be obtained at the time of purchase that are good for the succeeding 90 minutes, so a ferry ride could therefore be merely one component in a trip

Table 3-8 Vancouver Transit Fares (All figures in Canadian dollars)

Daily	Adult	Other	Monthly/ Books of 10	Adult	Other
Peak / 1 zone	$1.50	$0.75	1 zone	$54.00	$33.00
2 zones	$2.25	$1.10		$13.75	$7.50
3 zones	$3.00	$1.50	2 zones	$82.00	$33.00
Off-peak	$1.50	$0.75		$20.50	$7.50
All Day Pass (after 9:30 am)	$4.50	$2.25	3 zones	$106.00	$33.00
				$28.00	$7.50

that could consist of: a bus trip to the ferry terminal, the ferry trip, a rail trip on SkyTrain, and then another bus trip from the rail station to the passenger's final destination. All of this could be done on just a single ticket.

Cost and Ridership

As SeaBus relies heavily for ridership on its schedule and fare integration with the rest of the Vancouver regional transit system, the service tracks total passengers instead

of fare-paying passengers and fare revenue. While costs have been rising, growth in the number of passengers has also been occurring.

Table 3-9 SeaBus Operating Statistics (All cost figures in Canadian dollars)

	1992	1993	1994	1995	1996
Passengers	4,241,779	4,154,600	4,440,252	4,835,163	5,430,920
Direct Operating Cost	5,360,071	5,479,458	5,509,273	5,735,310	5,930,308
Debt Service Cost	211,512	260,544	287,784	287,784	287,784
Total Cost	5,571,583	5,740,002	5,797,057	6,023,094	6,218,092

While one of the main goals of SeaBus was to reduce vehicular traffic on the road network crossing Burrard Inlet, later analysis estimated that only 1% of traffic was eliminated as a result of introduction of the service. While 14% of commuters from North Vancouver reportedly switched to SeaBus from private automobiles, this allowed other commuters to change their travel patterns to keep auto volume relatively constant. However, over 61% of SeaBus passengers switched to that mode from bus services, and this enabled BC Transit to eliminate 22 peak period buses using the bridges.[10]

Future Plans

The demand for transportation across Burrard Inlet continues to grow, and as an alternative to another bridge or a tunnel, BC Transit is considering the expansion of Seabus to a system with eight ferries and correspondingly larger terminal space. This would allow headways of ten minutes during the peak period, as well as allowing higher service frequency on the weekends. As part of this project, the new ferries would have a different hull shape and engine system, and the older vessels would be upgraded to match.

This interest in the development of the ferry system, despite its expense, is due to its consideration as an alternative to the expense and impacts of constructing an additional road link from North or West Vancouver. The fact that constructing a road link would likely increase the demand for auto travel inside the downtown area is especially problematic, and leads to support for extending the ferry system.

[10] BC Transit Service. *The Seabus System in Vancouver, B.C.* (September, 1997.) pp. 4-5.

3.6 The San Francisco Ferry System

3.6.1 System Development

San Francisco has long been known for its bay and harbor. The focus on the waterfront and the geography of the region made waterborne transportation vital in the early years of the city's development. During the 1920's, the Ferry Terminal Building in San Francisco served up to 300,000 passengers a day, linking to the urban streetcar and trolley system. However, in the 1930's this began to change as automobile ownership and use grew rapidly, and there was demand for expansion of the road network. In 1936, the Bay Bridge between Oakland and San Francisco was completed, followed by the Golden Gate Bridge in 1937. These cross-water road links rapidly lead to the bankruptcy and disappearance of the ferry systems; though the last service, operated by a railroad company, continued to operate until 1956.

However, the population and economy of California have continued to expand at a rapid rate, and by the 1970's growth in the San Francisco metropolitan area was already overburdening the transportation network. In particular, the Golden Gate Bridge between Sausalito and San Francisco developed into a chokepoint for commuters and other travelers. As a result, ferry service was introduced between Sausalito and San Francisco, followed by other new ferry routes and services as road links continued to become more congested.

Currently, there are five main ferry routes in the San Francisco Bay area served by several public and private operators, sometimes operating parallel routes. All of these routes connect other cities in the metropolitan region to downtown San Francisco at two main locations along the waterfront: Pier 1/2, adjacent to the Ferry Terminal Building; and Piers 39 or 41, located in the Fisherman's Wharf tourist area (See Map 3-5). The cities served by the various ferry services are:

1. Sausalito
2. Larkspur
3. Tiburon
4. Oakland/Alameda
5. Vallejo

Of these services, the most heavily traveled is the Larkspur route, operated by the Golden Gate Ferry service which also provides service from Sausalito. While Golden Gate is a publicly owned and operated ferry service, the remainder of the ferry services are privately operated, either under contract or independently, primarily by the Blue & Gold Fleet.

The ferry services from Sausalito, Larkspur, and Tiburon to downtown San Francisco carry over 2,000 AM peak commuters. This is approximately 5% of the 40,000 commuters from Marin County traveling to San Francisco each AM period. Of the remainder, 16% travel by bus and the other 76% by car. Half of all commuters travel in single-occupant vehicles.

In terms of percentages, the Vallejo ferry service does even better, carrying over 20% of the approximately 5,300 commuters from the Vallejo area. This is the result of the long land route from the Vallejo area to downtown San Francisco. Other ferry services carry much smaller fractions of the commuter population, the Oakland/Alameda service, for instance, carries under 1.5% of the approximately 90,000 people commuting from the east side of the Bay to downtown San Francisco. A summary of the routes and their daily ridership is presented in Table 3-10.

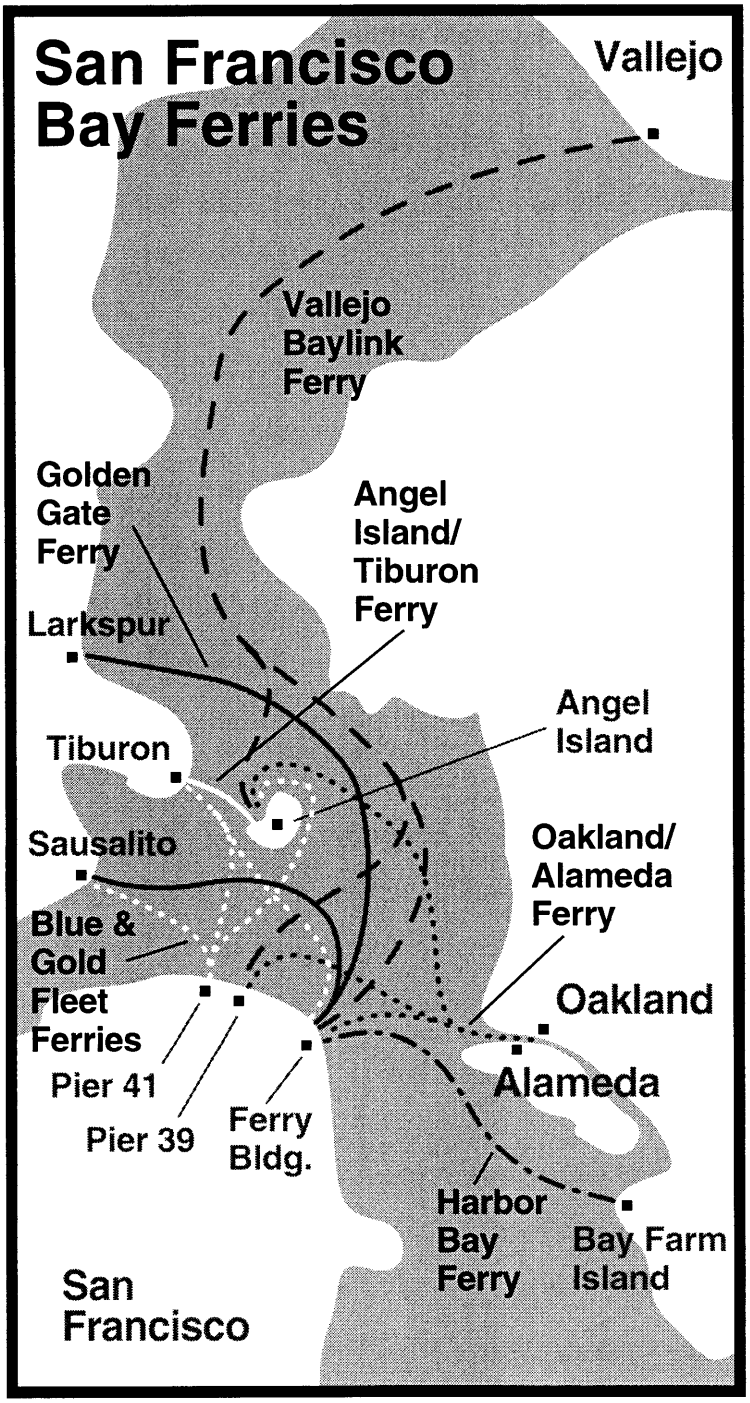
Table 3-10 Summary of San Francisco Ferry Routes (First Quarter, FY 1996).[11]

	Travel Distance (miles)	Travel Time (minutes)	Average Daily Ridership
Golden Gate			4,843
Sausalito	6	30	~30% of above
Larkspur	12	45	~70% of above
Blue & Gold Fleet			
Tiburon	6	16	~850*
Sausalito	6	30	~1050*
Oakland/Alameda	6	25	1,232
Vallejo	25	55	1,113

** exact ridership numbers proprietary.*

[11] Metropolitan Transit Commission. *Status of Bay Area Ferry Service Operations and Improvement Projects.* First Quarter, FY 1996-97.

Map 3-5 San Francisco Bay Area Ferry System



Source: San Francisco Bay Area Transit Information Project

In addition to the routes that are used for commuter service, there are a considerable number of other water transportation services that cater to tourism and excursion markets. Besides roughly two million commuters a year, it is estimated that another million passengers are carried for tourism purposes, while two million others take advantage of various harbor tour and charter vessels. These services take full advantage of the climate and scenery of San Francisco Bay to attract customers, as well as providing trips to such sites as the Alcatraz prison and Angel Island State Park.

3.6.2 Golden Gate System

The Golden Gate Ferry system is operated by the Golden Gate Bridge, Highway, and Transportation District (GGBH&TD), the agency responsible for the Golden Gate Bridge and managing the traffic using it. The objective of the ferry service is to provide a transit alternative and reduce travel demand on the bridge by travelers between Marin County to the north and downtown San Francisco to the south.

The Golden Gate Bridge opened in May 1937, carrying an average of just over 9,000 vehicles a day during its first year of operation. By 1970, double this number of vehicles were crossing the bridge to San Francisco during the AM peak period alone. It was apparent that the capacity of the bridge was being exceeded during the rush hours, and that the congestion would continue to worsen. The year before, the state legislature had authorized the authority responsible for funding and building the bridge, the Golden Gate Bridge and Highway District, to develop a mass transportation plan for travel between Sonoma and Marin counties to the north and the city of San Francisco to the south.

The bridge was clearly the limiting component of the road network, and a variety of plans for increasing the capacity of the north-south link by double-decking the bridge or building tunnels or other bridges were considered. However, these options were rejected due to considerations of cost and aesthetics. Consequently, studies concentrated on efforts to reduce car use by providing transit alternatives. This included proposals to reinstate the historical ferry service that had existed prior to the bridge, and also plans to introduce high frequency bus service.

The renamed Golden Gate Bridge, Highway, and Transportation District instituted its first ferry service in 1970, operating between Sausalito and downtown San Francisco. This initial transit service was followed by the introduction of a bus system in 1972, and then an additional ferry route in 1976 between Larkspur and San Francisco.

Assets

Golden Gate operates four large capacity ferry vessels. The original M.V. Golden Gate ferry acquired in 1970 still operates between Sausalito and downtown San Francisco, carrying up to 575 passengers at 15 knots. Three newer ferries operate between Larkspur, further to the north, and San Francisco, carrying up to 725 passengers at a speed of 20 knots.

The headquarters of the service is at Larkspur, and this terminal is fully developed, with an expansive parking lot and waiting areas for customers. In addition, the terminal also has a large bus terminal for connection to Golden Gate Transit buses and other services. At Sausalito, the facilities are more rudimentary, and parking is limited. Both routes connect to Piers 1&2 adjacent to the Ferry Terminal Building in San Francisco. Though this building has not been used as a ferry terminal for several decades, the growing importance of ferry systems has led to plans to convert a portion of the building back to its original purpose.

Level of Service

Schedule

1. Sausalito Ferry

- 9 weekday round trips at 70 to 90 minute intervals (10 in summer).
  - 7:05 AM to 8:30 PM.
- 6 round trips on weekends and holidays at similar intervals (7 in summer).
  - 10:50 AM to 7:25 PM. (8:35 PM in summer)

2. Larkspur Ferry

- 13 weekday round trips at 30 - 45 minutes intervals during the peak, 2 hours in mid-day.
  - 6:00 AM to 9:10 PM.

- 5 round trips on weekends and holidays at 2 hour intervals.
  - 9:45 AM to 7:35 PM.

Fares

1. Sausalito Ferry: $4.25 one-way.
2. Larkspur Ferry: $2.50 one-way on weekdays.
   $4.25 on weekends and holidays.

Both ferries have reduced fares for seniors, children, and disabled. Transfers are available both to the Golden Gate Transit bus fleet and the San Francisco Muni rail and bus system. Golden Gate Transit also operates free shuttle service in the areas immediately around the ferry terminals.

Eighty percent of passengers arriving in San Francisco walk to their final destination. At Larkspur and Sausalito the majority of customers arrive by car or transit. For Sausalito, walking is still a significant proportion, approximately one-third of passengers using each mode. At Larkspur, which has a 1,200 space parking lot, over 80% of the passengers drive or are driven to the terminal to take the ferry.

The ferries are slower than bus and auto transportation, generally taking from 5 to 20 minutes longer, depending upon the length of the commute. Despite this handicap, the ferries still attract a significant number of riders, and this accomplishes the primary goal of the service: to alleviate congestion on the Golden Gate bridge.

Ridership and Cost

Ridership had been variable over the last six years, affecting revenue and the resulting deficit. Costs have been slowly increasing, leaving the annual deficit at close to $6 million for the last several years. While the Golden Gate ferries transport over 2,000 commuters a day, off-peak ridership is a significant proportion of the system's total ridership. In fact, off-peak passengers form over 60% of the total ridership on the Sausalito route, and 28% of the ridership on the Larkspur route. (System ridership and expenditures are shown in Table 3-11.)

Table 3-11 GGBH&TD Ferry Operating Statistics (Fiscal Year)[12]

	1992	1993	1994	1995	1996	1997
Passengers, Larkspur	1,002,153	974,858	941,445	897,348	956,329	1,014,547
Passengers, Sausalito	521,310	491,197	464,805	434,918	475,876	495,336
Total Passengers	1,523,463	1,466,055	1,406,250	1,332,266	1,432,205	1,509,883
Fare Revenue[13]	$3,073,275	$3,255,638	$3,172,891	$3,080,382	$3,470,323	$3,657,561
Other Revenue[14]	$352,607	$360,098	$406,297	$390,639	$375,250	$369,803
Total Revenue	$3,425,882	$3,615,736	$3,579,188	$3,471,021	$3,845,573	$4,027,364
Funded Subsidies[15]	$2,014,199	$1,826,618	$1,468,571	$1,783,222	$1,664,416	$1,932,900
Total Expenditures	$9,217,104	$10,298,010	$10,104,175	$11,203,733	$11,438,169	$11,822,205
Deficit	$3,777,023	$4,855,656	$5,056,416	$5,949,490	$5,928,180	$5,861,941

Other Features

One of the early problems experienced with the ferry system was the power plant and propulsion system for the three Larkspur route vessels. These vessels originally used gas turbines to power a water jet propulsion system. This system was found to be unsatisfactory due to high maintenance costs and repeated breakdowns, as well as high fuel consumption. The decision was made to replace the complete system for all three vessels. Accordingly, the three boats were successively taken out of service in 1984 and 1985 to be re-equipped with diesel power plants and twin-screw propulsion systems. While this expense added $5 million to the original $13 million paid for construction of the three vessels, the result was a savings of 60% in fuel and maintenance costs. Unfortunately, the conversion also reduced vessel speeds from 25 to 20 knots, increasing travel time.

During the Loma Prieta earthquake in 1989, which closed the Golden Gate Bridge for several days, the quickly augmented ferry service carried 20,000 passengers a day during the recovery period. While ridership quickly returned to earlier levels when the bridge was re-opened, the experience served to introduce many people to the ferry system.

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[12] Provided by GGBH&TD Performance Statistics fact sheet.
[13] Ferry Ticket fare revenue only.
[14] Feeder Bus fares, concessions, advertising, property rental, and other.
[15] From Federal, State, and Marin County transit funds and bridge tolls.

The Larkspur ferries are constrained in speed by wake restrictions along the Larkspur Channel, which stretches for two miles between the terminal and the Bay, due to significant erosion problems. The ferry service is thus in a self-limiting bind, for if speeds were to be increased to attract more riders, the channel would be difficult to keep clear. Even with the current limits, the channel requires increasingly expensive dredging to keep it navigable.

The Golden Gate Ferry system is planning to improve its service significantly in 1998. A new 325-passenger catamaran, built in Washington state at a cost of $7.5 million, is expected to enter service on the Larkspur route in July 1998. Capable of 35 knots, this ferry will cut the current travel time from 45 minutes to 30 minutes. In anticipation of the ridership this is expected to generate, the Larkspur parking lot is being expanded and a plan to reserve parking spaces for carpools is likely to be implemented. Looking ahead, GGBH&TD plans to continue acquiring faster ferries that will attract more riders by offering travel times less than the land based commute times, though as riders are attracted to the ferry service auto congestion and travel time will also be reduced.

3.6.3 Blue & Gold Fleet - Tiburon & Sausalito

Two companies have come to dominate the private ferry market in the Bay area, the Blue & Gold Fleet and the Red & White Fleet, and the two companies have been reorganizing and trading routes and assets. While historically most of the ferry services were initiated by Red & White, as of June 1997 Blue & Gold took over the commuter ferry routes, while Red & White concentrates on the harbor excursion and tourist markets. Despite this present division of services, the competition between the two companies, as well as the many other smaller companies in the region, has undoubtedly contributed to the growth of ferry services by providing responsible, experienced operators willing to compete for ferry service opportunities.

Currently, the Blue & Gold Fleet provides independent ferry service from both Tiburon and Sausalito to downtown San Francisco. The Sausalito service was introduced in 1983 by the Red & White Fleet, and has been in continuous operation since then, though the schedule and the operator have changed. The Tiburon ferry was introduced at

the same time, and originally the service was operated as a triangle route between the three locations, although this is no longer the case.

The Tiburon ferry provides peak-hour only transportation between Tiburon to the north and the San Francisco Ferry Terminal on Monday through Friday, and an off-peak, weekend, and holiday service from Tiburon to Fisherman's Wharf. The service thus provides ferry travel from a location on the northern shore intermediate between Sausalito and Larkspur.

The Sausalito ferry operates during the off-peak period of the day during the week, and throughout the weekends between Sausalito and Fisherman's Wharf, complementing the Golden Gate service operating to and from the Ferry Terminal Building. The service uses the GGBH&D facilities at Sausalito.

Level of Service

Schedule

1. Tiburon to Ferry Terminal Building
    - 4 trips in the AM peak to San Francisco, 2 returning, at 50-70 minute intervals.
    - 4 trips in the PM peak to Tiburon, 3 returning, at 50-60 minute intervals.
2. Tiburon to Fisherman's Wharf
    - 5 trips to Tiburon, 4 to San Francisco during the mid-day period on weekdays, at 70-80 minute intervals.
    - 2 trips to San Francisco in the evening at same interval (with an additional round trip in the summer).
    - 6 round trips at 2 hour intervals on weekends and holidays (extra trip during the summer).
3. Sausalito to Fisherman's Wharf
    - 6 trips to San Francisco, 5 trips to Sausalito, on weekdays, beginning at 11:00 AM and running at 70 minute intervals until 6:00 PM, with one evening trip to San Francisco at 8:00 PM (with an additional round trip in the summer). No service from San Francisco after 4:50 PM (except in summer).

- 6 round trips on weekends beginning at 10:40 AM and running until 8:00 PM (with an additional round trip in the summer).

Fares

Fares are identical for all trips:

- one-way: $5.50 for adults, half-price for children.

The Fisherman's Wharf landing area is located near retail and commercial businesses rather than the office area surrounding the Ferry Terminal Building. This favors off-peak ridership, and most of the passengers on the ferry during those times tend to be traveling for non-work purposes. The service also provides an alternative to regular ferry commuters on the Golden Gate service, the two points in downtown San Francisco being approximately a mile apart.

As opposed to Sausalito, already mentioned as a ferry trip that is longer than auto or bus commute, the Tiburon ferry reduces travel time anywhere from 5 to 15 minutes over a typical land-based commute. Passengers for the ferry access the Tiburon terminal by walking, transit, and driving in roughly equal percentages. At the San Francisco terminal almost all passengers walk to their destination, with a small percentage continuing their trips via transit. Parking is limited at the Tiburon terminal, though Tiburon is a comparatively wealthy area and passengers on the ferry tend to have the highest average incomes of ferry-goers throughout the Bay area.

Ridership & Costs

The Tiburon service averages slightly over a hundred passengers a trip, carrying between a 250,000 and 300,000 passengers a year. The Sausalito service carries roughly 115 passengers a trip, or 350,000 passengers a year. Cost information is proprietary.

3.6.4 Alameda/Oakland Ferry Service

This service, abbreviated as AOFS, connects the island of Alameda and the adjacent city of Oakland to downtown San Francisco. The service was initiated following the Loma Prieta earthquake in 1989 by the Red & White Fleet acting without subsidy. This proved insufficient, and after some bargaining the service was subsidized by the two

cities beginning in 1991. The current operator is now the Blue & Gold Fleet. The service was improved in 1993 with the introduction of a faster 250-passenger catamaran.

The service is operated throughout the week, though the schedule heavily favors commuters. The route also changes during the day. Beginning at 6:00 AM, the ferries follow the route Oakland - Alameda - Ferry Terminal. After the AM peak, the ferries stop at Alameda before Oakland, and also travel on to Fisherman's Wharf after the Ferry Terminal. In the PM peak, the service operates split routes, half the trips stopping at Oakland before Alameda and the other half the reverse, with two trips also stopping at Fisherman's Wharf where the service ends at 9:20 PM.

Level of Service

Schedule

Weekday: 19 trips to downtown, 17 trips from downtown.

- AM peak frequency varies between 25 and 35 minutes;
- Mid-day - every two hours;
- PM peak between 15 to 35 minutes, with a 50 minute gap after 6:00 PM.

Weekends: 6 round trips.

- Headways vary from 90 minutes to two hours, from 10:00 AM to 7:50 PM.

Fares

- $4.00 one way, $30.00 for a book of 10, $55.00 for a book of 20. $99.00 for a monthly pass.
- Children, senior citizens, disabled, and military get discounts at various rates.

The ferry ticket also has free transfers for both the Muni rail and bus transit service in San Francisco, and the AC Transit bus service in Alameda (non-express service only).

The trip by ferry is faster than land-based alternatives for Alameda commuters. In contrast, Oakland commuters gain little advantage as a typical land based commute is 15-20 minutes versus the 25 minute ferry trip, with the ferry stopping at Alameda. For this reason, ridership is mostly commuters from Alameda during the AM peak service, while throughout the rest of the day ridership is more equally divided between the two cities, with a larger proportion of the off-peak passengers coming from Oakland.

The cities of Alameda and Oakland provide free parking, with validation, at lots near the ferry terminals. Alameda built a new ferry terminal building in 1992, and Oakland has also developed a basic terminal, shortly to be improved with a $400,000 state grant.

Ridership & Costs

As shown in Table 3-12, the commitment to ferry service demonstrated by the construction of the new terminal in 1992 and the introduction of the high-speed ferry in 1993 paid off in terms of increased ridership, though costs also increased over the same period.

Table 3-12 AOFS National Transit Database Summary

	1992	1993	1994	1995
Ridership	236,500	350,300	371,700	408,400
Operating Expense	$1,606,700	$1,832,200	$1,838,200	$1,923,400

The deficit for the service in FY 1996-97 was close to $550,000, subsidized by three percent of the Bay Bridge toll revenue as well as city funds from Alameda and Oakland.

3.6.5 Vallejo Ferry

The Vallejo Baylink Ferry provides service between the city of Vallejo to the north-east and the Ferry Building Terminal in downtown San Francisco. The service is relatively new, having been contracted by Vallejo Transit since 1993

At twenty-five miles, this is the longest ferry route in the San Francisco Bay area, and when introduced in 1986 it was the first in the United States to use a high speed catamaran vessel for a route that the traditional, slower ferries had been unable to serve. Service on the route was improved in 1996 with the acquisition of two new 300-passenger, 35 knot catamarans, shortening the original trip time of 70 minutes to 55 minutes and doubling the capacity provided on the route. The original catamaran is maintained as a reserve vessel.

The Vallejo Ferry operates ten round trips daily, eight on weekends, along with occasional additional stops at Fisherman's' Wharf and, during the summer season, Angel Island State Park. Service frequency is hourly during the peak hours seven days a week,

with approximately two hour intervals during midday. Fares are $7.50 one-way, half price for seniors, disabled, and children. Passes that allow use of Vallejo Transit and BartLink buses are available for $10 a day or $140 a month, the latter also including a San Francisco Muni transit pass. Parking is provided free in Vallejo, and bicycle carry-ons are encouraged on both buses and the ferry.

Ridership & Costs

Ridership on the service has been uneven, declining until 1995. However, costs were reduced proportionately, keeping the unit costs of the service constant over the period.

Table 3-13 Vallejo Ferry National Transit Database Summary

	1992	1993	1994	1995
Ridership	236,600	221,600	193,700	209,000
Operating Expense	$2,218,100	$2,008,900	$2,008,700	$1,952,400

The deficit for the service in FY 1996-97 was estimated at just over $800,000, subsidized from state transportation development funds.

Other Features

The Vallejo ferry is also affected by a restricted speed area, the Mare Island channel. This channel is the approach to the terminal at Vallejo, and has many commercial and government dock areas along its sides. The Coast Guard restricts operating speed to limit wave action on these vessels and the dock facilities.

As mentioned, the ferry stops once in the morning and once in the afternoon at the Angel Island State Park, on the route between Vallejo and San Francisco. This allows the ferry to pick up some additional arriving or departing excursion passengers, who can also use one of several excursion ferry services that provide transportation to and from the island. An additional excursion feature offered by the service is a combination ferry fare and ticket to the theme park Marine World Africa USA in Vallejo, allowing a round trip from San Francisco to Vallejo on the ferry, a shuttle to the theme park, and entrance to the park. This offering is designed to attract passengers on a reverse trip, going to Vallejo

from San Francisco in the first part of the day and then returning later. This serves to balance the passenger loads normally carried by the ferry.

3.6.6 Other Ferry Systems

There are several other ferry services in the San Francisco Bay area. The Harbor Bay Ferry provides service from Bay Farm Island, part of the city of Alameda, to the San Francisco Ferry Terminal Building. The service has eight daily trips to downtown and seven daily return trips to Bay Farm Island, concentrating on the peak periods. During the summer, there are also three round trips on weekends. Fare is $4.00, with seniors, children, and military paying reduced fares, and discount ticket books available. The service carried some 370 people daily in the first quarter of FY 1996, though this number has varied between 299 and 337 daily passengers averaged over a year since it's inception in 1993. An additional feature of the service is a special run to weekend afternoon football games at Candlestick Park stadium (now 3Com Park). Passengers can pay either $10 for a ferry trip to the stadium, or $15 for both a ferry trip and a stadium seat. Children and seniors again get discounts.

4. System Comparisons

This chapter summarizes the information gained from the previous chapters on the San Juan transit systems and the various urban ferry systems. The first part of the chapter summarizes some common characteristics for ferry systems identified in the previous chapter. This is followed by estimating a cost allocation model for the two routes served by *Acuaexpreso* based on the information acquired from research of the contemporary ferry systems. The chapter then concludes by comparing the overall and estimated performance measures for *Acuaexpreso* with both the other ferry systems and the other transit systems in San Juan.

4.1 Common Themes from Other Ferry Systems

4.1.1 Historical Development

A review of the historical development of urban ferry systems indicates that the primary reason for their introduction is the increasing congestion and delay on road networks. Because of the location of most port cities, usually centered on a river or natural harbor, geography acts to limit the road network to a few bridges or tunnels connecting the various regions of each city. When these road links become crowded, and the alternative of building more capacity becomes too expensive, ferries are a common solution.

This was critical in the development of the Hingham ferry service in Boston, where the primary highway between the South Shore and Boston was to be reconstructed. The existing private ferry service from the South Shore was expanded with public support as a mitigation measure, to lessen the congestion imposed by lane elimination and the movement of construction equipment during reconstruction. The added time and congestion that would result from the reduction in road capacity during the two year rebuilding process were expected to be severe enough to warrant subsidy of ferry service. However, after reconstruction, the ferry had become such a popular transportation alternative that public support was continued to maintain the expanded service.

These reasons for ferry system introduction apply to San Juan. The shape of the Isleta de San Juan naturally led to the early introduction of ferry service between Old San Juan and Cataño, which continues with the present *Acuaexpreso* service between the two regions. Meanwhile, the road network connects Old San Juan to the rest of the city by means of the bridges at the eastern end of the Isleta. While these bridges have provided sufficient capacity up to the present, the increasing congestion on the bridges and the San Juan Metropolitan Area road network in general, as well as the necessity for reconstruction of the bridges, suggest that this will not always be the case. An alternative to road-based transportation is the ferry service provided by *Acuaexpreso* between Hato Rey and Old San Juan. While currently underutilized, increasing congestion and the future construction suggest that this ferry route could play an important role as a transportation alternative in the near future.

4.1.2 Ferry Use

Many of the ferry systems surveyed do not necessarily have a large advantage in terms of travel time and are rarely competitive in fare with other transit modes. The question then is: 'Why do people take the ferry?' The answer lies in a variety of factors, dependent on the quality of the service and customer satisfaction, ranging from enjoyment of a waterborne trip, and the vistas presented, to the generally more pleasant conditions found on the ferry. A 1990 survey of NYC ferry customers[1] revealed the following reasons for ferry preference, listed along with the percentages of customers citing each:

- 36% Comfort
- 27% Travel Time
- 22% Reliability
- 15% Seating

This emphasis on factors besides travel time is repeated in the results of surveys of passengers of other systems. Certainly keeping travel time and cost competitive with other modes is important, however it is not the most important determinant in ferry use.

[1] Port Authority of New York & New Jersey Office of Ferry Transportation information.

A summary of approximate modal shares and travel time information for several of the ferry systems and cities described in Chapter Three is presented in Table 4-1.

Table 4-1 Approximate Modal Split and Travel Times for Urban Ferry Systems[2]

Travel Time & Mode Share	Ferry	Transit	Auto
Hingham Commuter Service	36 min	64 min	48 min
(Hingham to Boston)	8%	1%	91%
Vancouver SeaBus	12 min	36 min	
(North Vancouver to Vancouver)	6%	10%	84%
New York City Cross-Hudson	10 min	11 min	
(Hoboken to Manhattan)	3%	31%	66%
San Francisco - Golden Gate	45 min	50 min	
(Marin County to San Francisco)	5%	16%	76%

The results show the dominance of the automobile as the mode of choice in North American urban transportation. Though it is difficult to quantify auto travel times, which tend to be highly variable, the convenience, comfort, and generally faster travel time of the automobile tend to outweigh other considerations for auto users, despite congestion, tolls, and parking fees.

It is also evident that ferries are usually competitive with other public transit alternatives in travel time. However, ferry travel does tend to be more expensive. Fare

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[2] Information presented in Tables 4-1, 4-2, and 4-3 is based on a variety of sources.
Boston: Service comparison is for Hingham to Boston. Data is taken from MBTA 1997 Ridership & Service Statistics. Overall public transit vs. car modal split is that estimated for Hingham by the MBTA, split between the ferry and bus-rail combination by reported ridership. The Commuter Boat is compared to the #220 bus between Hingham and Quincy and Red Line rail service from Quincy Center station to downtown Boston. Travel times and fares are based on available schedule information, while auto travel time is taken from Schoon, J., P. Furth, and R. Lieb. *The Potential for Supplemental Freight Services in Ferry Planning and Operations: A Case Study and Planning Guideline.* (Final Report, August 1989).
Vancouver: Modal split, access, and service comparison information is taken from BC Transit Service's *The Seabus System in Vancouver, B.C.* (September, 1997) and available schedule information. SeaBus is compared to the #240 bus between North Vancouver and the downtown district.
New York: Overall cross-Hudson traffic modal split is based on Port Authority of New York & New Jersey Office of Ferry Transportation information. Travel time and fare comparison contrasts New York Waterway service between Hoboken and Central Manhattan with PATH subway service between Hoboken and the World Trade Center.
San Francisco: Modal split and access information is taken from Pacific Transit Management Corp. *Regional Ferry Plan: San Francisco Bay Area.* (Final Report, September 1992)., for the Marin County area. For fares and travel times, the Larkspur ferry is contrasted with the Golden Gate #30 bus between the Larkspur terminal area and downtown San Francisco.

information, and auto tolls where appropriate, is presented in Table 4-2 for some of the above systems.

Table 4-2 One-Trip Ferry and Bus/Rail Transit Fares

	Ferry Fare	Transit Fare	Auto Toll
Hingham - Boston	$4.00	$2.30	N/A
North Vancouver - Vancouver	~$1.80*	~$1.80*	N/A
New York Hoboken - Central Manhattan	$2.00	$1.00	$4.00
Golden Gate Larkspur - San Francisco	$2.50	$2.00	$2.00

** Converted to US dollars*

Given these characteristics of the other transportation modes, ferry services, while naturally trying to minimize travel time, have also concentrated on what is commonly referred to as "boutique" service; catering to passengers who place a greater emphasis on comfort and quality of the service.

In general, ferry vessels tend to be less crowded and more comfortable than other transit options, in fact often this is effectively mandated by safety regulations. However, a focus of private ferry companies on customer satisfaction, especially on longer ferry routes, has led to high-quality seating and other customer services such as on-board concessions. This tends to attract riders more concerned with comfort and other factors than out-of-pocket cost or slightly longer travel times. Even fare plays a part in increasing customer satisfaction, generally restricting passengers to the population with higher-than-average incomes. This removes some of the stigma that high-income passengers tend to associate with traditional transit systems.

Certainly these attributes are not common to all services, the Vancouver Seabus and New York Waterway concentrate instead on short trips with high passenger volumes. Still, these characteristics do point to features that should be considered in marketing ferry service. For instance, reliability is a key factor that can be emphasized for any service, a key factor in the success of the Hingham commuter boat has been a 99.5% on-time departure of the ferryboats, with no missed trips. This can be contrasted with the uncertainty associated with road congestion, where auto trips generally may be quicker but can be longer at particular times of the day.

4.1.3 Ferry Access

A key factor in ferry ridership is recognizing that potential customers are naturally limited by the waterborne nature of the system and, typically, a small network of only a few terminals. While many customers will be walking to a ferry terminal or to their final destination, this can limit the potential market, especially at suburban terminals.

To overcome this, ferry service must concentrate on integration with other modes, though walking will continue to generate a large proportion of the customers, at the downtown end in particular. Most travelers use as ferries as one mode in a multi-modal trip, accessing and/or continuing on from the ferry by car, bus, or another system. A summary of the percentages of riders using different modes to access several urban ferry systems, as well as that of the continuation modes of travel, is presented in Table 4-3.

Table 4-3 Access to Ferry Systems (AM - Weekday)[3]

	Origin - Ferry			Ferry - Destination	
	Auto	Transit	Walk	Transit	Walk
Vancouver SeaBus	11%	59%	26%	48%	44%
New York					
Hoboken	10%	81%	9%	13%	86%
Weehawken	83%	14%	3%	22%	73%
San Francisco					
Larkspur	80%+	-	-	-	80%+
Sausalito	~33%	~33%	~33%	-	80%+
Tiburon	45%	~25%	~25%	-	90%+

4.1.4 System Flexibility

However, while ferries transport only a small percentage of commuters they can still provide a valuable supplement to the road network, and depending on the city this can still be a significant number of people. This diversion of travelers from other modes, which tend to be congested, improves traveler satisfaction and reduces the cost of congestion for all concerned.

Ferry systems have played major roles in providing extra transportation capacity during natural (or other) disasters. In New York City, the flooding of the PATH subway

[3] Percentages do not total to 100% due to rounding and other modes of access, i.e. taxi or bicycle.

left thousands of commuters with no other option but ferry service, leading to a large temporary increase in ridership. Similarly, in San Francisco the Loma Prieta earthquake closed the bridges linking the city, and again ferry services provided the necessary transportation. These events were natural disasters, however the San Francisco Muni transit strike in 1997 produced a similar effect, boosting ferry ridership during the reduction in transit service caused by the labor dispute.

While these are infrequent occurrences, they do show the value of having a truly multi-modal transportation system. Different modes provide flexibility to travelers, offering a range of options that allow customers to choose the travel mode that best fits their needs and preferences. In addition, the multiple modes prevent dependency on any single mode which may become unavailable due to an unusual event. Other more common events, such as auto accidents or the temporary closing of a facility due to construction work, are also examples where the value of a multi-modal system, within which travelers can shift modes to reduce delay, is clearly apparent.

4.1.5 Wake Problems

Several ferry systems are subject to speed restrictions imposed on vessels by the need for wake reduction and environmental protection. A significant wake affects both man-made objects, such as marinas and docking for other vessels, and the natural environment.

The result of this has been the development of reduced wake vessels, with the lead being taken overseas where ferry systems tend to be both more heavily used and more advanced. In particular, Australia has pioneered the development of low-wake vessels, with designs that have been replicated under agreement in the United States.

Wake problems have been important in the performance of ferry systems in Seattle and San Francisco, high wakes resulting in speed restrictions and longer travel times. This decreases the attractiveness of the service versus the land-based transportation alternatives. This explains why a great deal of effort has been invested in environmental studies and ferry wake reduction by agencies and shipbuilders around the world.

4.2 Cost Estimation

This section estimates the cost of the *Acuaexpreso* service using the information provided by studies and reports from other ferry systems. This cost estimate can be used to assess *Acuaexpreso* data, which has varied due to service changes and disruptions, and to allow cost estimations to be made for the two routes of the system. Using these latter estimates, the reported cost of operation of the system can be allocated between the two routes to allow performance analysis at the route level.

4.2.1 Cost Estimation Approach

A great deal of work has been done on estimating the costs for ferry service by public transportation agencies, most significantly by agencies in New York. A study prepared in 1992, "An Assessment of the Potential for Ferry Services in New York Harbor", offers formulas and estimated data for expenses including crew, maintenance, and fuel costs. The results of the application of these formulas and data to *Acuaexpreso* is summarized below, with the calculations presented in detail in Appendix C.

Unfortunately, as discussed in Chapter Two the information available on *Acuaexpreso* is affected by the service changes and disruptions, making consistent analysis of the service difficult. For analysis purposes, the vessel operation schedule is assumed to consist of two monohulls for the Cataño - Old San Juan route during the peak period, with two catamarans during the off-peak service and one operating in the evening. Two catamarans operate the Hato Rey - Old San Juan service, including the trips between Cataño and Hato Rey during the peak periods.

This gives a total of four vessels operated in maximum service. In actual practice more vessels may be in operation, e.g. one completing a trip as another starts out. However, given the schedule this should be a low frequency occurrence with the overlapping time of operation minimal. The estimate for the costs of operation of the system and an approximate allocation of the costs between the two routes operated is therefore based on the above schedule.

In addition, due to interest in estimating the costs of increasing and reducing service, the hourly marginal cost of vessel operation is estimated. Due to fixed terminal

operating expenses, the cost of the first vessel is high, reflecting the high initial cost of terminal operation, however there is a lower marginal cost for additional vehicle operation.

4.2.2 Labor Costs

There are several types of labor associated with any ferry system, including crew, maintenance, terminal operations and administration. Actual employees for *Acuaexpreso* have varied between 131 and 110 over the last several years. In 1995, unionized employees were reported as:

- 14 captains
- 30 sailors (deckhands)
- 15 janitors
- 7 substitutes
- 2 mechanics
- 3 welders
- 26 maintenance and auxiliary workers
- 2 administrators

for a total of 99 unionized employees, along with an additional 11 non-unionized employees for a system total of 110.

For the purposes of route cost allocation, an estimation of employee assignments can be made. Appendix C presents a manning plan for *Acuaexpreso* which can be used to make a plausible allocation.

1. Crew

Ferry vessel crews can range from one to four or more personnel, depending upon vessel size and trip length. In the case of *Acuaexpreso*, the monohulls operate only a short route, but are large and unwieldy vessels, requiring extra personnel. A reasonable estimate for the crew size is four, one master and three deckhands. This is the number carried by one of the Vancouver 400-person ferries, which while larger are also more maneuverable. Unlike the Seabus craft, for instance, the docking method that *Acuaexpreso* uses requires personnel to be available to assist vessels in tying up, either

riding on the ferry as deckhands or available upon docking. The *Acuaexpreso* catamarans, on the other hand, are more maneuverable and modern than the monohulls, and can be operated by only one person, the master. However, assistance is still needed for docking, requiring that at least one additional crewmember be available.

2. Terminal

Terminal operations depend upon the size of the terminals and the volume of traffic through each terminal, which varies throughout the day. Personnel tasks include ticket sales, custodial services, and security, the latter performed under a separate arrangement for *Acuaexpreso.*

For *Acuaexpreso's* terminals, all of which are relatively large, estimated employees during times of operation include a custodian and a ticket agent, along with a supervisor. During peak periods, it is likely that an additional ticket agent will be needed. In addition, a custodian should be available to clean at night.

3. Maintenance

For a typical ferry system with in-house maintenance, normally one engineer is required for routine checks and troubleshooting on the operating vessels throughout the day, while shop maintenance employees during the day perform corrective or long-term maintenance and another team performs lengthy routine inspections and preventive maintenance at night. Normally, there are roughly two to three maintenance employees per vessel, again depending upon size and use.

For *Acuaexpreso*, with a large fleet available compared to daily usage, an estimate of the required maintenance employees is three employees for the operating vessels, along with one for each vessel in the overall fleet.

4. Administration & Support

Managerial staff can vary considerably, depending upon the size of the ferry system as well as the support it receives from other organizations. In the case of *Acuaexpreso*, some support services are provided by divisions of the Port Authority, including the preparation of statistics and marketing and advertising the service. Administrative and support staffing are therefore likely to be closer to the NYC study

minimum of a general manager, two secretarial staff, and an assistant, as well as a chief engineer for overseeing the maintenance of the vessels.

Overall Estimate for *Acuaexpreso*

An estimate of the necessary employee assignments for daily operation is presented in Table 4-4, based on the different periods of demand and operation of the system.

Table 4-4 Estimated Summary of *Acuaexpreso* Employees

	Salary	AM Peak	Midday	PM Peak	Evening	Night
Time Periods	per hour	0600-1000	1000-1600	1600-1900	1900-2200	2200-0600
Hours/Period		4	6	3	3	8
Vessel Crew						
Masters - C&SJ	$14	2	2	2	1	
Deckhands - C&SJ	$8	4	2	4	1	
Masters - HR	$14	2	2	2		
Deckhands - HR	$8	2	2	2		
Terminal Operations						
Cataño						
Supervisor	$14	1	1	1	1	
Ticket Agent	$9	2	1	2	1	
Custodians	$7	1	1	1		2
San Juan						
Supervisor	$14	1	1	1	1	
Ticket Agent	$9	2	1	2	1	
Custodians	$7	1	1	1		2
Hato Rey						
Supervisor	$14	1	1	1		
Ticket Agent	$9	1	1	1		
Custodians	$7	1	1	1		2
Maintenance Operations						
Supervisor	$14	1	1			1
Mechanics	$10	4	4			4
Management						
Secretarial Staff	$9	2	2			

In addition to the above employees, there are assumed to be three salaried staff: the general manager, an assistant, and the chief engineer. Using the above schedule, modified for weekends and including the salaried employees, gives a total of 85 full time employee equivalents, 10% lower than the unionized employees reported by *Acuaexpreso*.

With the addition of 60% for fringe benefits, a reasonable estimate of employee costs can be made, allocating the costs of the San Juan terminal and other system-wide expenses between the two routes in proportion to the number of vessel trips on each route. The analysis is presented in Appendix C, and is summarized in Table 4-5.

Table 4-5 Annual Employee Expenses Estimate for *Acuaexpreso*

	Salaries	Fringe Benefits	Total
Cataño - Old San Juan	$1,438,976	$863,386	$2,389,362
Hato Rey - Old San Juan	$1,034,264	$620,558	$1,712,822
Total	$2,473,240	$1,483,944	$4,102,184

Summing these for the year, an estimate of the total annual employee expenses for *Acuaexpreso* is $4.10 million, of which an estimated 42% can be allocated to operation of the Hato Rey - Old San Juan route. The total amount is less than but comparable to the estimated employee expenses of $4.59 million for F.Y. 1996-97, however the ratio calculated can be used to allocate the actual expenses between the two routes.

4.2.3 Maintenance Expenses

The NYC review of ferry operations produced the following "rules of thumb" for rough calculation of the costs of maintenance of urban ferry vessels.

> "Research in the private ferry service revealed that annual maintenance and repair costs typically average between 4 and 5 percent of the purchase price of the vessels. This includes such capital items as periodic replacement for engines and other systems.[4]"

In addition, an adjustment was included to account for daily operating hours, based on an average 5 hours a day. The following formula was developed by the NYC study:

> Annual Maintenance and Repair Costs = purchase price of the vessel multiplied by (2.7% + 1.8% of (daily operating hours/vessel)/5 hours).

Based on a estimated price or value of $2.5 million for the catamarans and $3 million for the monohulls, along with the daily hours of operation for the vessels in use, produces an

[4] Office of Ferry Planning and Private Operations. *An Assessment of the Potential for Ferry Services in New York Harbor*. Final Report, July 1992. p. 68. Section 5.64.

estimate of $848,880 for annual maintenance costs for *Acuaexpreso* (shown in Appendix C). Of this figure just over 75%, or $648,000, is upkeep for the entire fleet of nine vessels while roughly $200,000 is based on operation of the vessels in service.

This formula accounts for both labor and materials costs, and is based on a private operator contracting out maintenance operations. For *Acuaexpreso,* this would be double counting employee expenses. However, the National Transit Database provides a breakdown of costs by function. For *Acuaexpreso* in F.Y. 1994-95, the most recent date for which the data is available, vehicle maintenance expenses were just under $990,000, of which 47% was spent on employee related expenses. Applying this ratio to the estimated maintenance expense produces an estimate of the maintenance costs, with labor costs subtracted, for the system as a whole of $450,000, of which $345,000 is for fleet upkeep. The costs attributable to operation the of two routes are $87,000 for the Cataño - Old San Juan route and $114,000 for the Hato Rey - Old San Juan route. These figures can then be used for proportional allocation of the actual costs by route.

4.2.4 Fuel Expenditures

Fuel Price

Cost per gallon for *Acuaexpreso* has varied from $1.19 per gallon in F.Y. 1993-94 to $1.01 a gallon in F.Y. 1994-95. For computational purposes, cost per gallon will be assumed to be $1.10 a gallon, even though this appears to be somewhat high compared to other systems. In comparison, Golden Gate Ferry paid an average of 66 cents per gallon for fuel used by the ferries in 1995-96, while the NYC study estimated the combined cost of fuel and lubricants at ninety cents a gallon in 1992.[5]

Fuel Consumption

Fuel consumption is difficult to calculate, being based on hours of operation, distances traveled, speed of travel, and even such small effects as passenger loading and the weather. Based on the NYC study, full power fuel consumption rates for vessels similar to those operated by *Acuaexpreso* are:

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[5] *Ibid.* p. 68. Section 5.63

- 87 gal/hr for 150-person, 25 knot catamarans;
- 108 gal/hr for 250-person, 20 knot monohulls (similar to *Acuaexpreso*).[6]

This is at 100% speed, however the shortness of the Cataño route and the wake restrictions in San Juan Bay limit full speed operation of the *Acuaexpreso* vessels. A similar estimate from San Francisco estimates cruising speed fuel consumption for similar catamarans at 60-100 gallons per hour.[7] Fuel consumption while docking or idling is estimated at 10% of the full power rate.[8]

Application of these fuel consumption estimates to the *Acuaexpreso* schedule of operation leads to an estimate of fuel consumption of approximately 295,000 gallons annually (See Appendix C). Of this consumption, just under 60% is estimated to be by the Hato Rey voyages because of their greater length, despite fewer trips compared to the Cataño - Old San Juan route. This ratio will be used to allocate the fuel expenditures by route.

4.2.5 Cost Allocation by Route

Based on the estimated costs above, the overall costs of the *Acuaexpreso* service can be allocated using the calculated ratios for the two routes of operation. A summary of the estimated expenses for *Acuaexpreso,* along with the estimated values for the Hato Rey service, is presented below.

Calculated Expenditures	Total	Hato Rey Allocation	Estimate %
Employee Expenditures	$4,102,184	$1,712,822	41.8%
Fuel Expenditures	$324,418	$193,100	59.5%
Maintenance (w/o Labor)	$451,590	$60,806	13.5%
Totals	$4,878,192	$1,966,728	40.3%

The allocation of actual costs then uses the estimated percentages, applied to the estimated system costs for F.Y. 1996-97.

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[6] Office of Ferry Planning and Private Operations. *An Assessment of the Potential for Ferry Services in New York Harbor.* Final Report, July 1992. Appendix H, Generic Vessel Cartridges.

[7] Pacific Transit Management Corp. *Regional Ferry Plan: San Francisco Bay Area.* Final Report, September 1992. p. III-28.

[8] Office of Ferry Planning and Private Operations. *An Assessment of the Potential for Ferry Services in New York Harbor.* Final Report, July 1992. p. 68.

Allocated Expenditures	1996-97 Estimate	Hato Rey Allocation %	Hato Rey
Employee Expenditures	$4,590,840	41.8%	$1,916,855
Fuel Expenditures	$348,166	59.5%	$207,235
Maintenance	$644,259	*	$258,991
Other	$1,215,856	40.3%	$490,194
Totals	$6,799,121		$2,873,275

* Maintenance = Hato Rey costs + Fleet Upkeep * 40.3%

The allocated Cataño - Old San Juan cost then totals $3,925,846

The allocated costs can be used to estimate performance measures for the two routes of the system, which are presented in Table 4-6 along with the estimated system performance measures for *Acuaexpreso* based on the forecast for F.Y. 1996-97.

Table 4-6 Estimated Performance Measures for the *Acuaexpreso* Routes

	F.Y. 96-97 Estimate	Cataño Allocation	Hato Rey Allocation
Revenue Vehicle Miles	130,396	39,693	90,703
Revenue Vehicle Hours	20,258	10,768	9,490
Service Efficiency			
Operating Expense/ Revenue Vehicle Mile	$52.14	$98.91	$31.68
Operating Expense/ Revenue Vehicle Hour	$335.63	$364.58	$302.77
Cost Effectiveness			
Operating Expense/ Passenger Mile	$3.91	$2.60	$12.58
Operating Expense/ Unlinked Passenger Trip	$5.38	$3.25	$53.47
Service Effectiveness			
Unlinked Passenger Trips/ Revenue Vehicle Mile	9.68	30.46	0.59
Unlinked Passenger Trips/ Revenue Vehicle Hour	62.33	112.28	5.66
Passenger Miles/ Revenue Vehicle Mile	13.34	38.07	2.52
Farebox Recovery Ratio	9.48%	15.40%	1.40%

The estimated performance measures for the two routes show that the Cataño - Old San Juan route has higher costs of operation per revenue vehicle mile and hour, but that other performance measures are far better than those for the Hato Rey - Old San Juan route. The higher service efficiency measures for the Cataño - Old San Juan route are explained by the fact that the route is served by the monohull vessels during the peak period, with higher costs than the catamarans, raising the operating expense per vehicle.

The Cataño service also operates into the evening, raising costs. On the other hand, the greater length of the Hato Rey route acts to decrease the expense per revenue vehicle mile by spreading out the cost of the fewer trips over greater mileage.

The much higher ridership and effectiveness of the Cataño - Old San Juan route, however, are clearly demonstrated by much higher cost and service effectiveness measures than for the Hato Rey route. This better performance is reflected in the farebox recovery ratio, which is high for the Cataño route while very small for the Hato Rey route.

4.3 Performance Comparison

A traditional method of analyzing the efficiency and effectiveness of transit services has been though comparison of the performance measures developed from data supplied to the National Transit Database. In the case of *Acuaexpreso*, the system's performance measures can be compared both against the other transit systems in San Juan and against those of other ferry systems. Comparison with the other publicly operated San Juan systems places *Acuaexpreso's* performance in context with these systems, and reflects those characteristics inherent to San Juan. Comparison with the other ferry systems gives some idea of how *Acuaexpreso* does within the family of ferry systems.

However, no comparison is exact, and to some degree these performance comparisons are classic examples of comparing apples and oranges. For example, the fact that the average Gross Domestic Product per person in Puerto Rico is below $8,000 strongly affects labor costs and employment practices compared with mainland cities such as Boston or San Francisco. While comparison with other San Juan transit services controls for these local factors, the performance and cost of operation per vehicle for bus systems are naturally very different from ferry systems. Nevertheless, the information can be used to identify possible shortcomings or areas of further analysis in examining *Acuaexpreso*, as well as putting the service in a strategic perspective for San Juan.

As mentioned earlier, the National Transit Database figures for *Acuaexpreso* have several errors, and performance measures are estimated instead based on other available data (shown in Appendix B). Data for AMA and *Metrobus* for F.Y. 1995-96 is not yet available, so only data for the fiscal years ending in 1992 through 1995 will be examined.

4.3.1 San Juan Transit System Performance

The performance measures for *Acuaexpreso,* AMA, and *Metrobus* are presented in Tables 4-1, 4-2, and 4-3 respectively. Service efficiency measures are included for completeness, though the difference in operating expense by mode is such as to make direct comparison pointless.

Graphical comparison is presented for the performance measures of Operating Expense/Passenger Mile and Unlinked Passenger Trips/Revenue Vehicle Mile in Figures 4-1 and 4-2. Farebox recovery ratio, the proportion of the operating expenses paid for by passenger revenues, is presented graphically in Figure 4-3. For comparison, points are included for the 1996-97 estimated measures for *Acuaexpreso* by route and for the system. While these numbers are based on a different route structure and operating schedule, the numbers are close enough to show the relative performance of the two routes.

As the figures show, *Acuaexpreso* stands out as far different from the other services, although this is partly a function of the modal differences. In Figure 4-1, the operating expense per passenger mile is shown to be considerably higher for *Acuaexpreso* than for the bus systems. This is to be expected given both the much higher cost of operating a ferry boat and the declining ridership that *Acuaexpreso* has been experiencing. Though ridership and hence passenger-miles declined over the four years, operating expenses were not reduced proportionately, causing increases in the measure. The estimated measures for the two routes for 1996-97 show the difference in performance between the two routes, based on a somewhat lower overall measure estimated for that year but still showing the poorer performance of the Hato Rey route.

Figure 4-2 shows the effects of declining ridership initially with a slight downward trend. The termination of the regular Cataño - Hato Rey service in December 1993 then causes the 1993-94 measure to jump, as revenue vehicle miles decrease sharply. In the following year, the ridership effect again is dominant, causing the measure to decrease. However, the cessation of Hato Rey - Old San Juan service in January 1995 still keeps revenue vehicle miles lower than for the full schedule of operation. The 1996-97 point measure shows that with full service year around, the passenger miles per

Table 4-7 Estimated Performance Measures for *Acuaexpreso*

	91-92	92-93	93-94	94-95
Service Efficiency				
Operating Expense/ Revenue Vehicle Mile	*$34.35*	*$49.02*	*$123.06*	*$94.06*
Operating Expense/ Revenue Vehicle Hour	*$181.85*	*$259.54*	*$651.49*	*$497.99*
Cost Effectiveness				
Operating Expense/ Passenger Mile	*$1.37*	*$2.20*	*$4.31*	*$4.58*
Operating Expense/ Unlinked Passenger Trip	*$3.15*	*$4.35*	*$6.64*	*$5.82*
Service Effectiveness				
Unlinked Passenger Trips/ Revenue Vehicle Mile	*10.92*	*11.27*	*18.52*	*16.17*
Unlinked Passenger Trips/ Revenue Vehicle Hour	*57.82*	*59.69*	*98.05*	*85.62*
Passenger Miles/ Revenue Vehicle Mile	*25.00*	*22.29*	*28.53*	*20.53*
Farebox Recovery Ratio	19.0%	13.2%	8.3%	8.5%

** italicized measures are corrected estimates*

Table 4-8 National Transit Database Performance Measures for AMA

	91-92	92-93	93-94	94-95
Service Efficiency				
Operating Expense/ Revenue Vehicle Mile	$10.09	$5.99	$6.07	$6.49
Operating Expense/ Revenue Vehicle Hour	$43.15	$51.52	$54.34	$58.56
Cost Effectiveness				
Operating Expense/ Passenger Mile	$0.45	$0.45	$0.47	$0.53
Operating Expense/ Unlinked Passenger Trip	$1.64	$1.68	$1.70	$1.79
Service Effectiveness				
Unlinked Passenger Trips/ Revenue Vehicle Mile	6.16	3.56	3.58	3.62
Unlinked Passenger Trips/ Revenue Vehicle Hour	26.32	30.63	32.02	32.69
Passenger Miles/ Revenue Vehicle Mile	22.36	13.19	12.86	12.19
Farebox Recovery Ratio	14.4%	14.2%	13.5%	12.8%

Table 4-9 National Transit Database Performance Measures for *Metrobus*

	91-92	92-93	93-94	94-95
Service Efficiency				
Operating Expense/ Revenue Vehicle Mile	$5.49	$5.32	$5.49	$5.68
Operating Expense/ Revenue Vehicle Hour	$52.09	$44.43	$45.78	$52.31
Cost Effectiveness				
Operating Expense/ Passenger Mile	$0.23	$0.21	$0.24	$0.28
Operating Expense/ Unlinked Passenger Trip	$0.62	$0.62	$0.69	$0.82
Service Effectiveness				
Unlinked Passenger Trips/ Revenue Vehicle Mile	8.91	8.61	7.92	6.90
Unlinked Passenger Trips/ Revenue Vehicle Hour	84.65	71.84	66.12	63.56
Passenger Miles/ Revenue Vehicle Mile	23.74	24.97	22.63	20.29
Farebox Recovery Ratio	-	53.7%	59.7%	57.2%

Figure 4-1 San Juan Systems: Operating Expense/ Passenger Mile

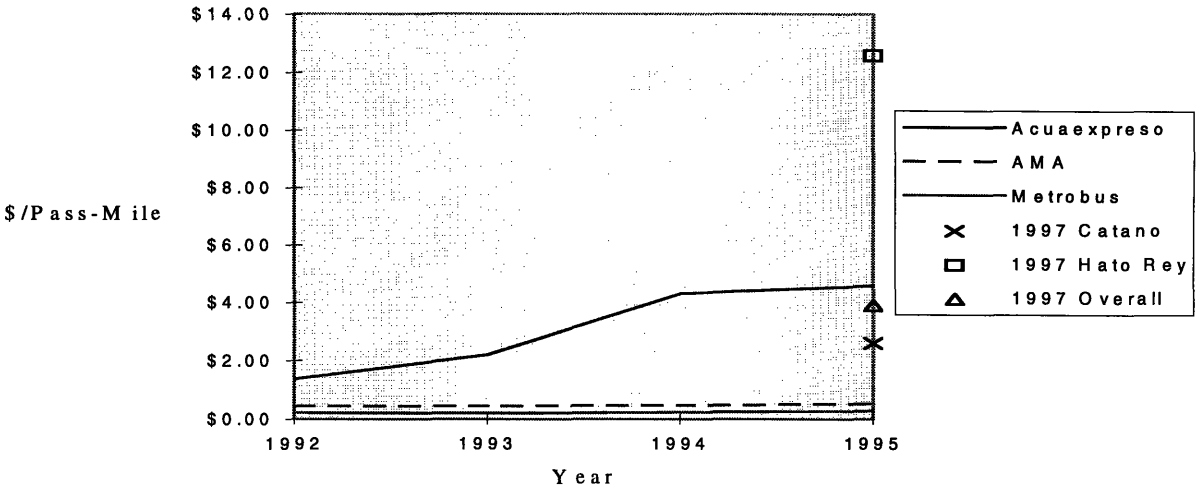


Figure 4-2 San Juan Systems: Passenger Miles/ Revenue Vehicle Mile

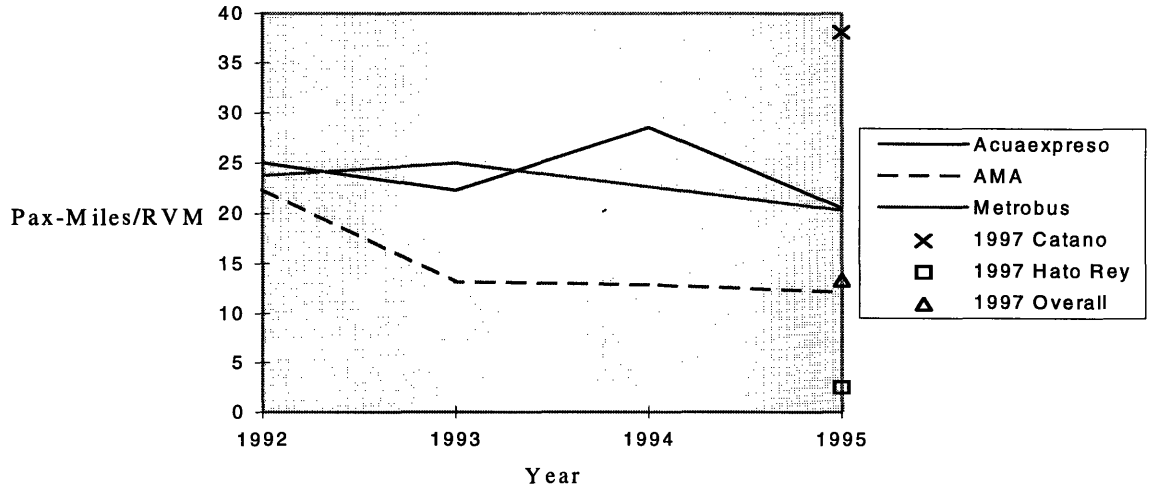
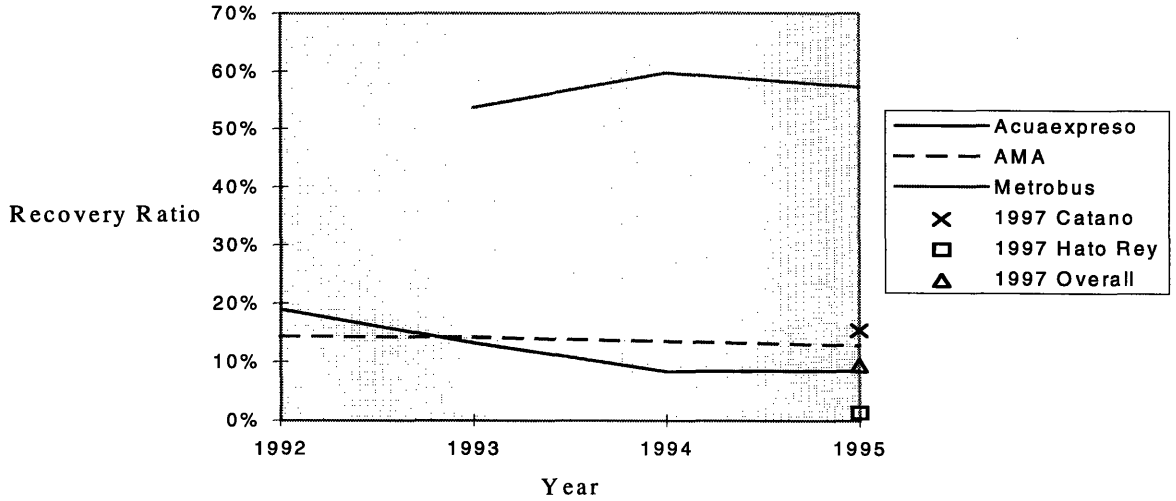


Figure 4-3 San Juan Systems: Farebox Recovery Ratio



revenue vehicle mile will be even lower, though the much better performance of the heavily traveled Cataño - Old San Juan route is clear.

The farebox recovery ratios, shown in Figure 4-3, show that in terms of fare revenue collected as a function of operating expense, *Acuaexpreso*, while worse than the other services, is not that much lower than AMA. The Cataño - Old San Juan route's recovery ratio estimate for 1996-97 is actually higher at 15.4%. The Hato Rey route, on the other hand, is clearly disastrous at just over 1%. *Metrobus* is the exception to the other services, with a much greater recovery ratio than the publicly operated systems. Note that the effects of the service disruption in 1995 are not evident, the ratio staying flat between 1994 and 1995. The small amount of revenue lost by not having any Hato Rey passengers was more than compensated for by savings in operating expenses .

4.3.2 Ferry Systems Performance

While the previous performance measures compared *Acuaexpreso* with the other transit services in San Juan, they failed to deal directly with the opportunities and constraints associated with ferryboat as opposed to bus technology. Performance comparisons with other ferry systems resolve this problem, and the measures for the Golden Gate Ferry, the Alameda - Oakland Ferry Service, the Vallejo Ferry, the Vancouver SeaBus, and *Acuaexpreso* are presented graphically in Figures 4-4, 4-5, and 4-6, with the 1996-97 estimate for *Acuaexpreso* dashed as it is based on estimated costs. In addition, farebox recovery ratio is presented in Figure 4-7 for the Golden Gate Ferry, *Acuaexpreso*, and the Washington State passenger-only ferries.

Financial information and statistics for these other urban ferry systems are included in Appendix B. Data for WSF is available only for farebox return up through 1995-96. SeaBus data for 1995-96 is available with the exception of farebox return due to the system's fare structure. Complete Golden Gate Ferry information for 1995-96 and 1996-97 is also available. The remainder of the information is taken from the National Transit Database reports, available up through 1995. An overview of the systems and their characteristics is provided in Table 4-10.

Table 4-10 Ferry System Summary

	Vessels in Peak Service	Vessel Capacity (Passengers)	Approximate Daily Ridership	Travel Time (minutes)
Vancouver SeaBus	2	400	14,000	12
New York Waterway				
Hoboken - Manhattan	4/5	375	8,600	6-7
Weehawken - Manhattan	2	375	7,500	5
Golden Gate				
Larkspur	3	725	3,400	45
Sausalito	1	575	1,450	30
AOFS	1	250	1,570	25
Vallejo	2	300	1,113	55
Acuaexpreso				
Cataño - Old San Juan	2	300	3,300	8
Hato Rey - Old San Juan	2	150	120	15

In examining the graphical comparisons of the performance measures, the effects of changes in ridership and operation for *Acuaexpreso* cause considerable variation is some of the measures. Figure 4-4 shows the effect of the elimination of regular service between Cataño and Hato Rey in December 1993 with a sharp upwards spike as operating expenses increased while revenue vehicle miles decreases sharply, exceeding even the measure for the Golden Gate Ferry, which is higher than that of the other ferry systems due to the high operating costs of the much larger vessels used by Golden Gate Ferry. Costs were brought under control in the following year to more closely match the service being provided, a trend which continues. In contrast the measures of other systems have been relatively stable, and with further stabilization it is evident that *Acuaexpreso's* costs per revenue vehicle mile are not that dissimilar from other mainland systems though given the different economic conditions in Puerto Rico labor and other expenses should presumably be somewhat lower. Note that the Cataño - Old San Juan route estimated measure is considerably higher than the Hato Rey route measure, due to the greater expenses of operating the less labor and fuel efficient monohulls as opposed to the catamarans, as well as the greater terminal expenses.

Figure 4-5 demonstrates the problem of falling ridership on *Acuaexpreso,* operating expense per passenger mile rising as ridership declined. The ridership of the regular Cataño - Hato Rey service, falling from 150,000 passengers in fiscal year 1991-

Figure 4-4 Ferry Systems: Operating Expense/ Revenue Vehicle Mile

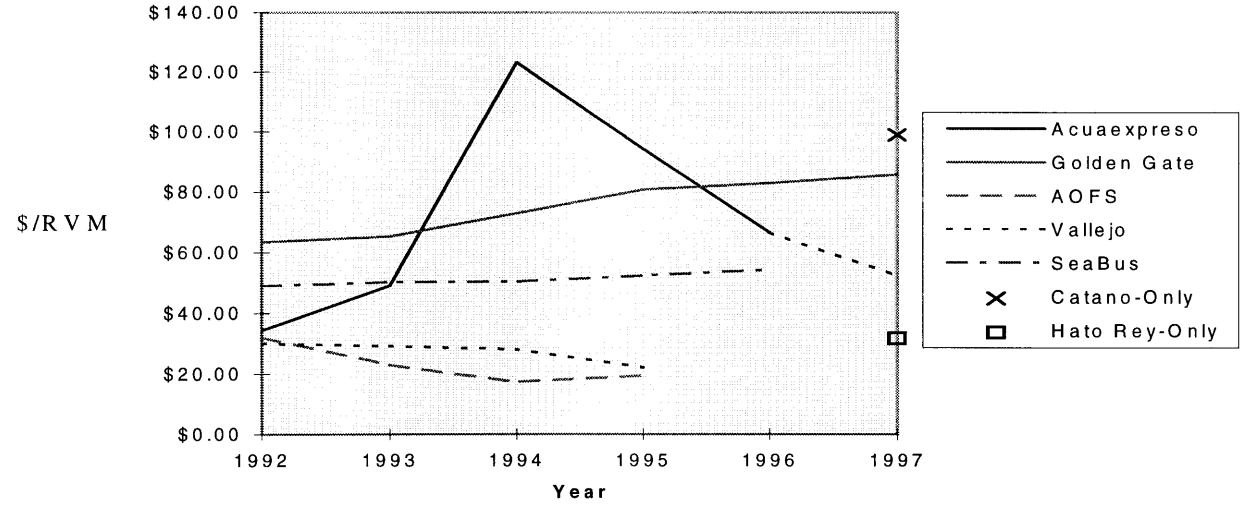


Figure 4-5 Ferry Systems: Operating Expense/Passenger Mile

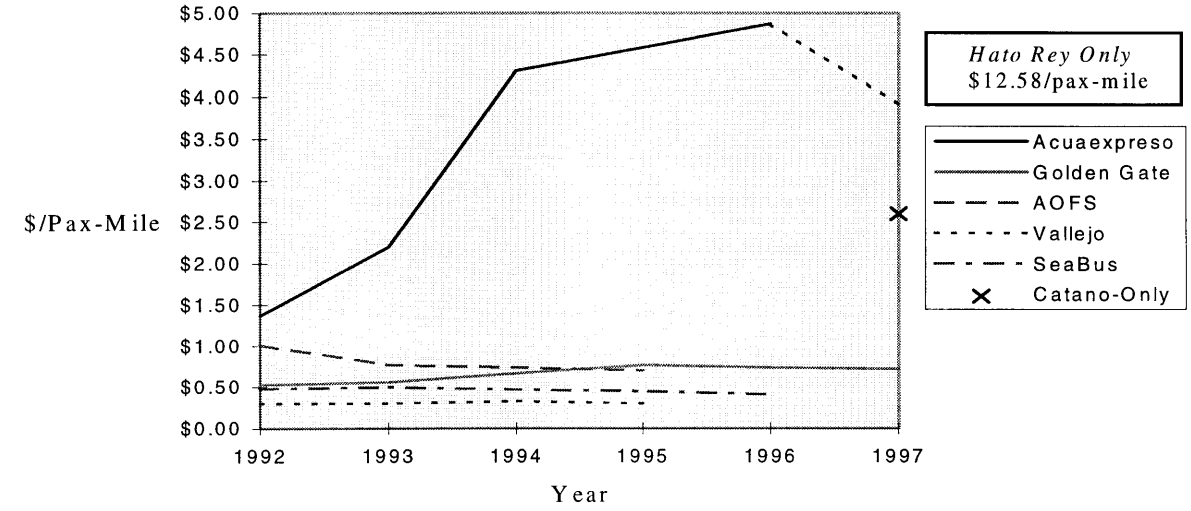


Figure 4-6 Ferry Systems: Passenger Miles/ Revenue Vehicle Mile

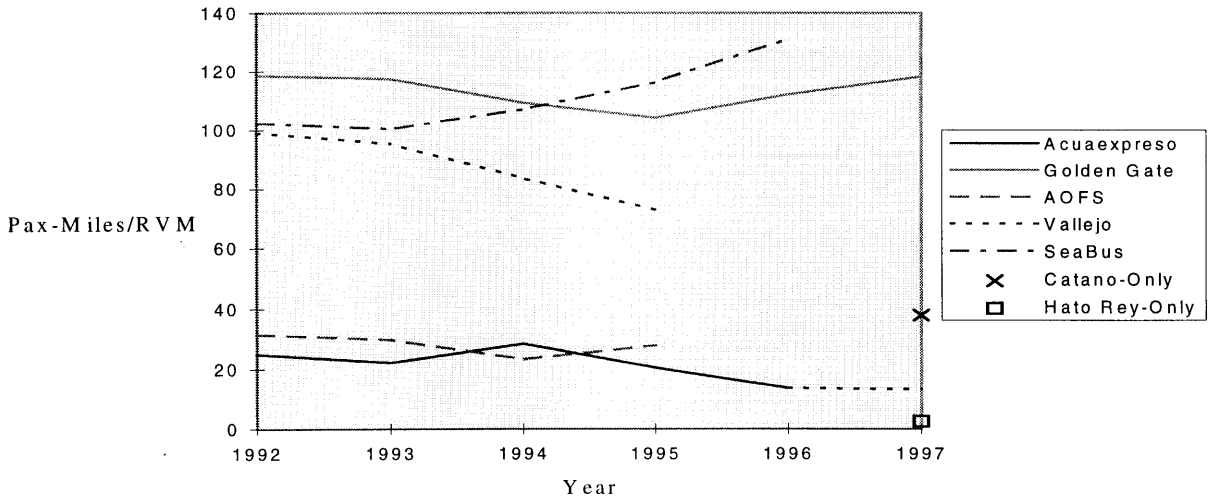
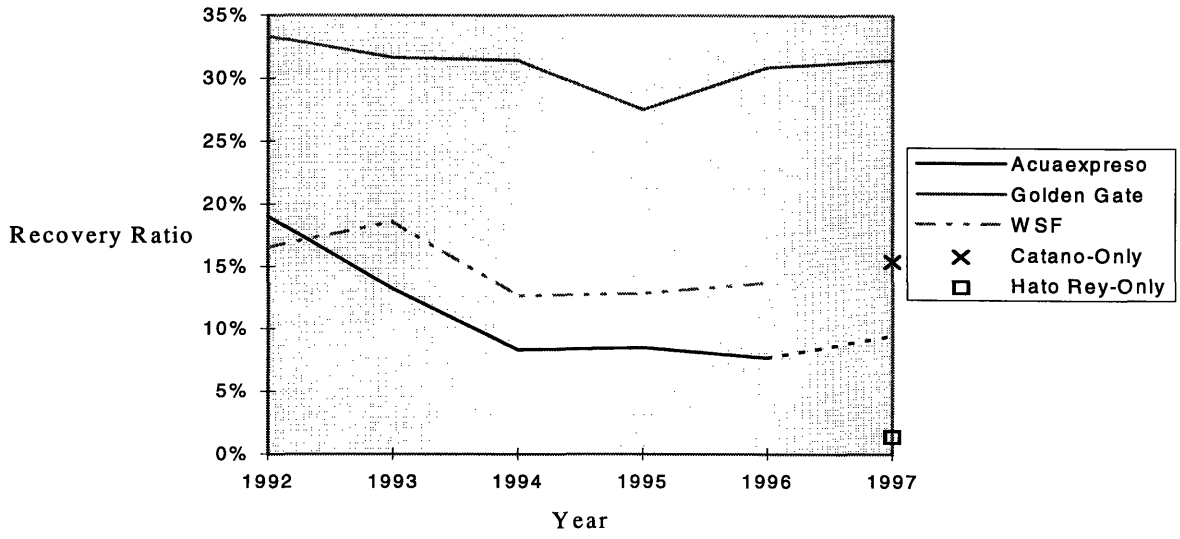


Figure 4-7 Ferry Systems: Farebox Recovery Ratio



1992 to zero in 1994-95, and the decrease from more than 600,000 passengers to less than 50,000 on the Old San Juan - Hato Rey route over the same time period, severely reduced the total number of passenger miles. Without a corresponding reduction in expenses, the performance measure for *Acuaexpreso* increased to levels much higher than those of the other systems. The recent improvements in ridership and a full year of service in 1996-97 cause the estimated measure finally to decrease modestly. However, even the estimated performance of the Cataño - Old San Juan route alone, based on the allocated costs of Section 4.2, is poor compared to other systems. It is still much better than that estimated for the Hato Rey - Old San Juan route though, which is a almost five times as great. Compared to other ferry systems, it is evident that *Acuaexpreso* needs to increase ridership for the amount of service it is providing.

Figure 4-6 shows the performance of *Acuaexpreso* in terms of passenger miles per revenue vehicle mile, equivalent to average vehicle loading. With the exception of the Alameda- Oakland long-distance small-volume ferry service, *Acuaexpreso* performs poorly compared to the other services. A better service comparison is between *Acuaexpreso* and the Vancouver Seabus service, which operates a high-volume, short-distance route similar in nature to the Cataño - Old San Juan route. The passenger miles per revenue vehicle mile performance measure for SeaBus is several times as great, and similar routes, such as those operated by New York Waterway, would also greatly exceed

the measure for *Acuaexpreso,* even taking into account the better performance of the Cataño - Old San Juan route. These higher figures for passenger miles per revenue vehicle mile represent the objective *Acuaexpreso* should be trying to reach.

Finally, Figure 4-7 shows that in terms of farebox recovery ratio *Acuaexpreso* is weaker than other ferry systems, though the overall system performance was actually better than that of the Washington State Ferry passenger-only routes in 1992. The estimated performance of the Cataño - Old San Juan route is comparable to the latter, indicating that the farebox recovery on this route is not unreasonable.

In conclusion, it is the decline in *Acuaexpreso* ridership, while the service provided and costs of service have remained high, that has made the performance of the system deteriorate. If the system could only recapture the ridership of its first year of operation, the costs of operation could be considered reasonable, with a farebox recovery ratio comparable to that of the AMA bus service in San Juan and to that of the WSF passenger-only ferry operation. As it is, performance of the system is disappointing, while continued operation of the Hato Rey - Old San Juan route is hard to justify.

To improve *Acuaexpreso's* efficiency and effectiveness general concepts and lessons learned from the review of other urban ferry systems can be applied, including the importance of integration with other modes, customer service, reliability, and the level of service of transportation offered. Implementation of these concepts and changes in the service provided could improve the attractiveness of *Acuaexpreso* to potential customers and reduce expenditures. The potential for increased ridership and more efficient service will be the topic of the next chapter.

5. Analysis and Recommendations for San Juan

This chapter assesses the *Acuaexpreso* system, examining each route's projected customer market and competitiveness as a transportation alternative. Options for improvements in the performance of each route are developed, focusing on service changes and improved integration with other modes. The recommendations are then combined into a timeline for implementation to the system. The chapter concludes by discussing organizational options for *Acuaexpreso*.

5.1 Analysis Overview

5.1.1 Analysis Categories

The previous chapter examined the cost and performance of *Acuaexpreso*, comparing it to other ferry systems and San Juan transportation services. This examination established why change is needed, demonstrating that overall, the current performance of the system is neither efficient nor effective compared either to other San Juan transit systems or other ferry systems, the Hato Rey - Old San Juan route being particularly poor.

The Cataño - Old San Juan and Hato Rey services will be analyzed in two separate sections (5.2 and 5.3), given the vast difference in current performance between the two. Clearly, both of the current routes would benefit from improvements in efficiency and effectiveness. If *Acuaexpreso* is to play a greater role in the San Juan urban transportation network, service effectiveness must be improved, the questions being what is the potential for higher ridership and how can it be achieved. Unit costs may also be improved, but this is probably a secondary concern.

Ridership is a function of the total customer demand modified by the relative attractiveness of *Acuaexpreso* as a transportation mode. Total transportation demand between the three regions that *Acuaexpreso* serves is based on travel demand forecasts for the SJMA, prepared for the year 2010 in support of the *Tren Urbano* project.[1] These forecast numbers of travelers can be used to analyze potential demand for the regions

[1] Travel Demand Information supplied by Cambridge Systematics, December 4, 1997.

served by the ferry system: Old San Juan, Hato Rey, and Cataño. Overall, the 2010 forecast is for over 115,000 people to be traveling daily to the Isleta de San Juan, including 59,000 to Old San Juan itself. At the same time, another 50,000 daily trips will be leaving the Isleta for destinations elsewhere in the city. This number of travelers greatly exceeds the capacity of the road network, in the peak period at least, especially given a predicted mode split of 90% by car, and suggests that effective transit alternatives will be needed if congestion is to be kept under control. Transit will also be vital for the segment of the populace that does not have access to automobiles.

Analysis will consider the current attractiveness of the ferry compared to public transit as well as to the automobile, the customer market being divided among the various alternatives or modes based on the relative qualities of the transportation services provided: travel time, frequency, fare, and comfort. In general, the decline in ridership on *Acuaexpreso* over the past five years suggests that there is a considerable potential market that has been discouraged by service disruptions and a history of poor reliability.

While the exact causes of the falling ridership are difficult to quantify, analysis concentrates on increasing the attractiveness of the service provided by identifying obstacles to ferry use. Service frequency and reliability in particular are usually the most influential factors affecting ridership, long and uncertain wait times being extremely unpopular with travelers, and therefore increases in frequency and reliability could attract more riders to the ferry. It is important to note that the marginal cost of vessel operation is relatively low, given the fixed cost of operating a terminal and other supporting functions, and thus it is comparatively inexpensive to increase service frequency.

Just as important as changes to the ferry service itself are changes to the system's integration with other modes. A ferry must rely on transit connections and/or on easy pedestrian access to the ferry terminals to encourage ridership. However, connecting ground transit to ferry systems faces the same uncertainties associated with rail-to-bus or bus-to-bus transfers, especially the problem of large numbers of riders on the ferry overwhelming the buses available when alighting. The primary areas for integration with other transit services are:

1. Network integration: developing intermodal connections and access.
2. Schedule integration: again encouraging linked transit trips and making the overall transit system more attractive by reducing wait times.
3. Fare integration: encouraging linked transit trips and reducing confusion and delay during passenger transfers.

Finally, there are other options that can be considered, including changes in the vessels utilized, network changes, and organizational changes.

The four steps of route analysis are summarized in the below table:

1. Demand	The projected travel demand and modal split for 2010 is given for the areas served by *Acuaexpreso*.
2. Service Comparison	Comparison of the service offered by *Acuaexpreso* and by public transit alternatives and the automobile. The Level Of Service attributes of the bus and ferry systems are contrasted, including frequency, travel time, and fare. The advantages of the automobile are discussed.
3. Service Improvements	Improvements that could increase the attractiveness or performance of the ferry are proposed, including service frequency changes and some strategic options.
4. Integration with Other Modes	Improved integration with public transit is examined, concentrating on network, scheduling, and fare structure options. The automobile is also examined, concentrating on parking.

Section 5.4 will present a timeline for implementation of some of the recommendations and options for changes to *Acuaexpreso*, as well as alternative visions for the long-range future of the service.

5.2 Cataño - Old San Juan Route Analysis

Acuaexpreso service between Cataño and Old San Juan is clearly important, as evidenced by the 3,300 passengers using this route daily. While other modes of travel could substitute for the ferry, the penalty to travelers from the much longer travel times required by circuitous land routes and the effect on other travelers of added congestion are such as to make the route a vital transportation link in the metropolitan area.

5.2.1 Demand

The Cataño - Old San Juan route serves three main customer groups. The primary group is travelers commuting to and from work, presumably from the lower-income residential areas of Cataño and Toa Baja to Old San Juan or the remainder of the Isleta. A second customer group is passengers using the ferry to access the business services of Old San Juan, including many government and other services. A third group is travelers on non-work trips, either tourist or locals. This latter group is particularly important on weekends and during holidays or special events in Old San Juan.

Examining the forecast 2010 market for travel between Cataño - Old San Juan, Table 5-1 presents an aggregate origin-destination travel demand matrix for travel to Old San Juan and the rest of the Isleta de San Juan from the municipalities to the south and west of the city center in 2010. These are the regions from which travel on the Cataño - Old San Juan ferry route offers a competitive if not superior travel alternative in terms of travel time, and the numbers suggest that there is a considerable market for potential ridership.

Table 5-1 Forecast Daily Travel Demand Matrix for 2010. (All Modes)[2]

Origin\Destination	Old San Juan	Remainder of the Isleta
Cataño	1,601	1,532
Bayamón	6,098	5,875
Toa Baja	2,337	2,255

If ridership were to stay constant, the mode share for the ferry in 2010 would be only 8%. While this may be high compared to urban ferry systems competing directly with other modes of transportation, given the travel time advantage of *Acuaexpreso* this fraction should be much larger. A more appropriate comparison would be to a ferry system like the Staten Island ferry in New York, which carries the majority of commuters between Staten Island and Manhattan.

There is also a sizable reverse commute market, with over 3,000 travelers forecast to travel from the Isleta de San Juan to Bayamón and Cataño. The ferry provides a logical

[2] Travel Demand Information supplied by Cambridge Systematics, December 4, 1997.

choice for travelers between these regions, as well as for travelers to such locations as the San Patricio mall complex.

The town of Cataño and the adjoining towns of Vietnam, Sabana, and Amelia in the neighboring municipality of Guaynabo are close enough to the *Acuaexpreso* terminal that travelers can walk to the ferry. Together, these towns are predicted to produce a total of 1,039 travelers to the Isleta de San Juan in 2010, split evenly between Old San Juan itself and the rest of the Isleta. Given the circuitous land routes to the Isleta, it is reasonable to assume that there should be a large modal split in favor of the ferry as the preferred mode of travel between these towns and Old San Juan. Interestingly, the forecast modal split for these townships alone suggests a continued preference for the personal automobile by travelers, as shown in Table 5-2.

Table 5-2 Cataño to Old San Juan & Isleta 2010 Forecast Modal Split

	Auto	Bus & Ferry	*Público*
Cataño to Old San Juan	76%	18%	6%
Cataño to rest of Isleta	81%	15%	4%

These forecasts suggest that auto will be the mode of choice for over three-quarters of the travelers between the two regions. This is despite the fact that Cataño is one of the less well-off regions of the city, making its inhabitants less likely to own a car, and also despite the fact that parking on the Isleta de San Juan is problematic. Based on travel time, the modal split should favor *Acuaexpreso* more, and it is reasonable to expect that better ferry service and/or worsening congestion would attract more travelers to the ferry.

5.2.2 Service Comparison

The experience of other ferry systems has shown that the primary competitors for ferry ridership are other transit systems. The restructuring of the bus system in San Juan allows comparison of an up-to-date transit system with the ferry.

Under the newly instituted transit center plan, bus travelers from Cataño to Old San Juan would take AMA bus #3 from Cataño to the San Patricio center. At the San Patricio center, travelers will then transfer to the #8 bus, which will run to Parada 18 (Stop 18) in Santurce and from there on to the Covadonga bus terminal in Old San Juan.

The #8 bus is designated as a local route, with a 20 minute frequency. The added waiting time reduces the attractiveness of the bus service considerably.

A summary of the level of service data associated with the bus and ferry alternatives is presented in Table 5-3.

Table 5-3 Cataño - Old San Juan Service Comparison (*Acuaexpreso* - AMA)

	Acuaexpreso	AMA[3] (#3 / #8 buses)
Headway	15 min. Peak 30 min. Off-peak	10 / 20 min. peak 15 / 30 min. off-peak
Travel Time	8 min.	43 - 75 min.
Fare	50¢	50¢

Comparing the two alternatives of ferry and bus:

- The out-of-pocket cost is the same, as there is no free transfer for the buses.
- The travel time savings of the ferry range from 35 minutes up to an hour or more.
- While frequency of the #3 bus is better than that of the ferry, any advantage is lost by the need to wait for the #8 bus, especially given its lower frequency.

The passenger preference between ferry and bus service should overwhelmingly favor the ferry, even during off-peak times, when the disadvantage of reduced ferry frequency can be offset by knowledge of the exact departure times.

No changes in these bus routes are expected following the inauguration of *Tren Urbano*, and no change in travel patterns is predicted as the train will not offer any particular advantage to travelers on the Cataño - Old San Juan trip.

Examining auto travel, the travel time between Cataño and Old San Juan is predicted to be in the neighborhood of 42 minutes by 2010, much longer than the ferry trip. Other factors besides travel time strongly favor auto use over ferry use for those with a car available, including the availability of a private car at any time, the delayed or monthly payment of its cost of operation as opposed to payment every trip on transit, the

[3] Travel Times from Transit Center Schedule prepared by Multisystems, Cambridge, MA.

increased walking time and distance generally associated with transit use, and the personal comfort and privacy of the car. Nevertheless, given the superior travel time of the Cataño - Old San Juan ferry route, a ferry service with improved customer orientation and better intermodal connections with transit services and the automobile should attract a much higher share of travelers.

5.2.3 Service Improvements

Ferry service between Cataño and Old San Juan is clearly an important link in the urban transportation network. The attractiveness of the time savings of the ferry route is so large that a good share of travelers from the entire municipality of Cataño, as well as the municipalities of Bayamón to the south-west and Toa Baja to the west, should be attracted to the ferry as the mode of choice for travel to the Isleta de San Juan. The experience of other ferry systems shows that even at a travel time disadvantage, ferry service still captures a consistent share of the commuter market. That ridership has fallen on the route indicates that there is room for improvement.

While the exact causes of the falling ridership are difficult to quantify, analysis can concentrate on increasing the attractiveness of the service by focusing on removing the various obstacles to ferry use. The two immediate areas of concern for the Cataño - Old San Juan route are the level and quality of service provided and the integration of the system with other modes. Changes in these areas, if complemented by an effective marketing effort and a strong customer orientation, should be able to increase ridership substantially.

Potential Barriers to Ferry Use

Service Provision	• Inadequate Schedule - long wait times - infrequent evening services • Reliability • Fare • Quality of Service
Integration	• Transit service to Cataño • Location of transit access • Parking availability and security

Each of these service provision items is discussed below, while the integration topics are discussed in the following section.

Schedule

A 1995 survey of *Acuaexpreso* riders boarding at Cataño found that only 37% felt there were sufficient trips during the day. Instead, 25% wanted more trips in the morning, 27% more trips in the evening, and 11% more trips at night.[4] The survey also found that 49% wanted extended hours of service, 41% indicating that they favored extended evening service. Similar results were obtained for passengers boarding at San Juan, 55% favoring more trips: 20% in the morning, 20% in the evening, and 15% at night. Sixty percent were also in favor of extended hours, evenly split between extending morning and evening service.

These numbers indicate that there is a considerable desire for more frequent service for extended periods throughout the day. Service frequency is usually the most influential factor affecting ridership, long wait times being extremely unpopular with travelers. Increases in frequency are therefore the primary method by which to attract more riders to the ferry. The marginal cost of vessel operation is relatively low, and compared to the terminal and other supporting operations required for operating just one vessel the cost of increasing service frequency could readily be justified by modest ridership gains.

Acuaexpreso has nine vessels, three monohulls and six catamarans. The monohulls are used for the Cataño - Old San Juan route, usually for peak service due to their 300 passenger capacity, while the 149 passenger catamarans operate during the off-peak hours and to and from Hato Rey. The number of vehicles in service is effectively four throughout the day, with one vessel operating in the evening.

For the peak period, the nominal Cataño - Old San Juan route frequency of 15 minutes can easily be met with two vessels. In fact, given the eight minute trip time, a better operating strategy for two vessels might be to simply coordinate departures such that the each ferry departs at the same time, reducing headway to twelve or ten minutes.

Via radio, when both ferries have boarded all the passengers that are waiting at the respective terminals, the ferries would coordinate their departures, passing each other half-way along the route. Under low passenger load conditions, such an arrangement could reduce headway with little increase in cost.

Further increases in peak period frequency are obviously possible, and may be attractive given better connections between the ferry system and other transportation modes. In conjunction with better access, decreases in headways to less than 10 minutes during peak periods might well be justifiable. Given the *Acuaexpreso* fleet size and current use of the vessels, there is no real impediment to this, at least for a trial period.

Off-peak service on the Cataño - Old San Juan route is also important, given the time savings of the route, and provides greater flexibility to commuters as well as attracting non-work trips and off-schedule workers. Off-peak frequency is every 30 minutes, and could be reduced to twenty minutes using a single vessel, without significant additional cost. This would retain the "clockface" headways, making it easier for people to remember the schedule and to time their arrivals to match the ferry departures. Given the current utilization of the fleet, operation of two vessels during the off-peak with 15 minute headways could be experimented with at a low marginal cost. Experimentation with increased off-peak service frequency could be attractive, and is possible with the currently underutilized fleet. Analysis could then be conducted on the numbers and time-of-day travel patterns of ferry passengers to determine the effects of schedule changes and an optimal operating strategy.

Changes in the hours the service is offered are also appropriate. The Cataño - Old San Juan service currently operates from 6:00 AM to 10:00 PM, however the last trips are made at hourly intervals and the end time is early compared to many of the attractions in Old San Juan. Operation until midnight is certainly appropriate for Friday and Saturday evenings to attract travelers returning from these events. Again a 30 minute or 20 minute headway in the evening, using a single vessel, could be attractive and alleviate some of the congestion that has been associated with these events. However, there are safety and

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[4] Puerto Rico Port Authority. *Informe de Monitorias Autoridad de los Puertos Servicio del Lanchas Puerto Rico.* Enero 1996. Survey done October, 1995 on 195 riders boarding at Cataño, 164 at San Juan, and 14 at Hato Rey.

security concerns at the terminals that would have to be resolved for later night service to be attractive to customers.

Reliability

Reliability has been a long term problem for *Acuaexpreso*, with missed or canceled trips due to vessel breakdowns and other circumstances. While difficult to quantify, missed or late service are clearly powerful disincentives to potential riders. Proper maintenance of the vessels is vitally important, and hopefully the new maintenance yard will improve the system's capabilities in this respect. Given that incidents do occur, the ability to replace vessels in service quickly with a spare craft could alleviate negative impressions of the service.

Service Quality

Service quality is an attribute of service that includes not only reliability but also such factors as security, safety, and comfort. As described, one of the key factors in the growth in ridership on other urban ferry systems has been a concentration on improving service quality over that of alternative transportation services. While these attributes tend to be less important for very short trips such as the Cataño and Old San Juan service, it is still beneficial to ensure that they are monitored. Having comfortable seating available, ensuring trash is promptly cleaned up, that facilities and the boats are kept clean and appearance is maintained are all important. The 1995 survey included customer complaints about poor sanitation in the terminals, graffiti, broken water fountains, and poor lighting.[5]

Fare

The introduction of *Acuaexpreso* was also accompanied by a fare increase in the Cataño - Old San Juan trip from ten cents to fifty, an additional explanation of why ridership on the route fell well below the levels existing prior to *Acuaexpreso*. As shown in the service comparison table, this fare is equivalent to that of the two fare bus journey, making this competitive. Fare reduction could attract more riders, however given that the current farebox recovery ratio of the system is already lower than other public transit

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[5] *Ibid.*

services, an across-the-board fare reduction is hard to justify and probably not necessary. Transfers from other modes to the ferry are important though, and a fare reduction for passengers transferring from the bus system could be an important incentive and should be implemented. This is an important aspect of improving integration of *Acuaexpreso* with the other modes.

More importantly, every other ferry system offers discounted rates for multiple ticket purchases. The introduction of a ten or twenty ticket book and/or a monthly pass would encourage occasional riders to use the service more often, while increasing the satisfaction of frequent users of the system. Such a multiple fare offering is strongly recommended.

A determined focus on customer service is vital, focusing on the comfort and composure of riders. Such efforts by private companies operating ferries explain the growth in successful ferry services. This entrepreneurial view has been highly effective in attracting customers from other transit options and even from automobiles. By concentrating on those aspects of mass transit systems that many find wanting or disagreeable, customer satisfaction and ridership attractiveness can be improved. Management efforts are the key to implementing such efforts. If improvements in management under public service prove ineffective, then management by a private operator is a possible solution. As evidenced in San Juan by the success of *Metrobus*, the introduction of private service can significantly improve public opinion and the performance of transit services.

5.2.4 Integration with Other Modes

As mentioned, intermodal connections are extremely important to the success of ferry service, extending the catchment areas for passengers from the limited areas around terminals. The location of intermodal connections, whether bus routes or parking, is important, while schedule and fare are important for transit interconnections.

Transit Connections

Achieving closer integration with other transportation modes is critical for the ferry, and there are indications that part of the decline in ridership can be attributed to the

degradation of transit links to *Acuaexpreso*. This has already received a great deal of scrutiny in reports concerning transit in San Juan. A 1992 survey of the San Juan transportation system, Integration of San Juan Metropolitan Region Público and Private Bus Routes into the Metrobus Transportation System, made the following comments about the integration of *público* service with *Acuaexpreso* at the Cataño terminal:

> "The Cataño ferry terminal is a good example of an effective, although simple, intermodal area. The ferries, *públicos*, and AMA buses are within a very short walking distance of each other providing for ferry-*público*, ferry-bus, or bus-*público* transfers within a compact area. This good system will be changed with the future implementation of the Cataño *Público* Terminal to be located several hundred feet to the west of the present *público* lot. The terminal does not provide for AMA buses and results in a longer walking distance to the bus and ferry terminals.
>
> This situation is a good example of the lack of adequate planning and, most importantly, interagency coordination. The most effective area for the construction of the *público* terminal was the area immediately fronting the ferry terminal. A combined *público*-bus terminal and parking garage would have further enhanced the intermodal transferability and accessibility, as well as augmenting the off-street parking capacity for private vehicles. This action would have enhanced the overall viability of the *Acuaexpreso* system.[6]"

Such a critique serves to emphasize the overriding need for integration of the several transit services, as well as highlighting some of the results of having multiple transportation agencies involved.

Besides the degradation of intermodal network links, there is also evidence that *público* service between Bayamón and Cataño has declined significantly. Ridership on *públicos* on this route made it the second most heavily traveled route in San Juan in 1991, since when it has fallen to sixteenth in 1994. *Público* data is not always accurate, however these changes in ridership indicate that demand has fallen sharply on the route. A possible explanation is that the decline in ridership on the ferry, a product of low reliability and poor frequency, has caused the decline in *público* ridership. As *públicos* are privately

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[6] Barton-Aschmann Associates, Inc. *Integration of San Juan Metropolitan Region Público and Private Bus Routes into the Metrobus Transportation System.* (Ft. Lauderdale, FL. September 1992.) p. 121.

operated, falling ridership will lead to decreased service as operators petition to switch routes (as regulated by the CSP). Improved ferry service might reverse this trend.

Unfortunately, the *público* system overall has been in a state of decline. The system faces some severe difficulties, and there is on-going work to resolve some of these issues.[7] In particular, *público* service tends to decrease in the PM peak and practically disappear at night. This suggests that travelers from more distant regions who might be attracted to the ferry by its time travel advantage and by better service are discouraged by poor *público* service, for some the only transportation option by which to reach the ferry terminal.

Similarly, bus service between Bayamón and Cataño has been of low frequency, with long trip times and requiring a transfer and additional fare. The bus system overall should be improved by the recent restructuring, but will still not be an attractive mode to access the ferry, with no area to wait near the ferry and no schedule or fare integration. Despite the large number of travelers from Bayamón destined for the Isleta, there is no bus service between this major municipality and the ferry terminal at Cataño, the route being served only by the *públicos*.

Conditions on the Isleta de San Juan are similar. The Covadonga bus terminal is over a quarter of a mile from the ferry terminal, and the buses do not stop much closer to the terminal along their route, thus eliminating them as a continuation mode for access to the Isleta. For Old San Juan there is a free shuttle bus service running through the old city. This stops closer to the ferry terminal, but is still some distance away. By and large, the continuation mode for travel is walking, with other modes being unattractive.

To correct the lack of intermodal connections, the three areas of network, schedule and fare integration need to be considered.

1. Network Integration

Undoubtedly the smoothest ferry-to-transit service connections of any system are those provided by New York Waterway. Passengers arriving by ferry are able to board any of several routes based on their ultimate destination, without any additional fare. The

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[7] Lau, Samuel. *Strategies for Improving Jitneys as a Public Transport Mode*. (M.I.T., September 1997).

disincentives of wait time and fare payment are eliminated, while a range of options gives almost every customer service within a block or two of their final destination.

As already discussed, the same can not be said for *Acuaexpreso.* Possible options for change include:

- Rerouting of existing transit services in Cataño to better serve the ferry terminal, including waiting areas in front of the terminal.
- While it is too late to change the location of the *público* terminal, a possible shuttle service connecting the ferry, bus and *público* terminals, as well as parking lots and important Cataño destinations could be implemented.
- Alternatively, *públicos* could be used to improve service connectivity at Cataño, perhaps using a dispatcher at the ferry terminal to call *públicos* from their terminal when passengers are waiting.
- In Old San Juan, rerouting the local shuttle service to join the ferry to locations throughout the old city and to the bus terminal should be implemented. Additional service to the rest of the Isleta should also be considered. Arrangements could also be made for taxi service or hotel limo service through courtesy phones.

2. Schedule Integration

Wait time is one of the major factors in discouraging ridership. While wait time naturally depends on service frequency to a large degree, transfer time between vehicles can be kept to a minimum through integrated scheduling and route planning. Again, New York Waterway offers the best example of schedule integration between ferries and its shuttle bus fleet, with buses waiting for the passengers to alight from the ferry. Vancouver is another good example of schedule integration between ferry and bus.

Schedule integration between AMA bus service to Cataño and *Acuaexpreso* could improve ridership on both systems. Matching the frequencies of the ferry and the #3 and #37 buses would reduce wait times for transferring passengers, if necessary having the bus wait for a minute or two if the ferry is delayed or heavily loaded. If the shuttle service in Old San Juan was also integrated with *Acuaexpreso*, shuttle headways could be made identical to those of the ferry, increasing the attractiveness of the system greatly.

Advertising or announcing this connection is very important, and should be done by both signs in the terminals and boats, as well as in schedules and other distributed information.

3. Fare Integration

Few ferry services have fare media in common with other transit services. Usually, passengers must pay separately to board each service, though in a few cases exceptions are made for disabled or special pass holders. Instead, ferry routes sell fares independently; usually offering savings for bulk purchases. This is the case in Boston, New York City, and Seattle. The Vancouver Seabus, on the other hand, is a good example of a publicly operated service that integrates ferry service with bus service. As discussed, the system is closely linked with the other Vancouver transit services in terms of transfers, fares, and schedules.

Acuaexpreso, despite being a public system, has no fare integration with the other transit systems in San Juan. The cost of a multimodal trip is therefore much higher than a trip on the bus alone, along with the extended wait time likely if the ferry is used. This is no different from the other transit services, even for intra-service transfers. Currently the fare must be paid each time a passenger boards a bus, even having just got off another. Though monthly passes and reduced fare transfers for the AMA system have been discussed, there are currently no plans to implement such a system.

The introduction of a fare system for the entire transit network, with monthly passes, reduced or free transfers, and/or discount ticket or token purchases, is highly recommended, encouraging use of both *Acuaexpreso* and AMA.

Automobile Connections

The automobile, with its advantages of flexibility, comfort, and privacy, is the dominant mode for personal transportation in Puerto Rico. The advantages of the automobile can be offset to some degree by better transit service, including more frequent trips, multi-ticket fare books or monthly passes, extended service coverage, and improvements in transit comfort. While, car use is unlikely to be strongly affected given the experience of other cities discussed in previous chapters, even a small percentage of diverted users can add considerably to ferry ridership. Given the travel time advantage of the Cataño - Old San Juan route, encouraging drivers to use the ferry as a continuation

mode for travel to Old San Juan should be very powerful if intermodal connections are easy and the arrangements publicized.

The major influence on automobile to ferry transfers is the availability of secure parking space near ferry terminals. This is linked to the distance between parking and the ferry terminal, this connection usually being made by walking though a shuttle bus service is also possible. In addition, such aids as traveler information, with clear announcements and signs concerning the availability of parking and ferry service, can affect the auto-ferry connection.

In many of the ferry systems studied, the parking spaces available at ferry terminals are a critical factor in the success of a ferry service at attracting riders. Many systems provide parking space for drivers who use the ferries. In Boston for instance, the MBTA paid to pave and expand the parking space adjacent to the Hingham terminal. In East Boston, on the other hand, residents opposed the provision of parking space for the cross-harbor ferry. Ferry users either had to find their own parking on the streets, a chancy, time-consuming proposition, or pay for garage parking, a factor in the route's lack of success and eventual termination.

Concentrating on Cataño as the major terminus for *Acuaexpreso* customers, the parking lot in front of the ferry terminal is full on a daily basis. This suggests that there is considerable demand for parking in the area, and indeed there are plans to turn the nearby former maintenance yard into an additional parking lot, though this yard is also limited in size. However, if auto transfers are to be encouraged, substantially more parking should be provided. As parking near the ferry terminal is limited due to cost and lack of land availability, a more distant lot with shuttle bus service could both reduce local congestion and encourage auto transfers. One example of this type of service is in Boston, where a shuttle at the Charlestown Navy Yard ferry terminus operates between the ferry terminal, the main tourist center at the Yard, and a large parking facility.

A tremendous potential for auto to ferry transfers is offered by the location of Cataño at the western edge of the San Juan Metropolitan Area. The ferry terminal and the town of Cataño are located to the north of the main highway, Expreso de Diego (P.R. 22), and have a good road connection via PR-5 to the expressway which enters San Juan from

the west. Cataño could provide a convenient transfer point for inter-city travelers coming from the northwestern portion of Puerto Rico. Again, to take advantage of this potential, more parking and better direction and information to road users would be necessary. Such a development could lead to diversion of travelers seeking to travel to the Isleta de San Juan or even to Hato Rey from the highways to *Acuaexpreso.*

Not only must parking be available for auto-ferry transfer travelers, but safety and security concerns issues must be dealt with for both automobiles and their users. For parking to be a preferred option, especially as the income level of the passenger and thus likely value of the car increases, there must be protection from theft and vandalism. This can be accomplished by supporting the development of private lots with guards, or by providing security personnel for public lots. In addition, the method by which travelers transfer between the parking lot and the ferry terminal is also critical, involving pedestrian safety and security issues.

Strong consideration should be given to a large, secure parking lot connected by a shuttle bus to the Cataño ferry terminal. This shuttle service could also serve other locations, including the bus and *público* terminals and allowing users of all modes to interconnect. Advertising and signing could make this parking service known and attractive to many auto users.

5.2.5 Summary

The existing benefits of Cataño - Old San Juan ferry service more than justify the cost of the system. Compared with the bus alternative, *Acuaexpreso* offers clear benefits to travelers in terms of travel time, and is comparable in other attributes including cost, as well as having much greater capacity. Thus, the ferry is likely to remain the preferred transit option for most passengers, given reasonable reliability and service. Even allowing for the other advantages of the auto, the ferry has such a travel time advantage as to make it competitive for a large portion of the overall customer market. In addition, as congestion on the road network to the Isleta de San Juan worsens, the auto is likely to become less and less attractive, leading to increased ferry competitiveness and ridership.

The advantage of ferry service between Cataño and Old San Juan is such that there should be much higher ridership on the route. The deterioration in transit

connections and past problems with service reliability can be overcome through service improvements and better integration. Experimentation with service changes, especially frequency, if properly advertised could publicize the advantages of the system and attract more riders. Parking is particularly important, and if ample space is provided that is secure and safe, drivers may be diverted from their cars, reducing the road congestion that hinders accessibility in the city.

Assuming the level of service provided and intermodal connections are improved, ferry ridership could increase significantly. Based on the 2010 demand and mode predictions, if *Acuaexpreso* could attract 50% of all travel between the Isleta and the local area around the town of Cataño, plus for the surrounding municipalities:

- 90% of all the transit demand to and from Old San Juan,
- 50% of the transit demand to and from the rest of the Isleta, and
- 10% of the projected auto travelers to and from Old San Juan,

daily ridership would approach 6,900. This estimate, while not huge, would represent a substantial increase in ridership, improve the performance of the route significantly, and appears to be eminently achievable.

5.3 Hato Rey Services

Acuaexpreso clearly provides a useful service between Cataño and Old San Juan even today, and with improved service has the potential to increase its ridership and become an effective and competitive transit service. The Hato Rey - Old San Juan route, on the other hand, is another story with abysmal ridership and a history of service disruptions and poor service. Nonetheless, the effects of increased demand, *Tren Urbano*, and future reconstruction on the Isleta de San Juan bridges may change this.

5.3.1 Demand

Two customer groups for service between Hato Rey and Old San Juan are commuters and travelers on non-work trips, both tourist or locals. This latter group clearly dominates on weekends, when ridership increases by fifty percent. A third customer base could be commuters from Cataño and Old San Juan to Hato Rey, since the

businesses of the latter region attract a considerable number of workers. While peak service is still offered for these Cataño commuters, and some make the trip via Old San Juan, the negligible ridership that led to cancellation of direct service in December 1993 indicates that most of these commuters likely use alternative modes of transportation.

Despite the current weekday average ridership of less than a hundred on the Hato Rey - Old San Juan ferry route, based on 2010 forecast travel demand there is a large potential market. Looking at the walk-on market alone, the area surrounding the Hato Rey terminal is predicted to generate 840 daily travelers to Old San Juan, for whom the ferry would be easy to access as well as being the fastest mode. In addition, the reverse commute may be just as important, with 790 daily travelers predicted in the reverse direction from Old San Juan to the immediate area in Hato Rey. For these two sets of travelers, the ferry should be competitive, with the exception of service frequency. The fact that there is currently such a small ridership, given an immediate potential market approaching 3,000 trips, indicates how strongly the poor service frequency and limited access to the ferry system discourage potential riders.

The predicted 2010 modal split of travelers between the Isleta de San Juan and the rest of the SJMA is presented in Table 5-4, the modal split being practically identical in each direction. The automobile is the dominant mode, however congestion will have an increasing effect and the proportion using transit may well be higher.

Table 5-4 Modal Split for Travel to and from the Isleta de San Juan (2010 Forecast)[8]

	Auto	Bus & Ferry	*Público*	*Tren Urbano*
SJMA - Isleta de San Juan	90%	6%	2.7%	1.5%

The experience of other systems indicates that increased ferry ridership is most likely to come from users of other transit services. Vancouver and Seattle especially have noted this, with ferry service having relatively little impact on auto volumes but having a considerable effect on the ridership of other transit alternatives. If conditions change in San Juan such as to reduce the attractiveness of the bus and *público* systems, e.g. road congestion, *Acuaexpreso* is likely to attract riders from these systems.

[8] Travel Demand Information supplied by Cambridge Systematics, December 4, 1997

Acuaexpreso service to Hato Rey has been interrupted for long periods of time, for eight months in 1995 and just recently for four months, October 1997 to January 1998. Completion of the flood control work on the Porto Nuevo waterway that occasioned the recent closure should prevent further disruptions to Hato Rey service, reducing the silting that currently requires biennial redredging of the Martin Peña canal. Without further interruptions, improvements in the service may have the potential to attract a larger part of the customer market on a more sustained basis.

The inauguration of *Tren Urbano* will affect travel patterns to and from Old San Juan, acting as an important travel mode for travelers in both directions. The necessary transfer to another mode for trip continuation offers *Acuaexpreso* a chance to become a significant link in a multi-modal trip, offsetting the current advantage of the bus system in offering a one-seat ride. The reconstruction of the bridges will also improve the competitiveness of the system, adding considerably to the congestion and delay auto and bus users will likely face. These future events have the potential of making the Hato Rey services an important part of the future urban transportation network, but only if service can be improved.

5.3.2 Service Comparison

The current ferry route between Hato Rey and Old San Juan is clearly uncompetitive with the transit alternative. The main public transit competition is offered by *Metrobus,* which operates from Río Piedras through Hato Rey to the Covadonga bus terminal in Old San Juan. A comparison of the two services for the trip between Hato Rey and Old San Juan is presented in Table 5-5.

Table 5-5 Hato Rey - Old San Juan Service Comparison (*Acuaexpreso - Metrobus*)

	Acuaexpreso	*Metrobus 1*[9] (Express)
Headway	30 min. Peak 60 min. off-peak	4 min. Peak (10 min. all day) 5 min. off-peak
Travel Time	14 - 18 min.	23 - 26 min. (18 - 20 min.)
Fare	75¢	50¢

[9] Travel Times from January, 1996 survey by Multisystems, Cambridge, MA.

While the ferry is marginally faster, and likely to grow more so as congestion on the road network increases, the headway is an extreme disincentive to travelers, with the fare also discouraging potential users.

Aside from transportation strictly between Hato Rey and Old San Juan, the unattractiveness of the Hato Rey service as a connecting link in a multi-vehicle trip to Old San Juan is also evident. The ridership for the route is likely limited to walk-ons from the immediate area. Travelers from other parts of the city to Old San Juan would clearly be unlikely to transfer to *Acuaexpreso* at Hato Rey when completing the rest of the trip by car, bus, or *público* would be easier, cheaper, and faster. To attract drivers *Acuaexpreso* would have to offer good parking, while both transit users and car users would require good reliability, security, and improved frequency of service.

In the reverse direction, from Old San Juan to Hato Rey, this is less of an issue though fare and wait time at the ferry is still critical. However, continuing transit service from Hato Rey is easy given the high volume, frequent service along the nearby main avenues of the district.

The estimate for 2010 is that auto travel time between Hato Rey and Old San Juan will be between 22 and 25 minutes. Even though the automobile is clearly the favored mode for trips heading to the Isleta from the rest of the city, if *Acuaexpreso* could provide reliable, frequent service on the route, given a fourteen to eighteen minute travel time it could capture a greater part of the market. Given the difficulty of parking in Old San Juan, and as travel times increase due to congestion or work on the bridges, ferry ridership should grow.

5.3.3 Service Changes

The Hato Rey service has been spectacularly unsuccessful. Current ridership levels are abysmal, averaging less than three passengers per trip. The operating cost of the route is high, while the competing *Metrobus* service is much more efficient and effective. The long ferry headways are particularly unattractive to riders, and the service offered on the route would need to improve considerably to stand even a credible chance of attracting ridership. Retention of the existing system unchanged is clearly not appropriate, however changes in demand and the transportation system may make the service valuable

in the future. Options are therefore to suspend the system, retain only a reduced service, or experiment with service options, all in anticipation of future changes that could make the system viable or even important.

Suspension

The suspension of Hato Rey service for several years would allow annual operating costs to be reduced by $2 million or more and still retain the vast majority of current *Acuaexpreso* passengers. Past Federal financial participation in the project might raise the question of possible repayment of Federal contributions to construction of the system, however the promise of future service could make this outcome uncertain.

Retaining the capability to offer ferry service to Hato Rey could become crucial as road congestion increases. The transportation alternative offered by the ferry, combined with the introduction of *Tren Urbano,* could reduce some of the demand on the road network and prevent congestion from becoming unmanageable, especially once the bridge reconstruction begins. Because of this, outright elimination of the system is not recommended for serious consideration. However, suspension of the service until *Tren Urbano* is opened is one possible option for the Hato Rey services.

Reduced Service

Alternatively, there are several options which would allow continued service to Hato Rey at a reduced cost. In particular, the operation of the Hato Rey terminal is a significant cost even before vessel operation is considered. One option is to cease terminal operations, blocking off or redesignating for alternative uses most of the facility, including the ticketing booths, concession areas, and lavatories. Fare collection could be automated, using a token or ticket machine instead of personnel. Alternatively or as an interim measure, fare collection could take place onboard the vessel, the fifteen minute travel time being more than sufficient to collect fares from the current ridership. Personnel for the Hato Rey terminal could then be reduced to a security guard. This type of operation is similar to many of the city water taxis and other small volume ferry services. The elimination of full-service terminal operation could reduce costs by $1.5 million a year, leaving only vessel operating costs of $750,000 a year for the route.

A review of other urban ferry systems indicates that many low volume routes are operated only during the peak-hour, so this is an additional service reduction option for Hato Rey service. A survey of ridership on the Hato Rey route, differentiated by time of day, might allow analysis of the consequences of changing the number of trips to Hato Rey during the mid-day period. Unfortunately, the number of riders is so low that gaining useful information for predicting the effects of service changes may be difficult. Of course, the elimination of off-peak service would reduce flexibility for riders and make other transit systems more attractive, possibly eliminating what little ridership there is on the route. This alternative should be considered for Hato Rey weekday service only, as ridership on the weekends is both greater and clearly composed of travelers making non-work trips and relying on service throughout the day.

Experimentation

Schedule frequency is clearly the number one service change that could improve ridership on *Acuaexpreso*, especially for the Hato Rey - Old San Juan route. The current hourly frequency in the middle of the day is especially hard to justify, considering that crew costs are already being paid for. A 30 minute headway should be maintained throughout the day, and two catamarans could even achieve a 20 minute headway schedule, though this is a high-frequency tempo that might not always be achievable. Adding a third catamaran could further reduce headways to fifteen minutes, and this increase in service frequency could attract a greater number of riders. Given the six catamarans available, this or even higher increases in frequency are possible, and can be considered for experimentation.

The above recommendation is for the direct Hato Rey - Old San Juan route, however there are the triangular routes stopping at all three terminals, currently during the peak period only, and the combined round trip time for a triangular route conveniently fits an hourly schedule. A possible arrangement is to operate two catamarans on a triangular route at thirty minute headways, providing both more frequent service in the mid-day to Hato Rey and additional service on the Cataño - Old San Juan route. In addition, the attractiveness of the ferry is increased as any travelers between Cataño and Hato Rey can accomplish the trip on one vessel, avoiding the transfer that is currently required.

The triangular route offers two paths, which could be chosen based on demand. Currently, the AM peak triangular route proceeds from Cataño to Hato Rey to Old San Juan. This route could be reversed, supplying additional capacity in the direction of greatest flow, Cataño to Old San Juan. Similarly, the current PM route, Hato Rey to Cataño to Old San Juan, could also be reversed to supply more capacity in the peak from Old San Juan to Cataño. These changes could increase service in the direction of peak demand while reducing the attractiveness of the current peak service only for commuters from Cataño to Hato Rey, a negligible number. However, further analysis should be conducted to determine the most appropriate direction for the peak periods.

Based on the higher ridership on weekends, there is potential for increased weekend frequency to attract a greater number of passengers. One service change would be to capitalize on this increased attractiveness by introducing higher frequency service on Saturday and Sunday. A schedule with 20 minute headways should certainly be implemented on these days, with 15 minute headways for special events taking place in Old San Juan. These improvements in service frequency, especially combined with a fare discount of some sort, could improve weekend ridership. In particular, based on the excursion customer market, the introduction of a weekend pass or family group fare could be attractive. With current ridership so minuscule, fare discounts would have a negligible effect on the finances of the route.

5.3.4 Integration with Other Modes

Much of the discussion of integration with other modes presented for analysis of the Cataño - Old San Juan route also applies to Hato Rey, as service depends on traveler access and transit service at the other terminals. Otherwise, Hato Rey is perhaps the most integrated of the three terminals, with a number of buses serving the ferry terminal and extensive transit connections available only blocks away.

However, the inauguration of *Tren Urbano* revenue service, scheduled for 2001, will offer additional transit connections for *Acuaexpreso* to the new travel mode in the city. Given that a considerable number of travelers will use *Tren Urbano* for transportation between Hato Rey and the other regions of the city, a possible outcome is

that *Acuaexpreso* may become a connecting mode of choice for train travelers coming from or continuing to Old San Juan or Cataño.

The true potential for increased ridership on the Hato Rey service clearly lies with the construction of the *Tren Urbano* station adjacent to the ferry terminal at Hato Rey. This station will be the second from the northern end of the first phase of the system, and for passengers seeking to travel on to the Isleta a modal transfer will be necessary. Transfer options will be to switch to a bus at the northern terminus or to change to the ferry at the Nuevo Centro train station. To make this latter an attractive option, *Acuaexpreso* service needs to be more closely aligned with the *Tren Urbano* in terms of schedule, as clearly the current 30 minute headways would be unattractive to train passengers arriving on a four minute headway service.

Service frequency and schedule integration will clearly be key in attracting more riders, and if ferry service could be increased to twelve or even eight minute frequencies the ferry alternative will become much more credible. Fare reduction is also important, allowing train users to receive discounts or even free rides on the ferry could make the service more attractive.

Additional integration measures include possible fare system integration; if *Tren Urbano* implements an advanced fare technology, a swipe magnetic-read card being the most likely, *Acuaexpreso* should also join the development. The advantages of such a system are that it allows passengers to reduce the cash they carry, and also reduced the need for terminal agents to sell tickets and make change. This improves security for travelers and reduces the necessary personnel for terminal operation. With only three ferry terminals, the cost of introducing card readers would be minor.

These integration measures, along with high service reliability and effective marketing, could make Hato Rey service an effective transportation service. The value of this service will only be increased by the reconstruction work that must take place on the bridges to the Isleta de San Juan, which will drastically affect road travel times to and from the Isleta and make ferry service much more competitive.

5.3.5 Cataño - Hato Rey Service

While regularly scheduled operation on this route ended in 1993, *Acuaexpreso* still provides limited peak-period service between these two points. Numbers of travelers making the trip, or using both regular ferry routes to accomplish the same trip, are not recorded, though based on ridership before service was terminated the numbers are not high.

The travel demand forecast for 2010 estimates there will be 627 local travelers from Cataño to Hato Rey for whom the ferry might be advantageous. There are also 229 travelers predicted in the reverse direction. These local commuters form an initial base for ferry ridership besides travelers from outside the town center of Cataño that might be attracted to the ferry. In addition, it might be possible to exploit the link with *Tren Urbano* to increase ridership.

The predicted modal split for travelers from Cataño to Hato Rey is almost identical to that for travelers from Cataño to Old San Juan, the car again dominant with a 75% predicted share. This is not surprising, given the huge advantage of the 22 minute predicted auto travel time versus bus. The difference is that of the remaining 25% using transit, approximately half, or 12% of all travelers, are expected to use *Tren Urbano* for at least part of their trip. Given the time advantage of the ferry over the bus (and even the car), plus the thirty to forty minutes it would take travelers from Cataño to reach the nearest *Tren Urbano* station by bus, a customer oriented ferry service with good frequency would provide the most competitive transit service.

The transit alternatives for the trip between Cataño and Hato Rey are shown in Table 5-6.

Table 5-6 Cataño - Hato Rey Service Comparison (*Acuaexpreso* - AMA)

	Acuaexpreso	AMA - #3 bus[10]
Headway	30 min. Peak no off-peak	10 min. Peak 15 min. off-peak
Travel Time	16 - 18 min.	44 - 50 min.
Fare	75¢	25¢

[10] Travel Times from Transit Center Schedule prepared by Multisystems, Cambridge, MA.

It is evident that #3 bus service is not competitive in travel time with the ferry, however it does provide service at a third of the cost, and even when ferry service is available in the peak the long headways of the current ferry service offset the added bus travel time. Alternatively, travelers could transfer to *Metrobus II* at San Patricio, however the five minute gain in travel time is offset by the likely waiting time of five minutes for that route (10 minute headway) and the additional fare payment.

Given the relative competitiveness of ferry and bus service between Cataño and Hato Rey, reconsideration of regular service between Cataño and Hato Rey may be in order. The direct link with *Tren Urbano* could prove attractive to many residents of Cataño for trips to and from the Hato Rey and Río Piedras sections of the city. As suggested earlier, a triangular route service throughout the day would provide service between Cataño and Hato Rey, and the additional flexibility provided by service throughout the day should be more attractive to riders.

5.3.6 Vessel Alternatives

Looking at longer term experimental changes to Hato Rey service, one strategy is to consider changes in the vessels by purchasing vehicles that could reduce costs and/or improve service. It is interesting to note that in the 1995 customer survey of *Acuaexpreso,* 30% of passengers recommended new boats for the system.[11] In particular, smaller vessels are an attractive option given the low levels of ridership. If a stable ridership for the service can be established through improved, higher-frequency service, depending on the number of riders a different type of vessel may prove more efficient. In addition, there are some improvements that could be made to the current vessels to improve their serviceability.

The catamaran vessels currently used by *Acuaexpreso* on the Hato Rey - Old San Juan route are comparable in size to those used by other ferry systems. However, they are currently clearly inappropriate for the volume of traffic to and from Hato Rey, carrying an average of less than three passengers per trip. The size of the vessels creates the following problems:

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[11] Puerto Rico Port Authority. *Informe de Monitorias Autoridad de los Puertos Servicio del Lanchas Puerto Rico.* Enero 1996. Survey done October, 1995.

- The waterfront and waterways the vessels can access are limited due to draft and maneuverability restrictions.
- Wake size is increased, adversely affecting the environment and shorefront activities and requiring lower speeds.
- Operational cost is increased

An alternative would be the acquisition of a number of smaller vessels. With reduced manning, fuel, and maintenance costs, such vessels could reduce operational expenses while still supplying the current level of service. Alternatively, smaller vessels could provide increased service frequency for the current cost of the system, improving the route's attractiveness.

The capital cost of a 50-passenger vessel, while still much larger than some of those in use by small ferry shuttle and water taxi services, is a third of that of the catamarans. In addition, the type of technology used on these vessels is more widespread and the vessels are simpler to maintain, reducing some of the upkeep expenses and difficulties that *Acuaexpreso* faces with the catamarans. Purchase of these vessels, offset by the sale of some of the current vessels, could be a prudent strategy.

There are difficulties with such an investment besides the significant capital cost associated with purchasing additional vessels, for the vessels would add to the types and thus cost of maintenance and repair. Nonetheless, the possible reduced cost of operation might be significant enough to warrant the acquisition. Smaller vessels could also play a significant role in allowing for expansion of ferry services to the east and within the Bahía de San Juan.

The vessels used by *Acuaexpreso* also suffer from a number of service problems besides their cost of operation. The advantages of the catamarans is that they are fairly modern and that they are air-conditioned. This latter feature is progressive and cuts down on the odor of the Martin Peña canal, however it also reduces one of the main attractions of ferry service, the views presented of the waterfront and city from the vessel. In addition, the catamarans were designed for calmer waters, and have been affected by the heavier wave conditions of the Bahía de San Juan as well as by poor operating practices. The older monohulls are sturdier, and while not as comfortable perhaps, do offer

passengers the chance to enjoy the open air, and use the opportunity to sightsee, take photographs, etc. This is an important factor, given that many ferries rely on the excursion aspects of the service to attract riders, especially private operators who typically mix commuter and excursion service.

One way in which the *Acuaexpreso* vessels are not advanced is in passenger boarding and alighting. Most systems today are designed together with docking facilities that do not require securing the ferries while loading and unloading, and that also allow at-grade access. Instead of tying the ferry to the dock or landing, landings are designed to match the bow shape of the vessel. During loading and unloading, the propulsion system maintains modest forward thrust to keep the ferry in place against the landing. This eliminates both the requirement for line handlers and the delay caused by tying the ferry to the dock. At the same time, landings are now designed to float at the same level as the ferry. Though there are minor differences in height created by the weight of passengers, fuel, etc., the difference is usually small enough to allow wheel chairs and bicycles to wheel directly off the ferry onto the landing and vice-versa. This latter feature also helps to meet Federal government American Disabilities Act (ADA) requirements.

The *Acuaexpreso* vessels are cumbersome for passengers in that the passage to alight and board is narrow and complicated by vessel equipment. Routinely, an employee stands at the gangway to help passengers on and off, and the process takes some time. This adds to the effective travel time, and a different vessel design might avoid some of these problems. In contrast, the Vancouver Seabus is able to arrive at the dock, off-load 400 passengers, load 400 more, and depart within 180 seconds.[12] Reworking of the catamarans to improve their passenger handling characteristics, including the removal of some seating and the addition of wide side doors for loading and unloading onto a floating landing could reduce turnaround times for the vessels, as well as bringing the service into compliance with ADA requirements. It is possible that financial support for this reconstruction could be justified through the effort to meet these requirements.

Another consideration for vessels is minimizing wake production. New vessels in a range of sizes are now on the market that allow high speed with very small wake

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[12] BC Transit Service. *The Seabus System in Vancouver, B.C.* (September, 1997.) p. 8.

effects. These vessels reflect the concerns that make the faster trip not necessarily by the vessel with the highest speed, but by the vessel that is faster while creating a permissible wake. A recent development, these vessels enable operators to offer faster service on routes where the wake problems associated with high speed travel have prevented full speed operation of the ferry vessels. In the San Juan case, while possible environmental damage to the mangrove swamps along the Martin Peña Canal is a concern, the main limitation on vessel speed is due to the effect of the wake on other vessels, marinas, and waterfront activities. Acquisition of reduced wake vessels could allow reduced travel times on the Hato Rey routes.

5.3.7 Summary

Given the current ridership on the Hato Rey service, one of the options of service suspension, reduction, or experimentation should be followed. Based on recent performance, a service suspension until other changes can be made or until the advent of *Tren Urbano* is an attractive option, since Federal funding for the project makes abandonment of the service difficult and with the infrastructure already in place retaining the ability to restart service seems appropriate.

Examining other options, there are several possibilities for changing the level of service to offer transportation in a more cost-effective or competitive manner. Doing away with some of the costs of the Hato Rey terminal by instituting an automated or onboard fare collection system is a recommended change. Service reduction to peak period-only can also be considered, though more analysis would be required before this can be justified.

Alternatively, some service experimentation can take place over the next several years, helping to lay the groundwork for service when *Tren Urbano* opens. Clearly, service frequency could be increased on the Hato Rey - Old San Juan route, especially at mid-day when labor costs are already paid for a vessel only making one trip an hour. Modification of the route structure to provide service to all three terminals on a connecting basis is an interesting service option to experiment with, and is recommended if service frequency is not increased to 20 minutes between Hato Rey and Old San Juan.

If experimentation with increased frequency and improved customer orientation can make the service attractive, given ridership levels the acquisition of new vessels may be an option to pursue. If the catamarans are underutilized, the sale of some of these vessels along with funding from other sources might allow the purchase of new vessels in the 25 to 50 passenger range, still capable of 25 knots, with improved wake and passenger loading characteristics and lower operating costs. Several of these vessels might be acquired as a package deal, reducing unit price, presumably three or four in total. Such vessels could then be employed on the Hato Rey - Old San Juan route to meet the current service schedule at a reduced operating cost while meeting ridership demands.

If *Acuaexpreso* service to Hato Rey can be made more attractive, the service could play an important role in the future urban transportation network. Based on the 2010 predicted travel demand, if *Acuaexpreso* could become the continuation mode for even 10% of the transit users traveling between Old San Juan and the rest of the metropolitan area (excluding the Cataño market), daily ridership would be near 1,400. Add in 25% of the travel demand between the immediate area surrounding the Hato Rey ferry terminal and Old San Juan, and daily ridership could reach 2,200. This level of ridership would make the Hato Rey services reasonably effective, however to reach such numbers much better service, in particular better intermodal connections in San Juan and reduced headways, is necessary. Given the link with *Tren Urbano* and the congestion that will be generated by reconstruction of the Isleta de San Juan bridges, such numbers, while optimistic, are not impossible.

5.4 Recommendations and Timeline

Implementation of immediate recommendations for the Cataño - Old San Juan service should improve the performance of the heart of the *Acuaexpreso* system, while the long range potential for the Hato Rey service along with substantial service improvements may also make this service effective. To integrate the above ideas into a strategy for *Acuaexpreso* it is important to recognize the major impacts which may occur with the inauguration of *Tren Urbano* and the reconstruction of the Isleta de San Juan bridges.

This leads to the development of a three phase strategy for changes to *Acuaexpreso.*

1. Short Term	1998-2000	Near term changes, concentrating on improvements to the Cataño service and reducing costs on the Hato Rey service.
2. Hato Rey and *Tren Urbano*	2001-2003	Changes in the Hato Rey service in tandem with the inauguration of *Tren Urbano*
3. Bridge Reconstruction & Long Range Future	2004+	Possible options for the reconstruction of the Isleta de San Juan bridges and the future.

5.4.1 Short Term Recommendations

The ferry service between Cataño and Old San Juan is clearly key to the urban transportation network. The time savings of this ferry route over the land-based alternatives is so large it should be highly competitive for travelers from the entire municipality of Cataño, as well as the municipalities of Bayamón to the south-west and Toa Baja to the west, for travel to the Isleta de San Juan. The experience of other ferry systems shows that even at a travel time disadvantage, ferry service can still capture a share of the commuter market. That ridership has fallen on this ferry route indicates that there are significant difficulties with the service and considerable scope for improvement.

Service Changes

The Port Authority has estimated the hourly cost of the Cataño - Old San Juan and Hato Rey - Old San Juan routes $705 and $785 respectively. This includes amortization and depreciation, which are not included in the FTA's calculation of operating expenses. In addition, as Cataño - Old San Juan service is justified based on the savings in travel time, the marginal cost of operation of the Hato Rey service is realistically the terminal operating expense and the cost of vessel operation. An estimate of the cost of this service alone is 33% of the total system expenditures; the shorter operating hours of the service and the better fuel efficiency and lower labor costs of the catamarans offset by the fuel and maintenance requirements of the longer routes. Based on this figure estimates of the cost per hour of operation for the basic service can be made (see Appendix C).

The estimated hourly operational cost of a catamaran is roughly $75/hour, and $125/hour for a monohull for two trips an hour. This includes labor costs, while for each pair of additional voyages the marginal cost is estimated to be at most $30 an hour (add 50% for a triangular route). Terminal costs are $8,300 per day for the Cataño - Old San Juan service (16.5 hours/day), $4,100 a day for the Hato Rey terminal (14 hours/day).

This cost analysis can be used to estimate the hourly costs of various schedule options for *Acuaexpreso*. Table 5-7 shows some of the estimated frequencies and hourly costs. (Calculations in Appendix C).

Table 5-7 *Acuaexpreso* Headway, Required Vessels, and Vessel Costs

Route	Frequency	Required Vessels		Hourly Cost
		catamarans	monohulls	
Cataño - Old San Juan	30 min.	1		$105
	15 min.		2	$310
	15 min.	2		$210
	10 min.	1	2	$415
"	10 min.	3		$315
Hato Rey - Old San Juan	30 min.	2		$150
"	20 min.	2		$180
	15 min.	3		$255
Cataño - Old San Juan - Hato Rey	30 min.	2		$180
"	20 min.	3		$270
Cataño - Hato Rey	20 min.	2		$180

Given the marginal cost of operation, the following service changes are recommended:

Cataño - Old San Juan

- Service continued at 30 minute frequencies until 10:00 PM, adding three trips a day, using catamarans.
- On Friday and Saturday evenings, service continued until midnight, a total of eleven added trips.

Combined with other changes to the service, additional frequency changes might be:

- Peak service headways reduced to ten minutes. With increased frequency capacity is less of a constraint, and three catamarans can be used.

- Off-peak headways reduced to fifteen minutes on days when special events are taking place in Old San Juan.

Hato Rey Services

Changes to the Hato Rey service are clearly mandatory, with the options of service suspension, reduction, or experimentation. Service improvements will be needed if the service is to serve as a valuable transportation alternative once *Tren Urbano* opens and especially when reconstruction of the bridges takes place. Experimentation pending a decision to suspend or pursue another course is recommended, ridership being so low that service changes can not have much of an adverse effect. In addition, service improvements at the other terminals could lead to increased ridership on the Hato Rey service, particularly improved transit connections in Old San Juan.

If Hato Rey services are kept operating, experimentation with the following frequencies is a recommended schedule reconfiguration:

- Peak service on the triangular route reduced to 20 minute headways, or serve only the Hato Rey - Old San Juan route at 15 minute intervals.
- Off-peak service continued at 30 minute frequencies throughout the day.

The implementation of higher frequency would increase daily operating costs by some $900; significant, but representing only a 14% increase in the cost of the Hato Rey services overall. Higher frequency experimental schedule options would be:

- Thirty minute service on the triangular route throughout the day.
- Off-peak headways reduced to twenty minutes on the Hato Rey - Old San Juan route for days when special events are taking place in Old San Juan.

Integration

Changes that can be made in the immediate term are increased integration with the AMA bus system and the construction of additional parking at Cataño at the old maintenance lot. Strong consideration should be given to construction of a large, secure parking lot connected by a shuttle bus to the ferry terminal at Cataño. This shuttle service could also serve other locations, including the bus and *público* terminals which would allow users of all modes to interconnect.

The shuttle service in Old San Juan should also be reorganized or augmented to link the ferry system with the bus terminal and other locations on the Isleta. This is key given the poor connections available at the Old San Juan ferry terminal for travelers who have trips longer than can be easily walked.

Working with AMA, a certification of bus fare payment should be instituted, allowing users of the bus to receive a discount on purchasing a ferry ticket. Copied from common fare transfer systems, the institution of a day and time marked transfer system would allow both systems to experiment with such a system in support of future fare integration efforts, as well as attracting riders.

To encourage auto users to transfer to the ferry, marketing and signs on the highways focused on attracting travelers arriving in the city from the west could inform potential users of the availability of parking combined with ferry service to Old San Juan.

Acuaexpreso should consider volume discount fares, including monthly passes. In addition, a reduction in the Hato Rey fare to fifty cents would match that of both *Metrobus* and the Cataño service. This would make the service more competitive and allow the introduction of a flat-fare token payment system.

Implementation

Implementation of the above service changes proposed for the Cataño - Old San Juan and Hato Rey - Old San Juan routes could take place over the years 1999 and 2000. This would allow assessment of the effects for a year prior to the next phase of changes which will coincide with the inauguration of *Tren Urbano*.

While there are advantages to combining the implementation of changes, in cooperation with a marketing effort, the importance of some of the proposed changes for the Cataño service leads to a recommendation for immediate action.

5.6.2 Hato Rey and *Tren Urbano*

The inauguration of *Tren Urbano* is clearly one of the greatest potential impacts on the *Acuaexpreso* Hato Rey - Old San Juan route, and could also impact the Cataño route. The co-location of the Hato Rey ferry terminal and the train station at Nuevo Centro (shown earlier in Map 2-4) could attract a much greater number of riders for

continuation trips on either mode. By supplying connecting service to the train for people coming from Old San Juan and Cataño, as well as continuation service for those alighting from the train to go to those regions, *Acuaexpreso* could greatly increase its ridership.

Acuaexpreso will clearly be competing with the bus system for travelers continuing on from the train. For continuation to Old San Juan, travelers will have a choice between *Acuaexpreso* from Nuevo Centro station or *Metrobus* from the Sagrado Corazon terminus (eventually the Minillas station when this early extension is complete). Given that access to either bus or ferry will be relatively easy for alighting train passengers, the emphasis will be on competing fares, travel times, and frequencies.

Frequency & Schedule

The most immediate way to increase the attractiveness of the service is to increase ferry frequency and schedule to more closely match that of the train. *Tren Urbano* is expected to operate with a four minute headway during the peak period. A consistent schedule for peak period ferry service would then be to offer trips on multiples of this period, every twelve or even every eight minutes (see Table 5-8).

Table 5-8 High Frequency Hato Rey - Old San Juan Service

Headway (minutes)	Required Vessels (catamarans)	Estimated Cost per Hour	travel time + layover (minutes)
12	3	$765	15 + 3
8	5	$965	15 + 5

A high frequency schedule could lead to *Acuaexpreso* becoming an attractive continuation mode to the Isleta de San Juan or Cataño. Unfortunately, operation at high frequencies could run into capacity problems in the Martin Peña canal. If smaller vessels are being used, this would not be a problem, however with the catamarans this could be an issue.

Integration

Once *Tren Urbano* is complete, the bus network will be reorganized to add feeder service to the train. The *públicos* will follow passenger flow too, together linking the train with the rest of the transit systems in San Juan in one combined network. Additional forms of integration are likely at this time or in preparation for the train service, and

Acuaexpreso should clearly be a part of this. In particular, a combined fare system for the reorganized San Juan transit network is likely, though still in the discussion phase.[13] While there are currently no free or reduced transfers within the existing bus system, the goals of the transit system to attract passengers from auto use suggests that some sort of reduced fare or free transfer system will be introduced.

Given the current fare of *Acuaexpreso* at 75 cents compared to 50 cents for *Metrobus*, some sort of free or reduced transfer between *Tren Urbano* and *Acuaexpreso* is also needed if the higher fare is not to discourage potential ferry passengers. If a common fare system is not introduced for all of the San Juan public transit services, transferring passengers could be separated out by the construction of a physically divided walkway from the train station to the ferry terminal, or a time-stamped paper transfer slip obtainable only in the train station on the ticketed side.

Other Options

Plaza las Américas is a major destination for many travelers in San Juan, the largest shopping mall in the Caribbean. *Tren Urbano* will not provide service to the mall, which has been a repeated criticism of the alignment, and connecting bus services between the train and the mall are certain to be introduced. The Nuevo Centro rail station is one of the two in close proximity to the mall, and the introduction of feeder service between the Nuevo Centro station and the mall would effectively be the restoration of the shuttle bus service the Port Authority formerly operated between the Hato Rey station and the Plaza. This roadway between the Nuevo Centro station and the mall is also less developed and hence less congested than the alternative to the Centro Judicial station, and tying in the feeder service to the Hato Rey station would clearly be of great benefit to *Acuaexpreso*.

The resumption of regular service on the Hato Rey - Cataño route, terminated previously due to low ridership, could be considered as the attraction of direct service from Cataño to *Tren Urbano* might be sufficient to warrant the restoration of the route. Such service would naturally reduce the frequency on the Hato Rey - Old San Juan route,

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[13] Barr, Joseph. *Intermodal Fare Integration: Application to the San Juan Metropolitan Area* . (M.I.T., June 1997).

however it could outweigh the effect of reducing the frequency of direct service to Old San Juan. To compensate, ferries could operate on a triangular route alternating their first stop between Cataño and Old San Juan. The attraction of this is that passengers could count on service to both terminals without transfers or wait times, though travel time would be lengthened for customers alighting at the second stop. Six vessels could operate an eight minute headway triangular route with layovers of just under three minutes at each terminal, or five vessels at a twelve minute headway schedule allowing six minute layovers. Again, channel constraints may be a limiting factor if the catamarans are used.

A strategic option for the Hato Rey services of acquiring smaller vessels, possibly by the sale of some of the existing fleet, could be considered leading up to this period. If the Hato Rey services are attractive enough to travelers to warrant continuation, but the efficiency of the service is poor, different vessels might be an option. The possible advantages of smaller vessel operation have already been pointed out and, though this would initially be costly, this strategy may still be attractive.

5.6.3 Bridge Reconstruction and Long Term Recommendations

The inauguration of *Tren Urbano* is likely to be followed by the reconstruction of the Isleta de San Juan bridges, some time between 2003 through 2005. The transportation alternative offered by the train will hopefully reduce congestion in the central part of the city, slightly alleviating the conditions approaching the bridges. Significant development is expected at the same time, a conference center and other new buildings to be constructed in "El Triángulo Dorado": Old San Juan, Condado and Isla Grande. The simultaneous completion of the bridge work and these developments would be sensible and is likely. In any case, there will be major additional delays caused by the bridge work, and if not already done will be an appropriate time to implement a high-frequency service on the Hato Rey - Old San Juan route. In addition, the construction of a major indoor arena near the Hato Rey train station and ferry terminal is scheduled for this period, adding to the customer market for transportation to and from this region.

The exact timeline for completion of these phases is uncertain, and *Acuaexpreso* service between Hato Rey and Old San Juan could be significant for several years to a decade or more even after 2004. In particular, the construction of a tunnel to the Isleta de

San Juan, as well as construction engendered by other work like building the train extension, promises to add to congestion and increase demand for transportation alternatives. Additional service provision and other changes recommended above could be implemented or added during this time as construction mitigation.

Another possibility is further system expansion, depending upon the success of *Acuaexpreso* service in the earlier phases. The current network offers limited accessibility to travelers, and other markets have been considered in the past. A plan to expand *Acuaexpreso* service to the east, across the Laguna San José and to the Luis Muñoz Marin airport, has been around for some time. Such a transportation link could attract passengers not just for trips between Hato Rey and the airport, but also for trips all the way to Old San Juan. Other possible connections in the lagoon include any of the surrounding residential areas and the Roberto Clemente sports complex at the south-eastern end of the lagoon.

There are two options for instituting ferry service across the Laguna San José. The first would be to extend the use of the current *Acuaexpreso* facilities in Hato Rey via the Martin Peña canal. This would require straightening and dredging the canal to accommodate the catamarans currently in service. To accomplish this work to the canal would almost certainly require relocation of the urban areas facing the canal. The expense of this combined work, along with the construction of terminals similar to those already in use for the new destinations, would be prohibitive. A 1988 estimate of $103 million dollars was based on the full system.[14] While a smaller plan may be possible for smaller vessels, the task is almost certain to be quite expensive.

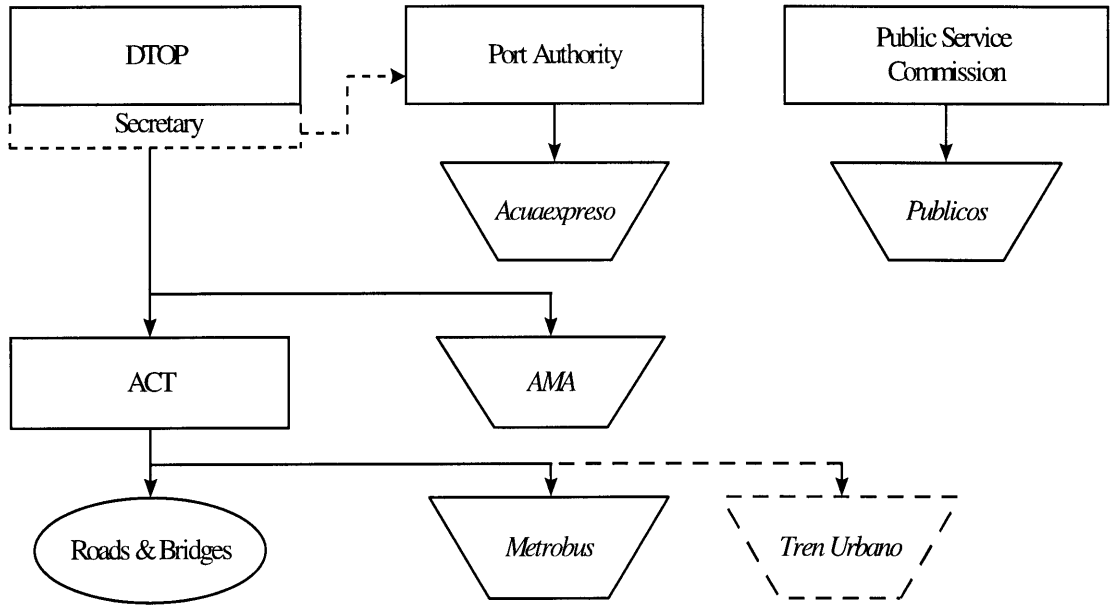
5.5 Organizational Issues

There are three government agencies that are involved with urban transportation in San Juan, including the provision of mass transit: The Department of Transportation and Public Works, the Port Authority, and the Public Service Commission. An

[14] Barton-Aschmann Associates, Inc. *Integration of San Juan Metropolitan Region Público and Private Bus Routes into the Metrobus Transportation System.* (Ft. Lauderdale, FL. September 1992.) p. 14.

organizational chart of the three agencies and their corresponding urban transportation services is presented in figure 5-1.

Figure 5-1 Organization of Urban Transportation Services in San Juan



The figure shows that *Acuaexpreso* is separated institutionally from the Department of Transportation and the majority of other urban transportation services, making cooperation and integration with those services more difficult, though the Secretary of Transportation is also chairman of the board of the Port Authority. Yet, *Acuaexpreso* is a publicly operated transit agency similar in purpose to AMA or any of the other publicly owned systems, all of which are governed by DTOP.

This organizational structure has lead to proposals in the past to reorganize *Acuaexpreso* as a division of DTOP. Such a reorganization would presumably lead to better integration of the various transit systems, including:

- Closer cooperation with the bus services provided by AMA and *Metrobus*, as well as *Tren Urbano* once completed. This could include not only scheduling, but also joint fares and marketing. In addition, the inclusion of ACT would encourage better signing and possibly road and parking space construction that would facilitate access to *Acuaexpreso*.

- Planning for all three systems at the metropolitan area level would be performed by the agency which also manages road construction. Travel needs as a whole and construction mitigation could therefore be used in managing and developing *Acuaexpreso.*
- DTOP and ACT have considerable experience at supervising contracted transit operators, the primary example being *Metrobus.*

This last point, concerning contracted operation, is an important secondary reason for reorganizing *Acuaexpreso* if the decision is made to involve the private sector through contracted operation.

Advantages to be gained by *Acuaexpreso* remaining under the Port Authority include:

- The service would remain integrated with other waterfront and harbor activities that are controlled or regulated by the Port Authority.
- The service would remain under the direction of an agency that is experienced with, and dedicated to, waterfront and waterborne activities.

In addition, while it would be difficult to quantify any specific advantage, the Port Authority also operates ferry services to the islands of Vieques and Culebra at the eastern end of Puerto Rico. The operation of all three services presumably provides a larger base of support and expertise than would a single service in the city.

Consideration of changes to the organizational arrangements must therefore be examined in light of the probable advantages of the two options. While the currently poor level of integration could be overcome by better cooperation between the various departments and agencies, in the long run this may be unsuccessful, as it has been in the past for *Acuaexpreso.* Perhaps the most important factor that may affect a decision to reorganize is the ownership and operation of future ferry service, the models of public-private cooperation having already proven highly effective in transportation in Puerto Rico.

Examining the transportation services in San Juan themselves, there are three possible categories of ownership and operation: public ownership & operation, public support & private operation, and private ownership & operation. The five urban

transportation services in San Juan, including the future *Tren Urbano*, furnish at least one example of each of the categories, as shown in Table 5-9.

Table 5-9 Ownership & Operation of the Transportation Services in San Juan

Private Ownership and Operation	Public Support and Private Operation	Public Ownership and Operation
Públicos	*Metrobus* *Tren Urbano*	*Acuaexpreso* AMA

The two examples of a public-private combination, *Metrobus* and *Tren Urbano*, were both introduced as a means of obtaining private expertise to deal with the problems that have traditionally been associated with publicly owned & operated services. The possibility exists that the same could be done for *Acuaexpreso*, which has also experienced high costs and ineffective service.

Developing a public-private partnership involving contracted service offers the potential of acquiring the two critical advantages of private operation; one, that private services often have improved customer orientation, and two, that it often leads to significant cost reductions or savings through improved service efficiency. Better customer orientation in particular could make the difference in the case of *Acuaexpreso*, focusing on improving the service's image through increased reliability, frequency, and passenger comfort. Given the past experience of *Acuaexpreso*, achieving better ridership and reduced costs are attractive features. Private operation could also allow more effective use of the vessels, operating off-peak excursion services for tourists.

Nevertheless, there are some important disadvantages to turning the service over to a contracted private operator, including the fact that the limited number of routes means that only one company would be likely to operate the service. The advantages a single incumbent has in re-bidding on future contracts are considerable, reducing effective competition. The less the chances of real competition, the less the possible cost savings are likely to be. If competition is to reduce the cost of operating water transport services, it is advantageous for the subsiding agency to sponsor the development of competitive service between several routes and/or operators.

In addition, the past history of *Acuaexpreso* and the limited size of the operation make the introduction of this type of arrangement unattractive to possible operators unless heavily subsidized. Private operations can also have problems in developing sufficient capital for instituting sufficient service or upgrading vessels as technology or the market changes, requiring public assistance. However, the usual long-term cost savings gained from private operation usually make contracted service the better option.

Tying the type of ownership and operation back into the organizational arrangement, the attraction of and the experience already acquired with these type of arrangements in Puerto Rico encourage application to *Acuaexpreso*. Given the expertise of DTOP in this field, reorganizing *Acuaexpreso* as a division of the department in such an eventuality is recommended. Given the apparent advantages of private operation, an effort to analyze the possibility for contracted operation of part or all of *Acuaexpreso* is also recommended.

Examining the timeline of recommendations, there are several opportunities for greater private participation in *Acuaexpreso*, including:

- privatization of various functions, such as custodial services or maintenance.
- contracting the operation of the entire system, or
- contracting only the Hato Rey services as a trial or interim step.

The contracting of custodial services in particular is common among an increasing number of transit agencies, and implementation should be comparatively easy. The construction of the new *Acuaexpreso* maintenance facility makes a transition to privatized maintenance services problematic in the near term, however this a certainly a possible long-range option.

Privatization of the entire system is an attractive option. The improvements in customer orientation that this would likely bring, attracting ridership back to the service, could make a significant difference in performance of the system. Contracted operation of the whole system would give the operator economy of scale, however, the political difficulties associated with turnover of the entire system to a contracted operator may be prohibitive. An alternative for private operation of the entire system would be to contract operation of the Hato Rey services. In a first phase, a company could be leased three of

the catamaran vessels and the terminal at Hato Rey. This would allow the public operation to continue in the vital Cataño - Old San Juan route. *Acuaexpreso* personnel would be offered the option of transferring to the private firm, if agreeable to the company. Those employees who do not transfer could be assigned to the Cataño - Old San Juan service or to other Port Authority jobs. A second phase might then take place in conjunction with the introduction of *Tren Urbano.* At this point, the remaining *Acuaexpreso* assets could be made available to the private operator, or could be split among a number of companies, allowing them to operate in competition or laying the framework for future competitive bidding after an initial break-in period. This latter option could also tie in with the use of smaller vessels by one or more of the operators for the different routes or time-of-day operation.

The introduction or extension of contracted operation would also be a good time to relocate the oversight of ferry services within the San Juan transportation agencies. The grouping of contracted services under one office, responsible for *Tren Urbano*, *Metrobus*, and a contracted ferry service, would allow negotiation expertise and government personnel to be used more effectively.

The introduction of a ferry system more focused on customer service and satisfaction could lead to greater ridership, accomplishing the system's primary goals of increasing society's benefit and alleviating congestion on the road network. However the means by which these are achieved, the time savings of the ferry routes and the geography of the Isleta de San Juan holds out the probability that an effective and efficient ferry service is practical.

6. Summary and Conclusion

The previous chapter presented recommendations for the *Acuaexpreso* service. Implementation of these proposals and their effectiveness is uncertain, given the past history of the service. Nevertheless, based on the experience of other urban ferry systems there is a potential for *Acuaexpreso* to play a greater role in the San Juan transportation system. This chapter summarizes recommendations for *Acuaexpreso* and the importance of ferry transportation for San Juan, and concludes with recommendations for future research.

6.1 Urban Ferry Systems in San Juan

The growth of urban ferry systems is a direct consequence of the increased demand for travel and the dominance of the automobile as the mode of choice. Economic growth continues to increase both automobile ownership and travel demand, however automobiles require street and highway infrastructure, and the expense and effects of continued road construction have lead to a strong reaction against further roadway expansion. The result is escalating congestion as the growth in car use is not matched by capacity increases, leading to greater demand for transportation alternatives.

The dilemma posed by the competing demands of congestion and the desire to limit further road construction has resulted in increased interest in public transit. Transit systems are a solution to the problem of avoiding the negatives associated with road construction while still providing additional transportation capacity, especially to densely developed downtown districts. Unfortunately rail systems have proven to be hugely expensive and lengthy undertakings, requiring a large number of passengers to justify, while bus systems, more appropriate for lower volumes, are often limited to the same congested road network as automobile users.

Another transit alternative is the urban ferry, able to use the waterways around which many cities are built and avoiding both congested road networks and the expense of separated grade transit systems. While ferry systems can play only a limited role in the urban transportation network, they are a solution that has been found effective in many

North American cities, including Boston, New York City, Seattle, San Francisco, and Vancouver. In addition, in many cases they are favored by geography, which limits land-based transportation systems to expensive tunnels or bridges when crossing rivers or harbors.

The current transportation developments in San Juan are the product of similar factors. San Juan has one of the highest densities of automobile use to road capacity in North America, and is facing increasing congestion in the urban core where the expense and effects of further road construction are prohibitive. In response, the construction of *Tren Urbano* has begun, and the rail system will provide an effective transportation alternative along its alignment. The San Juan bus services, meanwhile, are being improved to increase their effectiveness as an intermediate solution and to set the stage for further enhancement once *Tren Urbano* is complete.

However, access to the Isleta de San Juan is a significant issue, as one of the most geographically limited parts of the city and as a tourism and government center. Bus access is restricted to the three bridges that link the Isleta to the city, and these are both limited in capacity and facing future disruptions due to needed reconstruction. *Acuaexpreso* provides an additional means of access to the Isleta, yet the system has been facing declines in ridership and the cost of operation of the system makes continued operation of the system unattractive.

Given the performance of *Acuaexpreso* to date, the question is whether changes can be made to the system to improve its role and effectiveness in the urban transportation network. There are certainly improvements that can be made to the system, and the potential of these and changing travel patterns indicates that there is a possibility of *Acuaexpreso* fulfilling the expectations of the system.

The ferry system does have a great deal of potential, increased by the geography of San Juan. The Cataño - Old San Juan route of *Acuaexpreso* in particular offers a tremendous time savings to passengers. If intermodal connections to the service's terminals can be improved, and level of service increased, the route should attract a substantially higher ridership than at present, perhaps as much as doubling current levels.

The level of service offered by the Hato Rey - Old San Juan route of *Acuaexpreso*, on the other hand, is much less competitive with other transportation alternatives, and ridership on the route is abysmal. A relatively new service, its advantages in travel time have been met by competition from improvements in the bus system, which benefits from better access, higher frequency, and lower fares. Yet given the construction of *Tern Urbano* and the construction that will affect the bridge and road network, there is potential for the Hato Rey service. If the service could attract even a minor share of travelers from the system, the effectiveness of the service would increase dramatically.

Ridership is clearly the key to continued operation of *Acuaexpreso*, and the service must be competitive with other transportation alternatives if it is to attract more riders. To improve the efficiency of both routes changes in the schedule of operation are recommended: increased trip frequency, discounted volume fares or monthly passes, and above all increased reliability and customer service. Implementation of some of these services changes is recommended immediately, while experimentation with some of the other service options could be influential in restoring the system's role in San Juan.

In summary, the potential for *Acuaexpreso* lies in the need for efficient transportation that is not limited by the road network. This is especially clear in the near future before *Tren Urbano* is completed and extended to the Isleta de San Juan. While in the very long run *Acuaexpreso* service to Hato Rey and potential other locations may no longer be viable, in the near future the congestion expected on the road network due to reconstruction of the bridges to the Isleta de San Juan and growing travel demand indicate that a transportation alternative besides personal automobiles or the bus system could be valuable and effective.

6.2 Summary of Recommendations

Recommendations for *Acuaexpreso* are based on the current system performance and apparent potential and the major impacts which will occur with the inauguration of *Tren Urbano* and the reconstruction of the Isleta de San Juan bridges.

These lead to a three phase strategy for recommendations for *Acuaexpreso*:

1. Short Term Recommendations
2. Hato Rey and *Tren Urbano* Recommendations
3. Bridge Reconstruction & Long Range Recommendations

Short Term Recommendations

The Cataño - Old San Juan ferry route is clearly key to the urban transportation network. Despite ridership having decreased below pre-*Acuaexpreso* levels, the advantages of the service are so great that service changes could improve performance significantly. Recommendations for the Cataño - Old San Juan ferry service are:

- Increase service frequency throughout the day, and in the evening in support of special events in Old San Juan.
- Add shuttle bus service in Old San Juan.
- Improve or introduce schedule and fare integration with the AMA bus system.
- Construct additional parking at Cataño.
- Advertise and market the service, particularly to drivers.
- Introduce a discount fare structure for volume buys and/or monthly passes.

Improvements in the system's level of service and intermodal connections should lead to greater ridership on the Cataño - Old San Juan route. Immediate implementation is recommended.

The Hato Rey ferry service is an extremely poor performer, and drastic changes need to be made if the service is to be revitalized in the near term. Three options for the service are:

1. Suspension
2. Reduced Service
3. Experimentation with Service Changes.

The first option is perhaps the most attractive given the poor performance of the system, however Federal involvement in the system and the desire to maintain a Hato Rey service option may mitigate against this. A reduced service could curtail some of the costs of the system by introducing automated or on-board fare collection and reducing or

eliminating terminal operation at Hato Rey. Lastly, service experimentation is an interim option that could prove useful in preparation for improved service when *Tren Urbano* opens. Options for experimentation, besides those service changes listed for the Cataño service, are route and frequency changes, fare reduction, and the acquisition of smaller vessels. The latter is an interesting strategic option, building on improvements in ferry construction and the low passenger volume of the Hato Rey route to introduce a more efficient service.

There is also an opportunity in the near term for private participation, most plausibly for such functions as custodial services and maintenance, but possibly also for operation of the entire system. If this latter proves insurmountable, contracting out the Hato Rey services alone while continuing public operation of the Cataño - Old San Juan route might be a feasible option.

Hato Rey and *Tren Urbano* Recommendations

The inauguration of *Tren Urbano* will clearly have great potential impact on the Hato Rey service, and could also impact the Cataño route. *Acuaexpreso* will be competing with the bus system as a continuation mode for multi-vehicle trips to and from Old San Juan. Service improvements for the Catano - Old San Juan service should already have been implemented, and Hato Rey service can now be improved to match. Recommendations are:

- increase ferry frequency and modify the schedule to match that of *Tren Urbano* (expected to operate with a four minute headway during the peak period).
- Join in a combined fare system for the reorganized San Juan transit network.
- Reintroduce shuttle bus service between the Nuevo Centro station and the Plaza las Américas.
- Consider resuming regular service between Hato Rey - Cataño route, based on the attraction of direct transit service from Cataño to *Tren Urbano.*

This is also an opportunity to consider the introduction of contracted private service to replace the current arrangement. The advantages of customer service and increased efficiency make contracted operation an attractive strategic option.

Bridge Reconstruction and Long Range Recommendations

The inauguration of *Tren Urbano* will be followed by the reconstruction of the Isleta de San Juan bridges. The transportation alternative offered by the train will hopefully reduce congestion in the central part of the city, slightly alleviating the conditions approaching the bridges. Significant development is expected at the same time "El Triángulo Dorado" of Old San Juan, Condado and Isla Grande, including the convention center, along with the Hato Rey arena. Recommendations are:

- If not already introduced, high-frequency service on the Hato Rey - Old San Juan route to mitigate the effects of construction.
- Completion of a private-public cooperative arrangement for operation of the system.

Reorganization of the system as a division of the Department of Transportation and Public Works location could also take place at this time, to place the contracted public transportation services under central control and permit government expertise to be used for efficient operation of all the contracted arrangements.

In the very long run, *Acuaexpreso* service on the Hato Rey - Old San Juan route is questionable. Eventually *Tren Urbano* will be extended to Old San Juan, greatly reducing the attractiveness of the Hato Rey - Old San Juan route. Further system expansion is a possibility to offset this, though only if *Acuaexpreso* has established a solid record of performance will retention make sense. Still, low-cost utilitarian landings and smaller vessels could make a larger network viable, with possible service extension to the Laguna San José and the Luis Muñoz Marin airport.

6.3 Future Research

The analysis of *Acuaexpreso* leaves open several questions and concerns which need to be addressed if the system is to be made effective. In particular, a better study of ridership for both the ferry and other transit services is in order, examining time of day and trip purpose patterns, e.g. peak-hour commuters. This is important in determining service frequency and can be used to focus marketing efforts on segments of the customer population. Such information would be invaluable for *Acuaexpreso*, especially in

determining the utility of the peak service triangular route with service between Cataño and Hato Rey. Another research topic would be on fare system proposals, on which a great deal of conceptual work has been done, and experiments with these on portions of the transit network, preceded and followed by customer surveys, would also be valuable.

In support of the implementation of service changes to *Acuaexpreso*, there will be necessary work in monitoring and analyzing the effects of service changes. This will be needed both for the Cataño - Old San Juan route and in support of increased Hato Rey services once *Tren Urbano* opens. Again, increased knowledge of travel demand is needed if the service changes are to be implemented successfully.

Looking at future research possibilities for ferry systems in general, customer service and the importance of reliability and comfort play an important role in ferry ridership. More information on the influence of these attributes on ridership, relating quantified attributes to customer opinion and preferences, could aid both ferry systems and mass transit overall in improving customer service.

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Appendix A. *Acuaexpreso* Fleet

Monohull Fleet - Three 300 passenger vessels.

These vessels follow a traditional monohull design with two decks. The lower deck is enclosed; the upper deck is open with an awning cover to provide protection from rain.

Names:

1. Cataño II
2. Manuel Henriquez
3. Malén Lledó

All three vessels were built in 1975 by Blount Industries. The Malén Lledó was overhauled recently, returning to service in February 1996.

Catamaran Fleet - Six 149 passenger vessels.

These vessels are designed to carry 167 passengers, but limited to 149 by Coast Guard regulation. They are capable of speeds up to 25 knots. The catamarans have a single enclosed deck, allowing them to be air-conditioned. They are also equipped with lavatories.

Names:

1. Covadonga
2. Martín Peña
3. Amelia
4. San Gerómino
5. Cristóbal Colón
6. Viejo San Juan

All were built by Nichols Brothers Boatbuilders, the first three in 1989 and the others in 1990. All six vessels were overhauled between June 1995 and March 1996.

Appendix B: Performance Measures and Financial Data

B.1 *Acuaexpreso*

The reported measures for *Acuaexpreso* in the National Transit Database (shown in Table B.1) have a number of errors, as well as failing to account for service changes which makes comparison of low value. Specific errors include:

- F.Y. 1991-92 data is affected by the Grand Columbus Regatta. During this period, *Acuaexpreso* operated additional service to other locations besides the three terminals. This adds to the revenue vehicle miles and passenger mile data, while not accurately portraying the costs of operation of the actual three route structure.
- In F.Y. 1992-93, regular operation between Cataño and Old San Juan was terminated in December 1993, changing service miles and hours. However, the numbers of revenue vehicle hours and miles reported exceeded those of the previous year, while fuel consumption fell from 500,000 gallons to 333,000 gallons. This makes the RVH and RVM figures questionable.
- In F.Y. 1993-94, the National Transit Database used the previous year's ridership to calculate performance measures. Since actual ridership fell from 1.6 million to 1.2 million, this severely biased the data. In addition, the previous RVM and RVH were also used, though fuel consumption fell from 330,000 gallons to 146,800, making these numbers very questionable. In the report for this year, much of the data is annotated as being questionable.
- In F.Y. 1994-95, the Martin Peña canal was closed, and service ceased, affecting the performance of the system. However, other figures were revised to reflect this, and this data is probably the most accurate annual assessment of the system. Fuel consumption was 145,200 gallons, only one percent less than that of the previous year, though reported RVH and RVM were reduced by a factor of five.

To correct for these sources of error, and estimate performance measures for 1995-96 and 1996-97, estimates were made of the actual revenue vehicle mile, revenue vehicle hour, and passenger miles. For F.Y. 1991-92 and 1994-95, fuel consumption and the service consumption figures were used to arrive at an average figure of 0.45 RVM/gal and 0.085

RVH/gal. This measure was then used to recalculate RVM and RVH for these two years, as well as for the intervening years. Revised measures are given in Table B-2.

Table B-1 National Transit Database Performance Measures Summary for *Acuaexpreso*

	1992	1993	1994	1995
Service Efficiency				
Operating Expense/ Revenue Vehicle Mile	$29.42	$28.36	$31.39	$122.02
Operating Expense/ Revenue Vehicle Hour	$165.54	$156.30	$172.96	$580.65
Cost Effectiveness				
Operating Expense/ Passenger Mile	$1.33	$1.79	$2.01	$3.90
Operating Expense/ Unlinked Passenger Trip	$2.96	$4.35	$4.81	$5.85
Service Effectiveness				
Unlinked Passenger Trips/ Revenue Vehicle Mile	9.93	6.52	6.52	20.85
Unlinked Passenger Trips/ Revenue Vehicle Hour	55.93	35.94	35.94	99.21
Passenger Mile/ Revenue Vehicle Mile	22.20	15.80	15.60	31.27
Operating Expense	$7,728,576	$7,346,239	$8,129,274	$6,146,196
Revenue Vehicle Miles	259,000	259,000	259,000	50,370
Revenue Vehicle Hours	46,000	47,000	47,000	10,585
Fuel Consumption (gallons)	500,000	333,000	146,800	145,200
Passenger Miles	5,748,512	4,093,245	4,039,245	1,575,181

Table B-2 Revised Performance Measures Summary for *Acuaexpreso*

	1992	1993	1994	1995
Service Efficiency				
Operating Expense/ Revenue Vehicle Mile	$34.35	$49.02	$123.06	$94.06
Operating Expense/ Revenue Vehicle Hour	$181.85	$259.54	$651.49	$497.99
Cost Effectiveness				
Operating Expense/ Passenger Mile	$1.37	$2.20	$4.31	$4.58
Operating Expense/ Unlinked Passenger Trip	$3.15	$4.35	$6.64	$5.82
Service Effectiveness				
Unlinked Passenger Trips/ Revenue Vehicle Mile	10.92	11.27	18.52	16.17
Unlinked Passenger Trips/ Revenue Vehicle Hour	57.82	59.69	98.05	85.62
Passenger Mile/ Revenue Vehicle Mile	25.00	22.29	28.53	20.53
Operating Expense	$7,728,576	$7,346,239	$8,129,274	$6,146,196
Revenue Vehicle Miles	225,000	149,850	66,060	65,340
Revenue Vehicle Hours	42,500	28,305	12,478	12,342
Passenger Miles	5,624,632	3,339,425	1,884,968	1,341,433

Performance measures for the two most recent years were based on calculated passenger miles, and estimated RVM and RVH necessary to meet the system schedule, as covered in

the estimates of route allocation for the two routes for the 1996-97 cost estimate. A complete table is presented in Table 2-9 of the main text.

B.3 Washington State Ferries

Washington State Ferries operates two passenger-only ferry routes, route numbers 15 and 16. Data for the POF system is shown in Tables B-3 and B-4.

Table B-3 WSF Route 15 Express Seattle-Bremerton Statement Summary

	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
Passenger Trips	368,378	377,666	327,806	274,246	261,134	283,848
Revenue						
Fare	568,793	400,767	551,187	268,960	261,813	288,131
Other	35,498	9879	2382	14704	635	1559
Total	604,291	410,646	553,569	283,664	262,448	289,690
Vessel Operating Expenses						
Labor	793,426	861,883	1,035,872	1,061,705	925,976	1,107,867
Fuel	335,360	194,299	189,335	222,506	159,209	217,739
Other	224,262	193,327	185,558	127,960	161,848	128,087
Total	1,353,048	1,249,509	1,410,765	1,412,765	1,247,033	1,453,693
Terminal Operating Expenses						
Labor	112,744	107,868	138,315	73,235	130,970	75,909
Other	17,332	18,935	31,000	14,299	27,866	9,058
Total	130,076	126,803	169,315	87,534	158,836	84,967
Maintenance Expenses						
Vessel	273,362	400,621	503,336	250,889	133,777	100,466
Terminal	49,849	20,421	20,334	19,702	30,205	14,622
Total	323,211	421,042	523,670	270,591	163,982	115,088
Management and Support						
Labor	94,564	50,687	105,961	118,172	99,013	126,855
Other	81,410	84,952	86,830	88,752	102,027	150,755
Total	175,974	135,639	192,791	206,924	201,040	277,610
Total Expenses	1,982,309	1,932,993	2,296,541	1,977,220	1,770,891	1,931,358
Net	-1,378,018	-1,522,347	-1,742,972	-1,693,556	-1,508,443	-1,641,668
Recovery Ratio	30.48%	21.24%	24.10%	14.35%	14.82%	15.00%

Table B-4 WSF Route 16 Express Seattle-Vashon Statement Summary

	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
Passenger Trips	188,176	239,622	240,176	246,384	240,754	242,438
Revenue						
Fare	188,880	208,322	222,810	205,346	205,399	201,309
Other	14,568	8,023	,1016	12,290	510	1,982
Total	203,448	216,345	223,826	217,636	205,909	203,291
Vessel Operating Expenses						
Labor	570,136	826,232	892,679	869,297	916,628	868,376
Fuel	230,475	247,422	278,066	168,154	188,495	230,807
Other	172,652	134,420	144,621	111,832	293,763	86,155
Total	973,263	1,208,074	1,315,407	1,149,283	1,398,886	1,185,338
Terminal Operating Expenses						
Labor	24,347	35,521	38,810	39,289	36,294	42,981
Other	5822	8202	10,877	10,166	11,115	8,551
Total	30,169	43,723	19,687	19,455	47,409	51,532
Maintenance Expenses						
Vessel	199,652	256,712	307,761	385,963	188,578	106,515
Terminal	23,600	17,465	14,370	43,214	14,508	19,733
Total	223,252	274,177	322,121	429,177	203,086	136,248
Management and Support						
Labor	70,823	143,581	97,491	66,267	105,794	134,733
Other	53,106	78,606	71,793	72,228	101,453	124,244
Total	123,929	222,187	169,284	138,495	207,247	258,977
Total Expenses	1,350,613	1,748,161	1,859,509	1,766,410	1,856,628	1,632,095
Net	-1,147,165	-1,531,816	-1,632,683	-1,548,744	-1,650,709	-1,428,804
Recovery Ratio	15.06%	12.38%	12.06%	12.32%	11.09%	12.46%

B.3 Vancouver Seabus

As a Canadian system, SeaBus financial numbers are given in Canadian dollars, while distances are measured using the metric system (shown in Tables B-5 and B-6). Coat data was converted to US dollars at a ratio of $1.25:$1.00 and distances were converted to English units in the graphical figures presented in Chapter Four.

Table B-5 SeaBus Operating Statistics

	1992	1993	1994	1995	1996
Revenue Passengers	2,232,872	2,161,312	2,231,880	2,526,476	2,826,305
Boarded Passengers	4,241,779	4,154,600	4,440,252	4,835,163	5,430,920
Direct Operating Cost	$5,360,071	$5,479,458	$5,509,273	$5,735,310	$5,930,308
Debt Service Cost	$211,512	$260,544	$287,784	$287,784	$287,784
Total Cost	$5,571,583	$5,740,002	$5,797,057	$6,023,094	$6,218,092
Revenue Service Hours	10,373	10,410	10,437	10,432	10,416
Revenue Kilometers	140,821	140,703	140,948	141,353	140,805
Total Employees	79.8	81.7	79.1	80.2	81.8
Operators	17.4	17.9	17.5	19.0	19.8
Maintenance Employees	14.4	14.4	13.9	14.5	14.6

Table B-6 SeaBus Performance Statistics (Canadian Dollars)

	1992	1993	1994	1995	1996
Service Efficiency					
Cost Efficiency					
Operating Cost/Service Hour	$516.73	$526.36	$527.86	$549.78	$569.35
Total Cost/Service Hour	$537.12	$551.39	$555.43	$577.37	$596.98
Labor Efficiency					
Service Hours/Operator	596	582	596	548	526
Service Hours/Employee	130	127	132	130	127
Vehicle Efficiency					
Service Hours/Peak Vehicle	5,187	5,205	5,219	5,216	5,208
Service Kilometers/Service Hour	13.6	13.5	13.5	13.5	13.5
Cost Effectiveness					
Passenger Costs					
Total Cost/Revenue Passenger	$2.50	$2.66	$2.60	$2.38	$2.20
Operating Cost/Revenue Passenger	$2.40	$2.54	$2.47	$2.27	$2.10
Service Utilization					
Revenue Passengers/Service Hour	251.3	207.6	213.8	242.2	271.3
Revenue Passengers/Service km	15.9	15.4	15.8	17.9	20.1

Performance Measures Summary

Operating Expense/ Revenue Vehicle Mile

	1992	1993	1994	1995	1996	1997
Acuaexpreso	$34.35	$49.02	$123.06	$94.06	$66.48	$52.14
Golden Gate	$63.41	$65.25	$72.82	$80.60	$82.86	$85.61
AOFS	$32.04	$22.94	$17.26	$19.49		
Vallejo	$29.98	$29.07	$27.98	$22.01		
SeaBus	$49.03	$50.17	$50.35	$52.27	$54.26	

Operating Expense/ Revenue Vehicle Hour

	1992	1993	1994	1995	1996	1997
Acuaexpreso	$181.85	$259.54	$651.49	$497.99	$411.68	$335.63
Golden Gate	$772.46	$784.12	$920.07	$974.68	$1,009.37	$1,073.96
AOFS	$372.78	$288.81	$224.94	$243.59		
Vallejo	$665.91	$621.70	$596.16	$616.27		
SeaBus	$413.39	$421.09	$422.29	$439.82	$455.48	

Operating Expense/Passenger Mile

	1992	1993	1994	1995	1996	1997
Acuaexpreso	$1.37	$2.20	$4.31	$4.58	$4.87	$3.91
Golden Gate	$0.53	$0.56	$0.67	$0.77	$0.74	$0.72
AOFS	$1.01	$0.77	$0.74	$0.70		
Vallejo	$0.30	$0.30	$0.33	$0.30		
SeaBus	$0.48	$0.50	$0.47	$0.45	$0.41	

Operating Expense/Unlinked Passenger Trip

	1992	1993	1994	1995	1996	1997
Acuaexpreso	$3.15	$4.35	$6.64	$5.82	$6.73	$5.38
Golden Gate	$5.74	$5.99	$7.19	$8.38	$7.99	$7.83
AOFS	$6.79	$5.23	$4.95	$4.71		
Vallejo	$9.38	$9.44	$10.37	$9.34		
SeaBus	$1.01	$1.06	$0.99	$0.95	$0.87	

Unlinked Passenger Trips/ Revenue Vehicle Mile

	1992	1993	1994	1995	1996	1997
Acuaexpreso	10.92	11.27	18.52	16.17	9.87	9.68
Golden Gate	11.05	10.90	10.12	9.62	10.38	10.93
AOFS	4.71	4.39	3.49	4.14		
Vallejo	3.20	3.08	2.70	2.36		
SeaBus	48.51	47.55	50.73	55.08	62.11	

Unlinked Passenger Trips/ Revenue Vehicle Hour

	1992	1993	1994	1995	1996	1997
Acuaexpreso	57.82	59.69	98.05	85.62	61.15	62.33
Golden Gate	134.62	130.94	127.92	116.35	126.39	137.16
AOFS	54.87	55.22	45.48	51.73		
Vallejo	71.03	65.84	57.39	65.98		
SeaBus	408.92	399.10	425.43	463.49	521.40	

Passenger-Miles/Revenue Vehicle Mile

	1992	1993	1994	1995	1996	1997
Acuaexpreso	25.00	22.29	28.53	20.53	13.65	13.34
Golden Gate	118.60	117.43	109.32	104.21	112.10	118.31
AOFS	31.69	29.88	23.39	27.98		
Vallejo	99.12	95.38	83.63	72.83		
SeaBus	102.41	100.39	107.11	116.30	131.14	

Farebox Recovery Ratio

	1992	1993	1994	1995	1996	1997
Acuaexpreso	19.02%	13.22%	8.33%	8.51%	7.68%	9.48%
Golden Gate	33.34%	31.61%	31.40%	27.49%	30.87%	31.45%
WSF	16.55%	18.62%	12.67%	12.88%	13.73%	

Appendix C. Cost Estimation Analysis

This appendix includes the source data used for the cost estimates presented in Chapter 4, and provides more detail of the estimates and calculations used in producing the figures presented in that chapter. A primary source is the 1992 report An Assessment of the Potential for Ferry Services in New York Harbor, prepared by the New York City Department of Transportation, the New York & New Jersey Port Authority Office of Ferry Planning and Private Operations, and the Bureau of Transit Operations.

This report surveyed a number of vehicle types, and prepared generic profiles for application in service planning. One of these profiles is a close match for the catamarans used by *Acuaexpreso* (shown in Table C-1). There is no profile for a 300 passenger monohull, but the profile for a 250 passenger monohull should be similar except for cost.

Table C-1 NYC Generic Vessel Profiles

	250 Passenger Monohull	150 Passenger Catamaran
Speed (knots)	20	25
Passenger Capacity	250	150
Price	$1,000,00	$1,150,000
Crew per vessel		
Captains	1	1
Deckhands	3	2
Fuel Consumption (gal/hr)	108	87

C.1 Employee Data

Vancouver

For the Vancouver Seabus, average operators, maintenance employees and total employees are calculated for the year. For the most recent year, 1996, these were given as 19.8 operators, 14.6 maintenance employees, and 81.8 total.[1] Subtracting out the first two leaves 47.4 employees involved in tasks other then associated with the vehicles, including terminal operations. Dividing by the two vessels and the two terminals gives:

[1] BC Transit Service Planning. *Draft 1998/99 Concept Plan for the Vancouver Regional Transit System.* September, 1997. Table 7.1 Operating Statistics.

- 9.9 operators/vessel;
- 7.3 maintenance employees/vessel;

Because of the advanced design and control systems of the Seabus vessels as well as the short operating route, the system operators required are few compared to other vessels with different characteristics.

Washington State Ferries

A complete proposal for a greatly expanded passenger-only ferry fleet examined the numbers and assignments of the necessary employees for a two phase implementation program. These estimates are presented in Table C-2, though they do not take into account the support personnel provided by the greater part of the current vehicle ferry system.

Table C-2 WSF Expansion Plan for Staffing (Full Time Equivalents)[2]

	Phase I - 8 vessels	Phase II - 5 vessels	Overall
Vessel Operations	140	111	251
Terminal Operations	29	9	38
Management & Support	4	-	4
Total	173	120	293

For vessel operations, this gives an average of 17.5 operators/vessel for phase I, 22.2 operators/vessel for phase II, and 19.3 operators/vessel overall. Note that the increase for phase two includes not only operation of the additional vessels but more frequent operation of the first phase vessels. For employees assigned to terminal operations, given four terminals there initially are 7.2 employees/terminal, increasing to 9.5 employees/terminal with the second phase. Finally, as commuter boat operations are only a portion of the WSF system, the numbers for management and support do not reflect the administrative needs of a complete service.

[2] Washington State Transportation Commission. *Implementation Plan: Passenger-Only Ferry Program: Technical Appendix.* December, 1993. p. 4-6.

Table C-3 summarizes the employee estimates for the two systems, providing a rough figure that can be compared to *Acuaexpreso*. Computation of labor costs for *Acuaexpreso* for use in analysis of the system are covered in the attached pages.

Table C-3 Ferry Employment Summary

	Vessel Operations employees/vehicle	Maintenance employees/vehicle	Terminal Operations employees/terminal	Administration total
Vancouver	9.9	7.3	47.4	
WSF	19.3	-	9.5	4

Acuaexpreso

In 1995, unionized employees were reported in a Port Authority report as:

- 14 captains
- 30 sailors (deckhands)
- 15 janitors
- 7 substitutes
- 2 mechanics
- 3 welders
- 26 maintenance and auxiliary workers
- 2 administrators

for a total of 99 unionized employees, along with an additional 11 non-unionized employees for a system total of 110.

The employee numbers and assignments as reported in the 1995 National Transit Database[3] for *Acuaexpreso* are:

- 82 in vehicle operations;
- 9 in vehicle maintenance;
- 30 in non-vehicle maintenance;
- 10 in general administration;

totaling to 111 employees. An estimate by function of *Acuaexpreso* employees is shown in the attached worksheets, while reported employee expenses, broken down by category, are shown in Table C-4.

[3] 1995 National Transit Database, prepared by Federal Transit Administration. Table 19.

Table C-4 1995 National Transit Database *Acuaexpreso* Employee Expenses

	1995
Salaries & Wages	
Operations	$1,713,900
Other	$1,043,800
Benefits	$1,853,900
Total (difference due to rounding errors)	$4,611,635

C.2 Maintenance Cost Estimation Data

The estimation of maintenance costs is primarily accomplished using the NYCDOT formula:

Annual Maintenance and Repair Costs = purchase price of the vessel multiplied by (2.7% + 1.8% of (daily operating hours/vessel)/5 hours).

This formula is applied to the known costs of the publicly operated systems.

Application of NYCDOT Formula to Seattle (WSF) Data:

For comparison this rule-of-thumb can be applied to the costs of operation of the WSF system shown in Tables 4-1 and 4-2. Since the three passenger only ferries of the WSF system are used interchangeably for the two POF routes, all data will be aggregated for the calculations.

Table C-4 Annual Hours of Operation (WSF Routes 15 & 16)

	Days of Operation	Travel Time	Trips/Day	Total Hours
Route 15	Weekday (250)	50	11	2292
	Saturday (50)	50	8	333
	Sunday (50)	50	8	333
Route 16	Weekday (250)	25	17	1771
	Saturday (50)	25	12	250
	Sunday (50)	25	0	0
Total				4979

- Given a total of 5250 hours for a 5 hour day, 350 days a year, this gives a ratio of 0.948 of actual hours to standard hours.
- The sum of purchase prices for the three WSF commuter ferries was = $7,500,000.
- The NYCDOT formula result is then:

  0.027* $7,500,000 + 0.018 * 0.948

Rounded off, this gives an answer of $330,500 predicted per year for vessel maintenance.

- The actual expenses for the WSF system are:

Table C-5 Summary of WSF Maintenance Expenses

	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1995
Route 15	273,362	400,621	503,336	250,889	133,777	100,466
Route 16	199,652	256,712	307,761	385,963	188,578	106,515
Total	472,924	657,273	811,097	636,852	322,355	206,981

The estimate is roughly comparable to the data, realizing that such costs are engine replacement and other periodic items do not occur every year.

C.3 Fuel Consumption

Fuel consumption is difficult to calculate, being based on hours of operation, distances traveled, speed of travel, and even such small effects as passenger loading and the weather. Based on the generic vessels of the NYCDOT study, fuel consumption for the *Acuaexpreso* vessels is:

- 87 gal/hr for the 150-person, 25 knot catamarans;
- 108 gal/hr for 250-person, 20 knot monohulls (similar to *Acuaexpreso*).[4]

This is the sailing consumption. Fuel consumption while at dock is estimated at 10% of the rate.[5] However, the relatively short distances of the *Acuaexpreso* routes limit full speed operation, as so wake restrictions in San Juan Bay, improving average fuel consumption. To account for this, consumption is set at 55 gal/hr for the catamarans and 90 gal/hr for the monuhulls.

The data tabulated for *Acuaexpreso* is in the attached pages, giving an estimated consumption of 269,487 gallons per year for the current schedule.

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[4] Office of Ferry Planning and Private Operations. *An Assessment of the Potential for Ferry Services in New York Harbor*. Final Report, July 1992. Appendix H, Generic Vessel Cartridges.

[5] Office of Ferry Planning and Private Operations. *An Assessment of the Potential for Ferry Services in New York Harbor*. Final Report, July 1992. p. 68.

Appendix C: Employee Cost Calculations

Daily Employment

	Salary	AM Peak	Midday	PM Peak	Evening	Night	Sum	Daily Hours	Weekly Hours	(40 hrs/wk)	FTE's	Daily Salary
Time Periods	per hour	0600-1000	1000-1600	1600-1900	1900-2200	2200-0600					rounded	rounded
Hours/Period		4	6	3	3	8					up	up
Vessel Crew												
Masters - C&SJ	$14	2	2	2	1		$406	29	203	5.075	6	$672
Deckhands - C&SJ	$8	6	2	6	1		$456	57	399	9.975	10	$640
Masters - HR	$14	2	2	2			$364	26	182	4.55	5	$560
Deckhands - HR	$8	2	2	2			$208	26	182	4.55	5	$320
Terminal Operations												
Catano												
Supervisor	$14	1	1	1	1		$224	16	112	2.8	3	$336
Ticket Agent	$9	2	1	2	1		$207	23	161	4.025	5	$360
Custodians	$7	1	1	1		2	$203	29	203	5.075	6	$336
San Juan												
Supervisor	$14	1	1	1	1		$224	16	112	2.8	3	$336
Ticket Agent	$9	2	1	2	1		$207	23	161	4.025	5	$360
Custodians	$7	1	1	1		2	$203	29	203	5.075	6	$336
Hato Rey												
Supervisor	$14	1	1	1			$182	13	91	2.275	3	$336
Ticket Agent	$9	1	1	1			$117	13	91	2.275	3	$216
Custodians	$7	1	1	1		2	$203	29	203	5.075	6	$336
Maintenance Operations												
Supervisor	$14	1	1			1	$252	18	126	3.15	4	$448
Mechanics	$10	4	4			4	$720	72	504	12.6	13	$1,040
Management												
Secretarial Staff	$9	2	2				$180	20	80	2	2	$144
Total							$4,356	439	3013		85	$6,776
						Fringe	1.60					1.60
Fringe		**60%**					**$6,970**					**$10,842**

FTE's (Full-Time Employee Equivalents) 85

Estimated Annual Employee Expenses

	Days	Salary	Fringe + OT	**Final Total**
	365	$6,776	$4,066	
		$2,473,240	**$1,483,944**	**$3,957,184**
Salaries				
Manager				$65,000
Assistant				$35,000
Chief Engineer				$45,000

Total Estimated Annual Employee Expenses **$4,102,184**

Allocated Expenses

Hato Rey Allocation

Includes Employee Expenses for
- Operation of the Hato Rey Vessels
- Proportional Operation of the Old San Juan Terminal
- Proportional Maintenance and Management Expenses

Allocation is based on number of Hato Rey trips compared to total trips
58 trips out of 145 daily **40.0%**

Hato Rey Service	Days	Daily Salary	Fringe	**Final Total**
	365	$2,834	$1,700	
		$1,034,264	**$620,558**	**$1,654,822**
			+ Salaries	$58,000
Hato Rey Allocation			Total	$1,712,822
			Percentage	41.8%

Catano Service		Daily Salary	Fringe	**Final Total**
		$3,942	$2,365	
		$1,438,976	**$863,386**	$2,302,362
			+ Salaries	$87,000
Catano Allocation			Total	$2,389,362
			Percentage	58.2%

Fuel Consumption & Expenditure

Estimated Fuel Cost $1.10 per gallon

	Vessels	Operating Time hrs/day		Veh-hrs/day		
Monohull	2	6	Catano Peak	12		
Catamaran	2	7	Off-Peak	14		
Catamaran	1	3.5	Evening	3.5		
Catamaran	2	13	Hato Rey	26		Veh-hrs/yr
				55.5	x365	20257.5

Fuel Consumption	Estimated gal/hr	*NYCDOT*	Max Speed (mph)
Catamaran	55	*87*	28.4
Monohull	90	*108*	22.7

Catano - Old San Juan

	one way trips/day	distance (miles)	total distance	trip time (min)	total time (hrs)	avg speed (mph)	Annual Veh-miles
Catano	87	1.25	108.75	6	8.7	12.5	39693.75

Fuel Consumption = Average Speed/Max Speed*Max Consumption

	trips	gal/hr	Catamaran gal/day	Monohull gal/day	Expenditure Daily Cost
Catamaran	41	24.2	99.2		$109
Monohull	46	49.5		227.7	$250
					$360

365 days a year **$131,258** **Percentage 40.5%**

Hato Rey - Old San Juan

	one way trips/day	distance (miles)	total distance	trip time (min)	total time (hrs)	avg speed (mph)	Annual Veh-miles
Hato Rey	50	4.25	212.5	13	10.8	19.6	77562.5

	gal/hr	Catamaran gal/day	Expenditure Daily Cost
Catamaran	38.0	411.4	$453

Catano - Hato Rey

	one way trips/day	distance (miles)	total distance	trip time (min)	total time (hrs)	avg speed (mph)	Annual Veh-miles
Hato Rey	8	4.5	36	14.5	1.9	18.6	13140

	gal/hr	Catamaran gal/day	Expenditure Daily Cost
Catamaran	36.0	69.7	$77
		481.1	$529

365 days a year **$193,160** **Percentage 59.5%**

Total Daily Fuel (gal) 808.02

Estimated Annual Figures		Annual Revenue Veh-hours	Annual Revenue Veh-miles
Total Fuel (gal)	294,926		
Total Cost	$324,418	20,258	130,396

Vehicle Maintenance Expenses Estimation

Formula : 2.7% of purchase price + 1.8% of purchase price*(daily operating hours/vessel)/5 hours

	Catamarans	Monohulls
Estimated Value	$2,500,000	$3,000,000
Estimated Underway Hours per day		
Catano - Old San Juan	4.1	4.6
Hato Rey - Old San Juan	12.7	
	16.8	4.6

These estimated vessel values are based on the 1992 NYC estimates, adjusted upwards to account for changes in replacement costs, which have increased over the past six years.

Expenditure is then:

		2.7%	1.8%*Op Hrs	
	Catamarans	$67,500	$9,000	**Total**
		x6	16.8	
Summing up over all operating hours and vessels, so that number of vessels drops out of the equation		$405,000	$151,200	$556,200
		$81,000	$10,800	
	Monohulls	x3	4.6	
		$243,000	$49,680	$292,680

Total Estimated Annual Vehicle Maintenance Expenditure $848,880

To account for Double-Counting Labor Expenses

Actual Vehicle Maintenance Expenditures - 1995 NTD	
Labor	$144,254
Fringe Benefits	$318,559
Services	$468,718
Materials-Fuel	$240
Materials-other	$35,027
Casualty&Liability	$16,521
Misc. Expenses	$5,563
Total Expenses	$988,882

Of this amount, a large proportion is due to employee expenses $462,813

47%

The remainder is then $526,069

53%

Allocating Maintenance Expenditures by Route

Differentiating for the two vessel types and subtracting labor

		53%	
Fleet Upkeep (2.7%)	$648,000	$344,725	76.3%
Catano - OSJ Operation	$86,580	$46,059	10.2%
Hato Rey - OSJ Operation	$114,300	$60,806	13.5%
	$848,880	$451,590	100.0%

Cost Estimation and Allocation by Route

Proportional Costs by Route
Apply percentages and/or figures to actual expenditures to come up with proportional estimate

Estimated Expenditures - F.Y. 96-97

		Sub-Total
Operational Labor & Fringe Benefits	$2,793,804	
Maintenance Labor & Fringe Benefits	$1,797,036	
Maintenance Repairs	$644,259	
Diesel and Fuel Expenses	$348,166	$5,583,265
Police Services	$229,497	
Professional Services	$154,314	
Material Supplies	$78,706	
Telephone Expenses	$39,617	
Heat Light & Power	$70,369	
Water & Sewer Expenses	$47,717	
Insurance Expenses	$280,636	
Litigation Expenses	$315,000	$1,215,856
Total	$6,799,121	

Calculated Expenditures	Total	Hato Rey Allocation	%
Employee Expenditures	$4,102,184	$1,712,822	41.8%
Fuel Expenditures	$324,418	$193,100	59.5%
Maintenance (w/o Labor)	$451,590	$60,806	13.5%
Totals	$4,878,192	$1,966,728	40.3%

Allocated Expenditures	1996-97 Estimate	Hato Rey Allocation %	Hato Rey
Employee Expenditures	$4,590,840	41.8%	$1,916,855
Fuel Expenditures	$348,166	59.5%	$207,235
Maintenance	$644,259	*	$258,991
Other	$1,215,856	40.3%	$490,194
Totals	$6,799,121		$2,873,275

* Maintenance = Hato Rey costs + Fleet Upkeep *overall Hato Rey %

Overall Hato Rey % Allocation 42.3%

Estimated Route Performance Measures

	F.Y. 96-97 Estimate	Catano	Hato Rey
Ridership held constant	1,262,718	1,208,980	53,738
Allocated Cost	$6,799,121	$3,925,846	$2,873,275

	F.Y. 96-97 Estimate	Catano Allocation	Hato Rey Allocation
Revenue Vehicle Miles	130,396	39,693	90,703
Revenue Vehicle Hours	20,258	10,768	9,490
Service Efficiency			
Operating Expense/ Revenue Vehicle Mile	$52.14	$98.91	$31.68
Operating Expense/ Revenue Vehicle Hour	$335.63	$364.58	$302.77
Cost Effectiveness			
Operating Expense/ Passenger Mile	$3.91	$2.60	$12.58
Operating Expense/ Unlinked Passenger Trip	$5.38	$3.25	$53.47
Service Effectiveness			
Unlinked Passenger Trips/ Revenue Vehicle Mile	9.68	30.46	0.59
Unlinked Passenger Trips/ Revenue Vehicle Hour	62.33	112.28	5.66
Passenger Miles/ Revenue Vehicle Mile	13.34	38.07	2.52
Farebox Recovery Ratio	9.48%	15.40%	1.40%
Passenger Miles	1,739,612	1,511,225	228,387
Passenger Revenue	$644,794	$604,490	$40,304

Acuaexpreso Estimated Expenditure per Hour

Port Authority F.Y. 96-97 Hourly Estimated Expenses
Based on operating hours/day

	Catano San Juan	Hato Rey San Juan	Daily Total
Approximate Hours/day	16.5	14	
Operational Labor & Fringe Benefits	$236.58	$267.89	$7,654.03
Maintenance Labor & Fringe Benefits	$152.17	$172.31	$4,923.15
Maintenance Repairs	$54.55	$61.77	$1,764.86
Diesel and Fuel Expenses	$29.48	$33.38	$953.74
Police Services	$19.43	$22.00	$628.60
Professional Services	$13.06	$14.79	$422.55
Material Supplies	$6.66	$7.54	$215.45
Telephone Expenses	$3.35	$3.79	$108.34
Heat Light & Power	$5.95	$6.74	$192.54
Water & Sewer Expenses	$4.04	$4.57	$130.64
Insurance Expenses	$23.76	$26.91	$768.78
Litigation Expenses	$26.67	$30.20	$862.86
Total (without depreciation and amortization)	$575.70	$651.89	$21,955.25

Reallocate between Routes

	67%	33%
Fixed Costs per Hour		
Police Services	$25.52	$14.82
Professional Services	$17.16	$9.96
Material Supplies	$8.75	$5.08
Telephone Expenses	$4.40	$2.55
Heat Light & Power	$7.82	$4.54
Water & Sewer Expenses	$5.30	$3.08
Insurance Expenses	$31.22	$18.12
Litigation Expenses	$35.04	$20.34
	$135.21	$78.49
Variable Costs per Hour		
Operational Labor & Fringe Benefits	$310.80	$180.42
Maintenance Labor & Fringe Benefits	$199.91	$116.05
Maintenance Repairs	$71.66	$41.60
Diesel and Fuel Expenses	$38.73	$22.48

Allocate between Terminal and Vessel Operation

(Based on Estimated Ratios)	Terminal	Vessel
Operational Labor & Fringe Benefits	51%	49%
Maintenance Labor & Fringe Benefits	77%	24%
Maintenance Repairs	77%	24%
Diesel and Fuel Expenses		100%

	Catano San Juan		Hato Rey San Juan	
	Fixed	Vessel	Fixed	Vessel
Fixed	$135.21		$78.49	
Operational Labor & Fringe Benefits	$159.19	$151.61	$92.41	$88.01
Maintenance Labor & Fringe Benefits	$152.93	$46.98	$88.77	$27.27
Maintenance Repairs	$54.82	$16.84	$31.82	$9.78
Diesel and Fuel Expenses		$38.73		$22.48
	$502.15	$254.16	$291.49	$147.54

Terminal Operating Costs	Catano San Juan	Hato Rey San Juan
Hour	$502.15	$291.49
Day	$8,285.50	$4,080.92
Year	$3,024,207	$1,489,535
Vessel Operating Costs		
Hour	$127.08	$73.77
Two/day	$4,193.59	$2,065.50
Year (two)	$1,530,661	$753,908
Total Annual Cost	$4,554,868	$2,243,443
Combined Annual Cost	$6,798,311	
Port Authority Estimation	$6,799,121	

Estimated Schedule Hourly Costs

	headways (minutes)	catamarans	monohulls	Total # of trips
Catano - Old San Juan	30	1		4
	15		2	8
	15	2		8
	10	1	2	12
	10	3		12
Hato Rey - Old San Juan	30	2		4
	20	2		6
	15	3		8
Catano - Old San Juan - Hato Rey	30	2		*4*
	20	3		*6*
Catano - Hato Rey	20	2		6

	Operating Cost/hour	Each Additional Pair of Voyages
Catamaran	$75	$30
Monohull	$125	4 triangular trips = 6 regular trips

* including one round trip

	headways (minutes)	Vessel Costs	Additional Trips	Hourly Cost
Catano - Old San Juan	30	$75	2	$105
	15	$250	4	$310
	15	$150	4	$210
	10	$325	6	$415
	10	$225	6	$315
Hato Rey - Old San Juan	30	$150		$150
	20	$150	2	$180
	15	$225	2	$255
Catano - Old San Juan - Hato Rey	30	$150	*2*	$180
	20	$225	*3*	$270
Catano - Hato Rey	20	$150	2	$180

Appendix D. Travel Demand Analysis

In support of *Tren Urbano*, forecasts of travel demand and modal choice have been prepared for the San Juan Metropolitan Area for 2010. This data can be used to identify travel demand for the regions served by *Acuaexpreso*, including both Old San Juan and the remainder of the Isleta de San Juan, the region most limited in accessibility by the road network.

D.1 Travel Demand Zones

The SJMA is divided into a series of zones for travel demand estimates, based on census tracts and other divisions. Based on location, employment, and population, travel demand can be estimated for the rest of the SJMA. The zones used in the analysis of the local or walk-on customer market for *Acuaexpreso* are summarized in Table 5-1, and outlined on the attached maps.

Table D-1 Local Zones Summary

Old San Juan

TAZ	Cent	POP-2010	EMP-2010
N010	1	32	0
N011	2	85	1,086
N012	3	45	519
N013	4	282	99
N014	5	248	178
N015	6	41	2,408
N016	7	186	1,521
N017	8	334	0
N018	9	153	198
N019	10	37	667
N021	11	983	0
N031	12	859	42
N032	13	659	0
N041	14	0	501
N042	15	12	663
N043	16	596	2,056
N046	19	370	454
		4,922	10,392

Hato Rey

S020	109	3	362
S025	114	620	11,176
S041	120	1,530	1,941
S042	121	3,327	33
		5,480	13,512

Cataño

TAZ	Cent	POP-2010	EMP-2010
G011	460	3,134	190
G021	461	4,428	1,593
G032	463	2,496	131
K061	541	1,011	40
K062	542	266	0
K063	543	2,474	0
K064	544	355	700
K073	547	88	549
K074	741	0	143
		14,252	3,346

Isleta (-)

N044	17	90	1247
N045	18	3403	669
N051	20	23	3,644
N052	21	1,959	4,518
N053	22	1,307	615
N054	23	994	938
N055	24	79	162
N056	25	4	48
		7,859	11,841

These travel demand between these regions, and to and from the remaining municipalities and regions in the SJMA, can be summed to arrive at total travel demand to and from the Isleta, as well as modal split for the travel flows.

D.2 Local Travel Demand

A travel demand matrix for the areas in the immediate vicinity of the ferry terminals plus the remainder of the Isleta de San Juan is presented in Table D-1. The three regions used in the table cover those areas within a close distance of the ferry terminals, and can be considered to be the walk-on passenger market.

Table D-1 Local Travel Demand Matrix for 2010. (AM Peak - All Modes)[1]

Origin\Destination	Old San Juan	Rest of Isleta	Cataño	Hato Rey
Old San Juan			184	790
Rest of Isleta			211	939
Cataño[2]	529	510		627
Hato Rey	840	741	229	

If the Cataño - Old San Juan route could attract 50% of the traffic between the Isleta and Cataño, this would be approximately 720 travelers, or 1,420 trips a day. Similarly, if the Hato Rey - Old San Juan route could pick up 25% of all demand between these two regions alone, this would be approximately 405 travelers, or 810 trips a day.

D.3 Regional Travel Demand

As discussed in Chapter Five, the overall 2010 forecast is for over 115,000 people to be traveling daily to the Isleta de San Juan, including 59,000 to Old San Juan itself. Another 50,000 daily trips will be leaving the Isleta, 23,000 from Old San Juan. The auto is the dominant mode choice, used by approximately 88% of the commuters to and from Old San Juan and 10% of travelers to and from the remainder of the Isleta.

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[1] Travel Demand Information supplied by Cambridge Systematics, December 4, 1997.

[2] Cataño includes the area within roughly ¾ mile of the town center, including the towns of Vietnam, Sabana, and Amelia in the neighboring municipality of Guaynabo; Old San Juan is the old city, occupying roughly the western third of the Isleta de San Juan; and Hato Rey is the area within a quarter mile of the ferry terminal and south of the canal.

Concentrating on the Cataño - Old San Juan route, leaving aside the local market, there are 9,500 travelers predicted to be destined for Old San Juan from the municipalities of Bayamón, Toa Baja, and the remainder of Cataño. In the reverse direction, the number is 2,200. Given 10% transit use, if 90% of the transit users used the ferry, and even 10% of car users could be attracted to the ferry, there would be 4,300 daily riders. In addition, there are similar numbers going to and from the rest of the Isleta. If 50% of these transit users were to use the ferry, another 1,200 daily riders would be added.

For the Hato Rey services, there are 36,500 travelers destined for Old San Juan (leaving aside the Cataño market). Given 12% transit use, 10% of these users would total 437, adding 875 riders a day. In the reverse direction, there are 20,600 travelers leaving Old San Juan (again leaving aside the Cataño market). Given the same percentages this would add another 500 daily riders.

Possible 2010 daily riderships for the two routes are then 6,900 for the Cataño - Old San Juan route and 2,200 for the Hato Rey - Old San Juan route.