TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
TX/90-1930		

4. Title and Subtitle	5. Report Date
Ferry Operations Feasibility Study	June 1991
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
William A. Luker, Jr.	Research Report 1930-1F

9. Performing Organization Name and Address	10. Work Unit No.
Texas Transportation Institute The Texas A&M University System College Station, TX 77843-3135	11. Contract or Grant No. Study No. 2-18-91-1930

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas Department of Transportation - D-18 P.O. Box 5051 Austin, TX 78763	December 1990 Final -May 1991
	14. Sponsoring Agency Code

15. Supplementary Notes

Research Performed for the State of Texas
Research Study Title: Ferry Operations Feasibility Study

16. Abstract

This study has attempted to evaluate the feasibility of recovering some or all of the costs incurred by the Texas Department of Transportation (TxDOT) in providing ferry service free of charge at Galveston-Port Bolivar (GPB) and Aransas Pass-Port Aransas (APPA). Because operating, maintenance, and ferry replacement costs at GPB will be more than five times those at APPA over the next decade, if a toll is imposed at GPB this report recommends that it be structured to recover only 60 percent of those costs. Higher tolls might produce a significant decline in ridership among the out-of-country and out-of-state tourists who make up the vast majority of ferry riders. Local commuters who use the ferry for journeys to work, home, or school would be asked to pay only a small annual fee to use the ferry. A feasible and cheaper alternative to TxDOT's continued operation of the GPB ferry--even with tolls--is to build a bridge from Galveston to the Port Bolivar peninsula. TxDOT could then sell the ferry to the City of Galveston or a private firm who could operate it at reduced levels of service while still maintaining it as a tourist attraction for the Galveston area. At APPA, 100 percent of ferry operation, maintenance, and replacement costs can be recovered with tolls structured at less than $1.00 per vehicle-trip ($2.00 round trip). As in the case of Port Bolivar, local commuters would be asked to pay only a small annual fee, while tourists would be asked to bear the bulk of the costs of operating the ferry. While technically possible, bridge construction at this site would be far more expensive than continued operation of the ferry over the next 20 years, and would pose significant obstacles to ship channel traffic in the area.

17. Key Words	18. Distribution Statement
Ferry service, tolls, user charges	No restrictions. This document is available to the public through the National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	33	

Form DOT F 1700.7 (8-69)

FERRY OPERATIONS FEASIBILITY STUDY

by

William A. Luker, Jr.

Research Report 1930
Research Study Number 2-18-91-1930
Ferry Operations Feasibility Study

sponsored by
Texas Department of Transportation
Maintenance Division (D-18)

Texas Transportation Institute
Texas A&M University System
College Station, TX 77843-3135

June 1991

METRIC (SI*) CONVERSION FACTORS

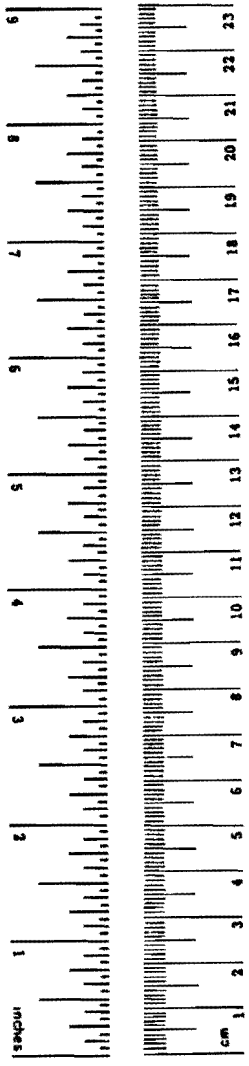
APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	2.54	centimetres	cm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
AREA				
in^2	square inches	645.2	centimetres squared	cm^2
ft^2	square feet	0.0929	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
mi^2	square miles	2.59	kilometres squared	km^2
ac	acres	0.395	hectares	ha
MASS (weight)				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
VOLUME				
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.0328	metres cubed	m^3
yd^3	cubic yards	0.0765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

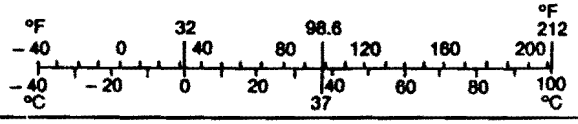


APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
AREA				
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
km^2	kilometres squared	0.39	square miles	mi^2
ha	hectores (10 000 m^2)	2.53	acres	ac
MASS (weight)				
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T
VOLUME				
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



These factors conform to the requirement of FHWA Order 5190.1A.

* SI is the symbol for the International System of Measurements

EXECUTIVE SUMMARY

This study has attempted to evaluate the feasibility of recovering some or all of the costs incurred by the Texas Department of Transportation in providing ferry service free of charge at Galveston-Port Bolivar (GPB) and Aransas Pass-Port Aransas (APPA). The principal findings and conclusions are summarized below.

PRINCIPAL FINDINGS

I. GALVESTON-PORT BOLIVAR FERRY

A. Operating Costs, Revenues, and Tolls

1. The cost of operating the Galveston-Port Bolivar (GPB) ferry system, including maintenance and ferryboat replacement, is estimated at $85.2 million (in 1990 dollars) from 1991 through the year 2000. A critical element of this finding is that while operating and maintenance costs of the GPB ferry are roughly five times those at Aransas Pass-Port Aransas (APPA) over the same period, the GPB ferry carries only 10 percent more traffic than the APPA system.

The principal apparent reason for these disproportionate costs lies in the radically different physical configurations of the two ferry systems. The GPB system operates over a 2.7 mile stretch of open water at the mouth of Galveston Bay, over ten times the distance of the crossing at Port Aransas (approximately one-quarter mile). Ferryboats must navigate across the Houston Ship Channel, one of the busiest sea lanes in the world, and currents (generated by Galveston Bay tides) at the landings on either end of the run are so severe that the boats must routinely carry out extensive docking maneuvers to avoid damaging the boats and the landings. This results in labor and marine equipment costs at GPB that are five times those at APPA.

2. Between 1991 and 2000, the average amount of annual revenue necessary to recover 100 percent of the yearly operating, maintenance, and ferry replacement (i.e., depreciation) costs of the GPB ferry will be approximately $8.5 million. Without ferry replacement, required revenues will be approximately $8 million. In either case, 100 percent cost recovery will require a toll of $4.25 or $4 per vehicle-trip--$8.50 or $8 per round trip. A toll structure that recovers 60 percent of ferry costs would be $2.55 or $2.40

per vehicle-trip ($5.10 or $4.80 per round trip), depending on whether ferry replacement costs are included.

3. The impact on ridership of imposing a toll on the GPB ferry is difficult to predict. Not counting walk-on passengers, traffic volume on the GPB ferry will average approximately 2 million vehicle-trips per year between 1991 and 2000. Approximately 75 percent of this traffic will be generated by out-of-county residents who come to Galveston and make a round trip on the ferry as part of their tour of the area. Unfortunately, since the Texas Department of Transportation (TXDOT) has never charged a toll on the GPB ferry, there is no precise way to calculate the potential impact on ferry ridership of a 100 percent cost recovery (i.e., $8 round-trip) toll. Neither are there examples in the Houston-Galveston area nor in Texas where the effect on traffic volumes of imposing tolls on previously free roads, bridges, tunnels, or causeways can be observed. Because of these circumstances, this study relied on qualitative evidence (interviews, first-hand observation, and educated intuition) to judge the price elasticity of demand for GPB ferry service.

Three groups of ferry riders will be affected differently by a toll: walk-on passengers, tourists, and local residents who use the ferry for journeys to work, home, or school (the latter two groups board the ferry by car). Clearly, the effects of tolls on these three groups' demand for ferry service will differ depending on what percent of ferry operating and depreciation costs TXDOT decides to recover.

*Walk-on passengers: Both 100 and 60 percent cost recovery tolls will virtually eliminate walk-on passengers. According to ferry personnel, most, if not all of this group are teenagers who ride the ferry purely for recreational purposes.

*Tourists: According to ferry personnel, tourist demand for ferry travel will not be significantly affected by either a 100 or 60 percent cost recovery toll. However, a 60 percent toll ($2.40 to $2.55 per vehicle-trip, approximately $5 per round trip) will generate significant revenue and will certainly have less negative effects on ridership than an $8 round-trip toll (the 100 percent cost recovery toll).

*Local residents: Because there is no feasible alternate route to the Port Bolivar peninsula from Galveston, and vice versa, both 100 and 60 percent toll structures will impose a significant hardship on local ferry users. The most direct alternate route to Galveston Island and the Port Bolivar peninsula involves a two to two and one-half hour detour of approximately 133 miles, compared to the 2.7 mile ferry crossing which can be accomplished--depending on the season--in a minimum of 12 to 15 minutes.

These differential impacts lead to the following conclusions about the manner in which GPB tolls should be structured:

(a) in order to avoid the complete elimination of walk-on passengers, tolls for this class of riders should be minimal--$1 per round trip or less;

(b) tourists should be required to pay a toll of $5.00 per round trip (i.e., an approximately 60 percent cost recovery toll); and

(c) local residents should be required to pay only annual or semi-annual tolls, which should not exceed $50 per year.

In addition, this report discusses alternative toll structures involving seasonal, rush-hour, and annual tolls for tourists and local commuters at Port Bolivar. These are relevant to the need to impose different toll structures on tourists and local commuters. Because the estimates of revenue derived from these types of tolls are based only on assumptions about the character of vehicular traffic at Port Bolivar, this researcher recommends further investigation into the actual number of tourist vehicles using the ferries on a monthly and yearly basis, as well as the number of trips each of those vehicles makes on the ferries during peak tourist months. Finally, axle-configured tolls are briefly examined and are not recommended for either ferry operation.

B. Alternatives to User Charges for Ferry Service

1. The composition of ferry ridership reported in A.3., above, is consistent with the small population and low levels of commercial development on the Bolivar Peninsula, the terminal point of the ferry. Evidence gathered from informal interviews of local residents indicates that prospects for development in the near-to-medium term (5 to 15 years) on the Bolivar Peninsula are not favorable. The ferry, therefore, has and probably will continue to function primarily as a tourist attraction for the Galveston area, and not as an essential link in the transportation network of the Houston-Galveston metropolitan area.

2. Because the ferry is primarily a state-subsidized tourist attraction, it could be replaced with a two-lane bridge capable of handling current and medium-to-long-term traffic volumes. There are no apparent technical problems that might prevent bridge construction. The most reliable current estimate--provided by the District 12 engineering

staff--of the cost of replacing the GPB ferry system with a 2-lane bridge is approximately $50 million, amortized over the 50-year life of the bridge. A 4-lane bridge would cost approximately $83 million. Due to the absence of an agreed-upon design, annual maintenance costs for these bridges are uncertain. In any case, however, they would not exceed $10 million over the life of either bridge. Assuming maintenance costs equal $10 million, the total cost of a 2-lane bridge from Galveston to Port Bolivar would be approximately $60 million, or $1.2 million annually over 50 years. Making the same assumption about maintenance costs, a 4-lane bridge would cost $93 million over 50 years, or $1.86 million annually. Either of these figures compares quite favorably with the $8.5 million annual average cost of ferry service over the next ten years.

3. It is important to note, however, that in its role as a tourist attraction the ferry is an important element in the Galveston economy. While there is no reliable estimate of the income generated for Galveston businesses by tourists who ride the ferry, it is probably not insubstantial given the generally depressed level of economic activity in the immediate area. Wages and salaries of those employed in ferry operations totalled $4.08 million in 1990, and between 1991 and 2000 wage and salary income is expected to amount to approximately $48.3 million. While bridge construction would generate temporary increases in income and employment in and around Galveston, it is likely that these would be more than offset by the multiplied effect of the long-term loss of jobs and income from the cessation of ferry operations.

Given the importance of the GPB ferry for local tourism, employment, and income, then, we suggest that:

(a) the TXDOT pursue plans for construction of a 2- or 4-lane bridge;

(b) and explore the possibility of selling the ferry to the City of Galveston or a private firm. Either the City or the firm could then operate the ferry at levels of service consistent with the ferry's role as a tourist attraction--thereby saving on operating and maintenance costs--while at the same time preserving it as a tourist attraction.

C. Summary of Conclusions and Recommendations

1. If tolls are imposed on the GPB ferry, walk-on passengers should be charged no more than $1.00 per trip, tourists should be charged $5.00 per round trip, and local residents should be charged an annual toll not to exceed $50 per year.

2. If an alternative to tolls is considered, planning for a two- or four-lane bridge should be undertaken, while at the same time a study should be carried out regarding the feasibility of continuing GPB ferry service under the auspices of the City of Galveston or a private firm.

II. ARANSAS PASS-PORT ARANSAS FERRY

A. Operating Costs, Revenues, and Tolls

1. The cost of operating the Aransas Pass-Port Aransas (APPA) ferry system, including maintenance and ferryboat replacement, is estimated at $16 million (in 1990 dollars) from 1991 through the year 2000. As noted above, this is more than five times less than the operating and maintenance costs of the GPB ferry over the same period, although the APPA ferry carries 90 percent of the traffic carried by GPB. The major reason for the cost discrepancy is that the APPA ferry system faces far less demanding physical conditions than does the GPB system, resulting in much lower costs.

Given the relatively low cost of the APPA system, it is possible for TXDOT to recover most, if not all, of the operating and replacement costs of this ferry operation with only a nominal charge to the public.

2. Between 1991 and 2000, the average amount of annual revenue necessary to recover 100 percent of the yearly operating, maintenance, and ferry replacement (i.e., depreciation) costs of the APPA ferry will be approximately $1.6 million. Without ferry replacement, required revenues will be approximately $1.5 million. In either case, the recovery of 100 percent of operating and replacement costs will require a toll of $1.25 or $1.20 per vehicle-trip--$2.50 or $2.40 per round trip. A toll structure that recovers 60 percent of ferry costs would be $.75 or $.72 per vehicle-trip ($1.50 or $1.44 per round trip), depending on whether ferry replacement costs are included.

3. As is the case with the GPB system, there is no precise way to calculate the potential impact on ferry ridership of imposing a toll on the APPA ferry. Not counting

walk-on passengers, traffic volume on the APPA ferry will average approximately 1.7 million vehicle-trips per year between 1991 and 2000. According to estimates made by TXDOT District 16 officials, the approximate composition of ferry traffic is almost identical to that of GPB: 75 percent will be generated by out-of-county residents who come to San Patricio County as their point of departure for Padre Island resorts and 25 percent are local residents who use the ferry for commuting purposes. In contradistinction with GPB, there are very few walk-on passengers at APPA.

Using the same method as that employed in estimating the elasticity of demand for ferry service of GPB ferry riders, then, the likely effects of a toll on the demand for ferry service by tourists and local residents are as follows:

*Tourists: According to ferry personnel, tourist demand for ferry travel will not be significantly affected by either a 100 or 60 percent cost recovery toll. Given that relatively small tolls are required to recover 100 percent of ferry costs, and that the alternate route to Padre Island--through Corpus Christi and across the John F. Kennedy Causeway--is time-consuming and much more expensive than the proposed toll, there is little reason to doubt this assessment.

*Local residents: The demand for ferry service by local residents will likely not be influenced by a toll, especially among those who have no alternative other than the ferry for journeys to work or places of business on Padre Island. However, the institution of either of the proposed toll structures (100 or 60 percent cost recovery) would force local residents to sustain a disproportionate burden of the costs of ferry operations.

These differential impacts lead to the following conclusions about the manner in which APPA tolls should be structured:

(a) While there are only a few walk-on passengers, tolls for this class of riders should be minimal--$.50 per round trip or less;

(b) tourists should be required to pay a toll of $2.50 per round trip (i.e., an approximately 100 percent cost recovery toll); and

(c) local residents should be required to pay only annual or semi-annual tolls, which should not exceed $50 per year.

This report also discusses the feasibility of imposing a 200 percent cost recovery annual toll at Port Aransas as a means of subsidizing the operation of the Port Bolivar ferry. It should be noted that while this is feasible from a technical standpoint, it may prove politically unacceptable.

B. Alternatives to User Charges for Ferry Service

1. Cost estimates for a bridge at Port Aransas are approximately $90 million, over five times the $16 million cost of ferry operations (including ferry replacement costs) over the next decade. In addition, because ship channel traffic currently operates with unlimited vertical clearance, the cost of building a bridge might become prohibitively expensive should a vertical clearance of 450 feet be desired by local fabricators and manufacturers. Given the nominal character of the toll required to recover 100 percent of ferry operating and maintenance costs, and the engineering and cost problems associated with a bridge at the APPA site, construction of a bridge is not recommended.

C. Summary of Conclusions and Recommendations

1. Because revenues required for 100 percent liquidation of ferry operation and replacement costs are low, a small toll--aimed principally at tourists--of approximately $1.00 to $1.25 per vehicle-trip can be imposed at APPA with little or no affect on current ridership levels. Local residents should pay an annual or semi-annual toll of no more than $50.

2. Construction of a bridge at the APPA site is not a cost-effective means of recovering ferry costs or saving money for the State of Texas.

TABLE OF CONTENTS

1. SUMMARY OF TOLL STRUCTURES AND TOLL REVENUES FOR FERRIES OPERATED BY OTHER STATE DEPARTMENTS OF TRANSPORTATION

These data are summarized on Table 1.

We examined ferry systems operated or regulated by Departments of Transportation in the states of Delaware, Louisiana, Massachusetts, New Jersey, North Carolina, Virginia and Washington, and calculated the degree to which toll revenues help defray operating costs. While the average contribution of toll revenues to operating costs is approximately 44%, Table 1 shows that this varies widely, from 7.7% to 105.2 % of operating costs. Most of these systems also receive revenues from investment and concession income, in addition to state subsidies.

2. COST AND FEASIBILITY ESTIMATES OF REPLACING FERRIES WITH BRIDGES AT PORT BOLIVAR AND PORT ARANSAS FERRY CROSSINGS

Cost estimates for bridges at both ferry crossings are summarized on Table 2.

a. PORT BOLIVAR

District 12 engineers regard this bridge as technically feasible. After review of earlier estimates from 1972, 1988, and early 1991, Gene O'Day, P.E., District 12, estimates the cost of a 2-lane bridge at approximately $49.8 million, with a 4-lane bridge at $83 million.

b. PORT ARANSAS

Thomas H. Bell, P.E., District 16, (1/22/91) reports that a bridge is technically feasible, and estimates the cost of a 4-lane bridge at $88.8 million (including $2,000,000 in ROW acquisition costs). This estimate assumes a 225-foot vertical clearance over the ship channel. District engineers report, however, that offshore drilling platforms as tall as 420 feet are routinely towed through the channel at Aransas Pass. A 225-foot vertical bridge clearance might not be adequate for fabricators in the area who currently enjoy unrestricted heights on ships and barges passing through the area. If the U.S. Navy completes its development of a home port at Ingleside, passage of the *U.S.S. Wisconsin* and its support vessels might also be restricted. Presumably, doubling the vertical clearance of a Port Aransas-Aransas Pass bridge to 450 feet would complicate its technical requirements and dramatically increase its cost. Given these considerations, then, it

TABLE 1

FERRY SYSTEM	TOLL *	ANNUAL TOLL REVENUE	ANNUAL OPERATING BUDGET	YEAR	TOLL REVENUE AS A PERCENT OF THE OPERATING BUDGET
Delaware River & Bay Authority (States of Del. & New Jersey)	$ 4.00p $ 16.00v	$ 8,463,913	$ 8,046,470	1988	105.19 %
Louisiana Department of Transportation and Development	$ .25p $ 1.00v	$ 640,000	$ 6,000,000	1990	10.67 %
Louisiana Crescent City Connection Division	$ 0.00p $ 1.00v	$ 521,234	$ 6,000,000	1990	8.69 %
Massachusetts Steamship Authority	$ 4.00p	$ 22,777,131	$ 23,531,104	1988	96.79 %
State of North Carolina DOT	$ 5.00v	$ 1,181,613	$ 15,345,635	1990	7.7 %
Commonwealth of Virginia DOT	$ 3.00v	$ 488,846	$ 3,883,209	1989	12.59 %
State of Washington DOT	$ 3.33p $ 9.33v	$ 59,560,000	$ 77,820,000	1989	76.54 %

* These toll figures represent fares collected for one way trips. For ferry operations with a toll schedule for passengers by age and vehicles by type, one toll has been calculated to represent an average of the passenger fares (p), and one toll has been calculated to represent an average of the vehicle fares (v).

should be understood that a Port Aransas-Aransas Pass bridge is technically feasible only in a narrow sense.

Rymer and Urbanik of TTI prepared an estimate of $94 million for a 4-lane causeway in 1986. Tunnel costs were also estimated. Construction costs exceeded $225 million and maintenance and operating costs were much higher than those associated with the existing ferry service or the proposed bridge or causeway.

Table 2--Cost Estimates of Bridge/Causeway Construction at Port Bolivar/Port Aransas Ferry Systems

Ferry System	Proposed Structure	Cost Estimate	Date Prepared	Prepared by
Port Bolivar	2-Lane Bridge	$49.8 million	5/91	TXDOT Dist. 12
	4-Lane Bridge	$83 million	5/91	TXDOT Dist. 12
Port Aransas	4-Lane Bridge	$88.8 million	1/22/91	TXDOT Dist. 16
	4-Lane Causeway	$94 million	1986	TTI
	4-Lane Tunnel	$225 million	1986	TTI

3. OPERATING AND MAINTENANCE COSTS FOR PORT BOLIVAR AND ARANSAS PASS FERRIES, 1990-2000

Tables 3a, b, c, and d summarize the data presented in this section. Tables 3b and d are of special interest. They show operating and maintenance costs for the two ferry systems, including depreciation charges on new or completely renovated ferryboats. The purchase price of new ferryboats, as a lump-sum, line-item expenditure, is <u>not</u> included as an element in the total costs of ferry operations over the next ten years. Instead, the cost of new ferryboats is added to annual expenditures as an annual depreciation charge amortized over the expected 40-year life of the

vessel. Total line-item expenditures for new ferryboats at Port Bolivar over the next decade will be approximately $24 million; at Port Aransas, $2.4 million (Tables 3b and 3d).

a. PORT BOLIVAR

Table 3a summarizes operating and maintenance costs through the year 2000. These exclude the cost of new ferryboats and include lump sum expenditures for rehabilitation of older ferryboats and shore facilities. Figures for FY 1990 have been provided by TXDOT D-3. Operating costs for 1991 through 2000 are derived by assuming a 2 percent annual increase in ferry traffic volumes (see Section 4, below), and a commensurate 2 percent increase in wages and salaries, marine fuel, and other supplies.

Table 3b also summarizes annual operating and maintenance costs from 1991 through the year 2000, including lump sum payments for ferry overhaul, and annual depreciation on new ferryboats that have recently come into service or are scheduled to come into service during the next decade. Actual purchase prices of new ferries are included in parentheses for the year in which these budgeted expenditures have been or are scheduled to be made. Total costs for ferry operations, including maintenance and depreciation on the ferryboats, are $85.2 million (1990 dollars).

b. PORT ARANSAS

Table 3c summarizes operating and maintenance costs from 1991 through the year 2000. As with Table 3a, these figures exclude the cost of new ferryboats and include lump sum expenditures for rehabilitation of older ferryboats and shore facilities. Figures for FY 1990 have been provided by TXDOT D-3. Similarly, operating costs for the years 1991 through 2000 are derived by assuming a 2 percent annual increase in ferry traffic volumes, and a 2 percent increase in wages and salaries, marine fuel, and other supplies.[1]

Table 3d, like Table 3b, summarizes the annual operating and maintenance costs, including lump sum payments for ferry overhaul and annual depreciation on ferryboats through the year 2000. Purchase prices of new ferries are included in parentheses for the

[1]Actual increases in traffic volume over the last decade have averaged 1.66 percent per year, but the 2 percent figure was used for ease of calculation and to facilitate cost comparisons between Port Aransas and Port Bolivar.

year in which these budgeted expenditures have been or are scheduled to be made. Total costs for ferry operations, including maintenance and depreciation on the ferryboats, are $16 million (1990 dollars).

A complete schedule of depreciation charges on capitalized expenditures for FY 1990 through FY 2000, for both ferry systems, is provided in Appendix A.

Table 3a--Operating Costs, Excluding Ferryboat Replacement, Galveston/Port Bolivar Ferry System, 1990-2000			
Fiscal Year	**Operating Costs**	**Shore/Ferry Rehabilitation**	**Total Costs**
1990	*$6,882,563*	[1]*$950,000*	*$7,832,563*
1991	$7,020,214	[2]$1,500,000	$8,520,214
1992	$7,160,618	[3]$1,000,000	$8,160,618
1993	$7,303,830	[4]$1,150,000	$8,453,830
1994	$7,449,906	$0	$7,449,906
1995	$7,598,904	$0	$7,598,904
1996	$7,750,882	$0	$7,750,882
1997	$7,905,899	$0	$7,905,899
1998	$8,064,016	$0	$8,064,016
1999	$8,225,296	$0	$8,225,296
2000	$8,389,801	$0	$8,389,801
TOTALS	$83,751,929	$4,600,010	[5]$88,351,939

[1] Purchase of new engines for the Gibb Gilchrist ferry
[2] $750,00 for the overhaul of three existing ferries, and $750,000 for replacement of the timber breakwater at Bolivar with a rock breakwater
[3] $1,000,000 to improve existing work docks and add 2 new work docks on the Galveston Island side of the ferry system
[4] $450,000 for expansion of ferry system offices, and $700,000 to overhaul, modify, and repair ferry staging areas
[5] Including costs from FY 1990
Sources: TXDOT Divisions 3 (Finance-Accounting Management) and 18 (Maintenance)

Table 3b--Operating Costs, Including Ferryboat Replacement, Galveston/Port Bolivar Ferry System, 1990-2000				
Fiscal Year	**Operating Costs**	**Shore/Ferry Rehabilitation**	**Ferry Depreciation (acquisition cost-new boat)**	**Total Cost**
1990	*$6,882,563*	[1]*$950,000*	*$146,441 ($0)*	*$7,979,005*
1991	$7,020,214	[2]$1,500,000	$146,441 ([5]$7,500,000)	$8,666,657
1992	$7,160,618	[3]$1,000,000	$333,941 ($0)	$8,494,562
1993	$7,303,830	[4]$ 1,150,000	$333,941 ($0)	$8,787,771
1994	$7,449,906	$0	$333,941 ($0)	$7,783,847
1995	$7,598,904	$0	$521,441 ([6]$7,500,000)	$8,120,345
1996	$7,750,882	$0	$521,441 ($0)	$8,272,323
1997	$7,905,899	$0	$521,441 ($0)	$8,427,340
1998	$8,064,016	$0	$521,441 ($0)	$8,585,457
1999	$8,225,296	$0	$729,916 ([7]$9,000,000)	$8,955,212
2000	$8,389,801	$0	$729,916 ($0)	$9,119,717
TOTALS	$76,869,366	$3,650,000	$4,693,860	[8]$85,213,225

All figures are in 1990 dollars. All Ferry Depreciation figures are derived using a straight-line depreciation method over the typical 40-year service life of a ferryboat.

1 2 3 4 See Table 3a for descriptions of these expenditures.

5 Lump-sum acquisition cost of the 70-car ferry *R.C. Lanier*, acquired in 1991

6 Lump-sum acquisition cost of new 70-car ferry budgeted in FY 1993

7 Lump-sum acquisition cost of new 70-car ferry budgeted in FY 1995

8 All total costs are from 1991 through the year 2000, *excluding* costs in FY 1990.

Sources: TXDOT Divisions 3 (Finance-Accounting Management) and 18 (Maintenance)

Table 3c--Operating Costs, Excluding Ferryboat Replacement, Port Aransas/Aransas Pass Ferry System, 1990-2000			
Fiscal Year	**Operating Costs**	**Shore/Ferry Rehabilitation**	**Total Costs**
1990	*$1,334,335*	*$0*	*$1,334,335*
1991	$1,361,021	$0	$1,361,021
1992	$1,388,241	$0	$1,388,241
1993	$1,416,005	$0	$1,416,005
1994	$1,444,325	$0	$1,444,325
1995	$1,473,211	$0	$1,473,211
1996	$1,502,675	$0	$1,502,675
1997	$1,532,728	$0	$1,532,728
1998	$1,563,382	$0	$1,563,382
1999	$1,594,649	$0	$1,594,649
2000	$1,626,541	$0	$1,626,541
TOTALS	$16,237,113	$0	[1]$16,237,113

[1]Includes costs from FY 1990

Sources: TXDOT Divisions 3 (Finance-Accounting Management) and 18 (Maintenance)

Table 3d--Operating Costs, Including Ferryboat Replacement, Port Aransas/Aransas Pass Ferry System, 1990-2000				
Fiscal Year	**Operating Costs**	**Shore/Ferry Rehabilitation**	**Ferry Depreciation (acquisition cost-new boat)**	**Total Cost**
1990	*$1,334,335*	*$0*	*$73,521 ($0)*	*$1,407,856*
1991	$1,361,021	$0	$73,521 ($0)	$1,434,542
1992	$1,388,241	$0	$73,521 ([1]$1,200,000)	$1,461,762
1993	$1,416,005	$0	$103,521 ($0)	$1,519,526
1994	$1,444,325	$0	$103,521 ($0)	$1,547,846
1995	$1,473,211	$0	$103,521 ([2]$1,200,000)	$1,576,732
1996	$1,502,675	$0	$103,521 ($0)	$1,606,196
1997	$1,532,728	$0	$133,521 ($0)	$1,666,249
1998	$1,563,382	$0	$133,521 ($0)	$1,696,903
1999	$1,594,649	$0	$133,521 ($0)	$1,728,170
2000	$1,626,541	$0	$133,521 ($0)	$1,760,062
TOTALS	$14,902,778	$0	$1,095,731	[3]$15,997,988

All figures are in 1990 dollars. All Ferry Depreciation figures are derived using a straight-line depreciation method over the typical 40-year service life of a ferryboat.

[1] Lump-sum acquisition cost of new 20-car ferry budgeted in FY 1992

[2] Lump-sum acquisition cost of new 20-car ferry budgeted in FY 1995

[3] Excludes costs from FY 1990

Sources: TXDOT Divisions 3 (Finance-Accounting Management) and 18 (Maintenance)

4. TRAFFIC VOLUMES AT THE GALVESTON-PORT BOLIVAR AND ARANSAS PASS-PORT ARANSAS FERRIES

Relevant data from this section of our report is summarized on Table 4.

a. PORT BOLIVAR

From 1980 to 1990, vehicular traffic at the Galveston-Port Bolivar ferry increased at an average rate of 2.15 percent a year. Total traffic volume in 1980 was 1,470,206 vehicle-trips, and in 1990 this had increased to 1,808,125, a cumulative increase of approximately 23 percent for the decade. According to transportation planners at TXDOT D-10, to their knowledge there are no pending commercial, industrial, or government projects of a magnitude large enough to significantly change the rate at which ferry traffic will increase during the coming decade. Projections of population growth rates (prepared by the Department of Rural Sociology at Texas A&M) for Galveston County range from 4.6 to 7.4 percent for the 1990-2000 period. However, there is no data on the contribution of local population growth--and consequent increases in local vehicular traffic--to changes in demand for ferry service. If the 1980-1990 growth rate continues at 23 percent per decade, then, traffic on the ferry will exceed 2.223 million vehicle-trips by the year 2000.

In 1982, average monthly traffic volume was 134,458 autos and 4659 trucks; in 1990, this had increased to 145,794 autos and 4883 trucks. Typically, these averages were exceeded during the months of March (Spring Break for colleges and universities around the state) and May through September. In 1982, ferry loadings during these six months accounted for over 60.01 percent of all of the ferry's yearly vehicular traffic, or 1,001,710 vehicle-trips out of the year's total of 1,669,403. Ridership on the ferry averaged 166,952 vehicles per month during this period. In 1990, ridership during peak seasonal months averaged 179,007 vehicle-trips, accounting for 59.4 percent of total yearly traffic volume (1,074,045 out of 1,808,125 vehicle-trips).

The composition of vehicular traffic on the ferry is dominated by passenger automobiles: on average, throughout the decade, no more than 3.4 percent of the traffic carried in any given month consisted of trucks. There is no data on the axle configurations of these trucks, nor to what extent they are engaged in commercial vs. non-commercial activity. While no hard data exists on the local/non-local (i.e., residents vs.tourists) composition of ferry traffic, Port Bolivar ferry officials estimate that as much as 75 percent of the annual ridership comes from out-of-county and

out-of state tourists, with the remaining 25 percent generated by local commuters and service vehicles.[2]

b. PORT ARANSAS

From 1980 to 1990, vehicular traffic at this ferry increased at an average rate of 1.66 percent a year. Total traffic volume in 1980 was 1,372,534 vehicle-trips, compared to 1,603,010 in 1990 (93 and 88.6 percent, respectively, of the traffic on the GPB ferry). This represented a cumulative growth rate of 16.8 percent for the decade. Earlier in the decade, transportation planners at TXDOT predicted that the development of home port facilities at Ingleside for the *U.S.S. Wisconsin* and its support ships would cause increases in vehicular traffic for most roads in San Patricio county, where the Port Aransas ferry is located. There are, however, no other pending commercial, industrial, or government projects of a magnitude large enough to significantly change the rate at which ferry traffic will increase during the coming decade. Population growth projections for San Patricio County range from 11.4 to 15.8 percent for the coming decade. There is no data, however, on the contribution of local population growth to changes in demand for ferry service. If the growth rate of roughly 17 percent for 1980-1990 continues, therefore, approximately 1.8 million vehicle-trips will be made on the ferry by the year 2000.

In 1982, average monthly traffic volume was 129,255 vehicles of all types. There is no breakdown of autos versus trucks for that year. By 1990, the monthly average vehicle load had increased to 133,562: 130,928 autos and 3031 trucks. As with the Port Bolivar ferry, these averages were typically exceeded during the months of March and May through August. In 1982, ferry loadings during these six months accounted for over 53 percent of all of the ferry's yearly vehicular traffic, or 820,528 vehicle-trips out of the year's total of 1,551,065. Ridership on the ferry averaged 156,091 vehicles per month during these months. In 1990, ridership during peak seasonal months averaged 158,693 vehicle-trips, accounting for 52 percent of total yearly traffic volume (829,203 out of 1,603,010 vehicle-trips).

Data on the composition of vehicular traffic on the Port Aransas ferry is not available for the years 1982-87. For 1988-90, however, as with Port Bolivar, it was dominated by passenger automobiles: on average, for these three years, no more than 2.4 percent (as opposed to 3.4

---

[2] Telephone communication with D. K. Daniels, P. E., Maintenance Engineer, District 12, 4 April, 1991.

percent for Port Bolivar) of the traffic carried in any given month consisted of trucks. There is no data on the axle configurations of these trucks, nor to what extent they are engaged in commercial vs. non-commercial activity. As with the Port Bolivar ferry, officials estimate that approximately 75 percent of ferry traffic is generated by out-of-county and out-of-state commuters, and 25 percent by local commuters.[3]

Table 4--Traffic Volumes at Port Bolivar and Port Aransas Ferry Systems, 1980-1990

Ferry System	Year	Monthly Average Vehicle-Trips	Peak Monthly Average Vehicle-Trips	Total Annual Vehicle-Trips
Port Bolivar	1980	NA	NA	1,470, 206
	1982	139,117	166,952	1,669,403
	1990	150,667	179,007	[1]1,808,125
Port Aransas	1980	NA	NA	1,372,534
	1982	129,255	156,091	1,551,065
	1990	133,562	158,693	[2]1,603,010

[1] Average annual percent change, 1980-1990: 2.15 percent. Cumulative percent change over same period: 23 percent
[2] Average annual percent change, 1980-1990: 1.66 percent. Cumulative percent change over same period: 16.8 percent.
Sources: TXDOT Districts 12 and 16

[3] Telephone communication with Don Mosier, P.E., Assistant Maintenance Engineer, District 16.

5. QUALITATIVE ESTIMATES OF PRICE-ELASTICITY OF DEMAND FOR FERRY SERVICE AT PORT BOLIVAR AND PORT ARANSAS

Perhaps the most important element in determining the feasibility of imposing tolls on ferry service at Galveston and Port Aransas is to calculate the degree to which motorists' demand for ferry service is responsive to price changes. Economists call this concept the "price elasticity of demand" for a good. While we know that demand for a given good or service changes in response to price changes, elasticity tells us the degree to which demand changes. With respect to ferry service, the question of price elasticity becomes: if a toll is charged for ferry service, to what degree will ridership be affected? Will there be a decrease large enough to negate the intent of the toll (i.e., to offset operating costs)?

Normally, calculating the price elasticity of demand for a good involves measuring changes in demand for it over time as a function of price changes. In this case, however, since ferry service has been free of charge to motorists since TXDOT assumed responsibility for it in the 1930s, there is no basis for these kinds of measurements. However, there is another way to approximate the price elasticity of ferry service.

Elementary economics tells us that **in most cases**, if the price of a good increases, the quantity demanded by consumers will fall. This depends, however, **on whether or not there are close substitutes for the good in question, and whether the good is a necessity or a luxury.** If there is a perfect substitute, such as is the case with generic goods like salt, even a very small price increase will result in a very large decrease in demand, as consumers switch from the higher-priced version of the good to the lower priced one. If there are no substitutes, or very imperfect ones, and the good is a daily necessity (such as gasoline or transportation services), then even a large price increase will cause only a very small decrease in demand. For ferry service, then, price elasticity can be approximated by asking whether motorists have other, lower-priced alternatives to using the ferry should they regard a toll as financially onerous.

a. PORT BOLIVAR

There are three classes of riders on the Galveston-Port Bolivar ferry: walk-on passengers, tourists in cars, and local commuters in cars. For local commuters travelling to and from Port Bolivar, there are few alternatives to the ferry. The most direct route involves a three to three and one-half hour detour of approximately 133 miles, compared to the 2.7 mile ferry crossing which can be accomplished--depending on the season--in a minimum of 12 to 15 minutes. Much longer

transit times occur during peak hours and at the height of the tourist season. Assuming that the average late-model car achieves 25 miles per gallon of gasoline, and that gasoline prices stabilize in the near future at $1.00 per gallon, this detour would cost approximately $5 for gasoline, plus the additional cost of the motorist's time. The monetary value of a given motorist's time has been estimated by various researchers, but the best and most recent estimate is approximately $12 per hour for passenger cars and as much as $26 per hour for trucks (McFarland, *et. al.*, 1990, p. 115).

For tourists who come to Galveston and ride the ferry as part of their recreational activities in the area, it is assumed that a nominal charge will not cause a significant reduction in their demand for ferry service. A toll would represent a small fraction of their total vacations budgets, and would be absorbed into their overall tourist-related expenditures in the area.

For walk-on passengers--many of whom are teenagers who make several round-trips on the ferry on any given afternoon--the imposition of a toll would probably significantly reduce their ferry ridership. It should be noted in this regard, however, that none of the calculations related to ferry traffic volume, necessary break-even revenues, or toll structures have included walk-on passengers. Their relatively high price elasticity of demand for ferry service, therefore, is not a factor in our calculation of the overall impact of tolls on ferry ridership.

Conclusions:

For local commuters, price elasticity of demand for ferry service at the Galveston-Port Bolivar site is close to zero. If the toll is less than $5, detouring around the ferry is not an economically viable alternative. There will be little, if any, decrease in ridership as the result of imposing a toll.

For tourists, price elasticity of demand is also very low. Nominal tolls will probably not decrease their demand for service by an appreciable amount.

For walk-on passengers, price elasticity of demand is very high. A toll will significantly reduce their ferry ridership.

b. PORT ARANSAS

There are two main groups of ferry riders at Port Aransas. Local commuters can take an alternative route to Padre Island that involves a detour of approximately 70 miles on state highways in the area. Given that portions of this route pass through developed areas of Corpus Christi, the approximate driving time would be from one and one-half to two hours. During non-peak hours

and in the off-season, the Port Aransas ferry covers the 1/4 mile distance to Aransas Pass in approximately 5 minutes. Much longer waiting times (up to two hours) occur during peak periods. Again, using the same assumptions about average fuel efficiency and gasoline prices as were employed in the Port Bolivar estimate, the cost of the detour can be estimated at approximately $3 for gasoline, plus the monetary value of a given motorist's time, estimated at approximately $12 per hour as in the case of the Port Bolivar ferry. (McFarland, *et. al.*, *op. cit.*, 1990, p. 115). valuation made by the motorist of his or her time. It is therefore presumed that a nominal toll--i.e., under $3--will not discourage ridership from this class of ferry users.

Tourists who might wish to avoid a toll at the Port Aransas ferry can enter Padre Island by driving through Corpus Christi and across the John F. Kennedy causeway. For many, this may already be a preferred port of entry if their destination includes Padre Island National Seashore. However, the most direct route to Mustang Island and its hotels, resorts, and state parks is the Port Aransas ferry. Given that, and the recreational and romantic flavor of the ferry--which many tourists include in their visit because of its novelty--it is assumed that a nominal toll will not reduce ferry traffic from tourists to any substantial degree.

Conclusions:

For local commuters, price elasticity of demand for ferry service at the Aransas Pass-Port Bolivar is close to zero. If the toll is less than $5, detouring around the ferry is not an economically viable alternative. There will be little, if any, decrease in ridership as the result of imposing a toll.

For tourists, price elasticity of demand is also very low. Nominal tolls will probably not decrease their demand for service by an appreciable amount.

6. REVENUES NEEDED TO LIQUIDATE FERRY OPERATING COSTS

Table 5 summarizes annual revenues needed to completely liquidate the operating costs--with and without ferry replacement--of the Port Bolivar and Port Aransas ferry systems. It should be noted that as ferry operating costs rise by 2 percent annually over the next ten years, and as depreciation charges are added as new ferryboats come into service, revenues will need to rise, necessitating annual toll increases. To avoid this complication, revenue calculations have been based on an average of the projected annual operating and ferryboat replacement costs over the next decade.

Table 5--Annual Revenues Necessary to Liquidate Average Annual Operating and Maintenance Costs, 1990-2000, Port Bolivar and Port Aransas Ferries

Ferry	Without Replacement	With Replacement
Port Bolivar	$8.0 million	$8.5 million
Port Aransas	$1.5 million	$1.6 million

7. POSSIBLE TOLL STRUCTURES

a. SINGLE AND ROUND-TRIP TOLLS

Table 6 summarizes a set of single and round-trip toll structures that would provide 100, 80, 60, and 40 percent, respectively, of the revenues necessary to liquidate Port Bolivar and Port Aransas operating and ferry replacement costs. As described in Section 4, roughly 1.8 million vehicle-trips were made on the Port Bolivar ferry in 1990, an annual increase of 2 percent from 1980. If this growth rate remains steady throughout the 1990s, it was projected that approximately 2.2 million trips will be made during the year 2000. Revenue and toll projections for Port Bolivar are therefore based on an average of 2 million vehicle-trips per year from 1991 through 2000. The same reasoning was applied for Port Aransas, and a figure of 1.7 million annual vehicle-trips was arrived at for 1991 through 2000.

Table 6-- Single- and Round-Trip Toll Structures, Port Aransas and Port Bolivar Ferries, 1990-2000

Percent of costs liquidated	Port Bolivar without ferry replacement	Port Bolivar with ferry replacement	Port Aransas without ferry replacement	Port Aransas with ferry replacement
100 percent	$4.00 per vehicle-trip, $8.00 round trip--100% of costs	$4.25 per vehicle-trip, $8.50 round trip--100.3% of costs	$.88 per vehicle-trip, $1.76 round trip--100% of costs	$.94 per vehicle-trip, $1.88 round trip--100% of costs
80 percent	$3.20 per vehicle-trip, $6.40 round trip--79.7% of costs	$3.40 per vehicle-trip, $6.80 round trip--80.3% of costs	$.70 per vehicle-trip, $1.40 round trip--80% of costs	$.75 per vehicle-trip, $1.50 round trip--80.6% of costs
60 percent	$2.40 per vehicle-trip, $4.80 round trip--60 % of costs	$2.55 per vehicle-trip, $5.10 round-trip, 60% of costs	$.53 per vehicle-trip, $1.06 round trip, 60% of costs	$.56 per vehicle-trip, $1.12 round trip, 60% of costs
40 percent	$1.60 per vehicle-trip, $3.20 round trip--40% of costs	$1.70 per vehicle-trip, $3.40 round trip--40% of costs	$.35 per vehicle-trip, $.70 round trip, 40% of costs	$.38 per vehicle-trip, $.76 round trip--40% of costs

The fare structures summarized above have one important problematic dimension: they may unfairly burden local residents for whom ferry service is a daily necessity rather than a seasonal luxury associated with a vacation on Galveston or Padre Islands. This potential inequity might be mitigated by imposing annual or seasonal tolls. These two types of tolls are discussed in the following two sections.

b. ANNUAL TOLLS

Revenue projections from annual tolls at Ports Bolivar and Aransas are summarized on Table 7. These projections are based on estimates--presented earlier in Section 4--that approximately 75 and 25 percent of the traffic on both ferries is generated by tourists and local

commuters, respectively. Given this distribution, there may be three advantages to imposing annual tolls at Ports Bolivar and Aransas:

(1) Local residents would pay only once a year to use the ferry, relieving them of the unfair burden of paying a toll each time they were required to cross on business or family matters. With a relatively small amount of additional data collection, tolls could be structured in order to accurately reflect the contribution of local commuters vs. tourist traffic to ferry costs.

(2) Tolls could be easily and inexpensively collected. At the ferry landings, motorists would pay once a year for a sticker that would be placed on their front or rear windshields. Ferry staging areas would not require extensive redesign and construction to accomodate toll plazas, and relatively little specialized equipment would be required for toll collection. (See Section 8, below, for cost estimates of toll collection systems.)

(3) Since operating and replacement costs at the Port Aransas ferry are less than 20 percent of those at Port Bolivar, lower annual tolls can be charged at Port Aransas while providing revenues approximately double those necessary to liquidate all operating costs. The additional revenues--in this case, approximately $1.5 million--can be used to reduce the toll and help liquidate as much as 84 percent of operating costs at Port Bolivar. The proposed annual $15.00 toll at Port Bolivar raises approximately $5.6 million; the additional $1.5 million raised from Port Aransas, added to the $5.6 million raised at Port Bolivar equals $7.1 million, or 83.5 percent of Port Bolivar operating and ferry replacement costs.

A cautionary note should be sounded, however. Estimates of ferry traffic composition--75 percent tourist, 25 percent local--are believed to be reliable. The translation of those figures into approximate vehicle counts, crucial when considering an annual toll, is based on reasonable but still arbitrary assumptions. This researcher recommends further research into the actual number of tourist vehicles using the ferries on a monthly and yearly basis, as well as the number of trips each of those vehicles makes on the ferries during peak tourist months.

Table 7--Projected Revenue from Annual Tolls, Port Bolivar and Port Aransas Ferries

Costs, Vehicles, Tolls, Revenues	Port Bolivar	Port Aransas
Average Annual Operating Costs, 1991-2000[1]	$8.5 million	$1.6 million
Approximate Annual Number of Tourist Vehicles[2]	375,000	325,000
Proposed Annual Tourist Toll	$15.00	$10.00
Projected Annual Revenue from Tourist Vehicles	$5.62 million	$3.25 million
Approximate Annual Number of Local Vehicles[3]	950	800
Proposed Annual Toll for Local Vehicles	$5	$5
Projected Annual Revenues from Local Vehicles	$4750	$4000
Total Revenues from Annual Tolls	$5.625 million (66% of operating costs	$3.254 million (217% of operating costs)

[1] From Table 5. Includes ferry depreciation charges.

[2] Defined as ferry users residing outside of Galveston and San Patricio Counties. Assumptions used to calculate these figures: (Port Bolivar) 75 percent of 2 million annual vehicle-trips = 1.5 million trips, with each vehicle making four one-way trips = 375,000 vehicles; (Port Aransas) 75 percent of 1.7 million annual vehicle-trips = 1.3 million trips, with each vehicle making four one-way trips = 325,000 vehicles.

[3] Defined as ferry users residing in Galveston, San Patricio, and Nueces Counties. Assumptions used to calculate this figure: (Port Bolivar) 25 percent of 2 million annual vehicle-trips = 500,000 trips, divided by 12 months, 22 working days per month, and two trips per day = 950 vehicles. (Port Aransas) 25 percent of 1.7 million annual vehicle trips = 425,000 trips, divided by 12 months, 22 working days per month, and two trips per day = 804 vehicles.

Sources: TXDOT D-3, D-18, and Districts 12 and 16.

c. SEASONAL AND RUSH HOUR TOLLS

Another way to structure tolls at Ports Bolivar and Aransas is by charging different tolls at different times of the year and day. Higher tolls could be charged during peak demand months, thereby shifting some of the increased costs of ferry service during this period to the tourists who comprise almost the entirety of the increased ridership. To illustrate the feasibility of this type of toll structure, a seasonal fare structure for Port Bolivar is proposed on Table 8. Higher tolls are charged for ferry service during peak tourist months, thereby shifting some of the toll burden from local residents to tourists during this period. The toll would raise approximately $5.1 million annually, or roughly 60 percent of the annual average operating costs (including depreciation charges for ferry replacement) as presented on Table 5. Eighty percent of the $5.1 million, or $4.08 million, would be raised during the peak months of March and May through September. Historically, this is the period which accounts for approximately 60 percent of annual ridership.

The feasibility of a seasonal toll at Port Aransas, however, is more difficult to assess. From Section 4 we saw that while ridership on this ferry system increased during the months of March and May through September, traffic volume during this period comprised only 52 percent of yearly ridership. This does not reflect in any real sense a "peak" season, because half of the annual ridership is accounted for during half of the year.

Rush-hour tolls at both ferry systems are also problematic. Estimates from Maintenance Engineers at Ports Bolivar and Aransas are that 1000 and 800 local vehicles, respectively, use the ferries for daily commutes to work on a year-round basis. Presumably, these vehicles use the ferry during typical rush hours: 7 to 10 A.M. and 4 to 7 P.M. One of the major tenets of this report is that local ferry users should not be made to bear unfair burdens if tolls are placed upon ferries that are used primarily by tourists. Unless TXDOT wishes to alter local commuting patterns by imposing burdensome tolls on Galveston, San Patricio, and Nueces County residents--and there is no reason to believe that imposing rush-hour tolls would have any affect on the behavior of commuters, given the absence of feasible alternative routes to Galveston and Padre Islands (see Section 5) above--a rush-hour toll is neither fair nor feasible as a significant revenue-raising alternative.

Table 8--Projected Revenue from Seasonal Toll, Port Bolivar Ferry System	
Projected Annual Average Traffic Volume, 1991-2000	2 million vehicle-trips per year
Projected Average Monthly Traffic Volume, 1991-2000[1]	166,000 vehicle-trips
Projected Average Monthly Traffic Volume, 1991-2000, Peak Tourist Months[2]	200,000 vehicle-trips
Proposed Peak Seasonal Toll	$3.40 per vehicle-trip ($6.80 round-trip)
Proposed Off-Peak Seasonal Toll	$1.28 per vehicle-trip ($2.56 round-trip)
Projected Annual Revenue from Peak Seasonal Toll	$4.08 million
Projected Annual Revenue from Off-Peak Seasonal Toll	$1.024 million
Projected Total Revenue from Seasonal Toll Structure	$5.104 million (60% of average annual operating/replacement costs)

[1] Two million annual vehicle-trips divided by 12 months.
[2] 60 percent of 2 million annual vehicle-trips, divided by six months.

d. AXLE-CONFIGURED TOLLS

As noted in Section 4, vehicular traffic on both ferry systems is dominated by passenger automobiles. To recapitulate, between 1982 to 1990 no more than 3.4 percent of monthly traffic on the Port Bolivar system consisted of trucks; for Port Aransas between 1988 and 1990, no more than 2.4 percent. Given these percentages, we can project an average monthly number of vehicle-trips by trucks from 1991-2000 at approximately 5,600 at Port Bolivar and 3,300 at Port Aransas. If we assume that 80 percent of these trips are made by trucks engaged in local economic activity, then approximately 100 trucks use the Port Bolivar ferry for commercial purposes on any given

day during the year, and 60 are engaged in similar activities on the Port Aransas ferry.[4] Again, as noted earlier, there is no data on the axle configurations of these trucks, and the percentage of them that are engaged in commercial activity is a matter of conjecture. The absence of this data makes it difficult to discuss the feasibility of or propose a set of axle-configured tolls. Nevertheless, it is obvious from the data that is available that imposing tolls for different truck axle configurations would not bring in substantial amounts of revenue above that raised from two-axle passenger vehicles.

8. TOLL COLLECTION METHODS AND COSTS

a. FEASIBILITY OF INSTALLING TOLL COLLECTION SYSTEMS

There have been separate evaluations of the Port Bolivar ferry landings by representatives of two competing toll systems equipment companies (Mr. Gary Milliken of Cubic Toll Systems, Inc., and William F. Ginegaw, Vice President & General Manager of Automatic Revenue Collection Group). Both have determined that minimal equipment, effort and expense would be necessary to construct a toll collection system at the Port Bolivar ferry landings.

Operating costs and waiting times could be minimized by placing the toll collection system at the crossroads on the approach road rather than collecting tolls at each of the six staging lanes or on the ferry itself. This would allow for minimum manpower and would also keep the staging area full and ready for ferry loading.

As for Port Aransas, it should be noted that prior to the takeover of the ferry by TXDOT in 1968, tolls were charged by San Patricio County. The ferry staging area is therefore already designed to accomodate a toll collection system. It could be placed on the approach lane before vehicles reach the staging area. Tolls would be collected before the vehicles loaded the ferry.

---

[4] 80 percent of 5,600 = 4480, divided by 22 working days = 203 trips per day, divided by two trips for each vehicle = 100 vehicles. Similarly, for Port Aransas, 80 percent of 3,300 = 2,640, divided by 22 working days = 120 trips per day, divided by two trips per vehicle = 60 vehicles.

b. TOLL COLLECTION METHODS AND APPROXIMATE INSTALLATION COSTS

There are a variety of toll collection methods that might be appropriate for the Port Bolivar and Port Aransas ferries. Should TXDOT decide to impose a toll at either of these locations, the choice of the toll collection method will depend in large part on the toll structure adopted and the topography of the ferry landings. The following is a brief description of three of the most widely used collection systems, and the toll structures to which each seems appropriate. Table 9 summarizes the approximate installation costs of these systems.

Table 9--Cost Estimates for Installation of Toll Collection Systems at Port Bolivar and Port Aransas Ferries

Collection System	Installation Cost
Automatic Vehicle Identification	$30,000 per lane
2 Automatic Lanes (coin hoppers)	$160,000 ($80,000 per lane)
2 Attended Lanes	$30,000 ($15,000 per lane)

Source: Texas Turnpike Authority, Cubic Autotmatic Revenue Collection Group

(1) Electronic toll collection system

The advance of Automatic Vehicle Identification (AVI) technology enables the collection of tolls electronically without causing the patron to stop and pay tolls on site. A passive electronic device is mounted on the antenna of the vehicle. As the vehicle passes the site, the device reads a unique code which is later translated to a billing system that itemizes each transaction for which the patron is billed monthly.

While more information needs to be collected about this system, it appears at first glance to be particularly well-suited for the annual toll structure outlined in Section 7b,

Clearly, it would lessen the inconvenience experienced by daily commuters. If the system could be adapted so that tourists could pay an annual toll and then paste an electronically sensitive sticker on their windshields, it would also be feasible for the large numbers of tourists that frequents the two ferries. Amtech Corporation has successfully implemented this system on the Dallas North Tollway (DNT).

(2) Automatic Lane

This is the most frequently used toll collection method in Texas. An automatic coin hopper is positioned next to the lane where the toll collection occurs. Automatic coin machines reduce labor costs significantly over manned systems, but a toll attendant is still necessary for bill changing unless the coin hopper has automatic bill-changing capabilities. If TXDOT were to adopt single-trip fares, i.e., where ferry patrons pay a toll each time they use the system, an automatic lane method might be appropriate.

(3) Attended Lane

This toll collection method provides great flexibility with respect to fare structure. All vehicles regardless of season, time of day, axle configuration, or local resident vs. tourist may use it because the attendant classifies and charges each vehicle individually. However, if several different vehicle types were serviced by only one attended lane, waiting times may be greater that in an automated system. In order to avoid extended lines, a total of ten (10) full time employees would be required to operate one attended lane, twenty four hours a day, 365 days per year. Additional part time help would be required for the operation of the second booth when used.

Any one or all three of the methods described could be incorporated into a toll plaza at the ferries. An attended lane could service patrons who need to purchase annual tolls, an AVI lane could provide efficient access to the ferry for patrons who have already purchased their annual passes (antenna sensors or windshield stickers), and/or an automatic lane could be installed if TXDOT decided to impose single-trip tolls.

c. ADMINISTRATIVE AND OPERATING COSTS OF TOLL COLLECTION

Administrative and operating costs for toll collection are difficult to estimate. These will depend on the system chosen and the topography of the ferry sites themselves. Table 10 provides a summary of the costs associated with toll collection at various sites around Texas. Estimates are in 1991 dollars. As noted above, both ferry systems can accomodate the installation of toll collection systems with only minimal alterations to ferry staging areas. While the topography at each ferry system appears to be well-suited for installing toll collection systems, more data is necessary in order to accurately assess the cost of operating toll collection systems at Ports Bolivar and Aransas.

Table 10--Operating and Administrative Costs of Toll Collection at Other Toll Collection Sites in Texas

Site	Annual Operating Cost	Number of Vehicle-Trips per Year
Beltway 8 Tollbridge	$800,000	6.02 million
San Louis Pass Bridge	$135,000	350-400 thousand

APPENDIX A

Estimated Depreciation for the Port Aransas and Bolivar Ferries

PORT ARANSAS FERRY SYSTEM

Ferry	Capacity	Acquisition Date	Original Cost	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000
Janie Briscoe	9 Car	1978	$205,007	5,125.17	5,125.17	5,125.17	5,125.17	5,125.17	5,125.17	5,125.17	5,125.17	5,125.17	5,125.17	5,125.17
D.C. Greer	9 Car	1967	$83,000	2,075.00	2,075.00	2,075.00	2,075.00	2,075.00	2,075.00	2,075.00	2,075.00	2,075.00	2,075.00	2,075.00
B.L. Deberry	20 Car	1986	$779,310	19,482.75	19,482.75	19,482.75	19,482.75	19,482.75	19,482.75	19,482.75	19,482.75	19,482.75	19,482.75	19,482.75
J.C. Dingwall	20 Car	1986	$890,237	22,255.93	22,255.93	22,255.93	22,255.93	22,255.93	22,255.93	22,255.93	22,255.93	22,255.93	22,255.93	22,255.93
Mark Goode	20 Car	1989	$983,300	24,582.50	24,582.50	24,582.50	24,582.50	24,582.50	24,582.50	24,582.50	24,582.50	24,582.50	24,582.50	24,582.50
FY 92 Budgeted	20 Car	1993	$1,200,000				30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00
FY 95 Budgeted	20 Car	1997	$1,200,000								30,000.00	30,000.00	30,000.00	30,000.00
TOTAL				73,521.35	73,521.35	73,521.35	103,521.35	103,521.35	103,521.35	103,521.35	133,521.35	133,521.35	133,521.35	133,521.35

BOLIVAR FERRY SYSTEM

Ferry	Capacity	Acquisition Date	Original Cost	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000
Cone Johnson	70 Car	1950	$661,000											
R.S. Sterling	70 Car	1950	$661,000											
E.H. Thornton, Jr.	70 Car	1959	$661,000	16,525.00	16,525.00	16,525.00	16,525.00	16,525.00	16,525.00	16,525.00	16,525.00	16,525.00		
Gibb Gilcrest	70 Car	1977	$5,196,671	129,916.77	129,916.77	129,916.77	129,916.77	129,916.77	129,916.77	129,916.77	129,916.77	129,916.77	129,916.77	129,916.77
Lanier	70 Car	1992	$7,500,000			187,500.00	187,500.00	187,500.00	187,500.00	187,500.00	187,500.00	187,500.00	187,500.00	187,500.00
FY 93 Budgeted	70 Car	1995	$7,500,000						187,500.00	187,500.00	187,500.00	187,500.00	187,500.00	187,500.00
FY 96 Budgeted	70 Car	1999	$9,000,000										225,000.00	225,000.00
TOTAL				146,441.77	146,441.77	333,941.77	333,941.77	333,941.77	521,441.77	521,441.77	521,441.77	521,441.77	729,916.77	729,916.77

Assumptions: The useful life of a ferry is 40 years with no salvage value.
Depreciation is calculated only for full years.

Source: SDHPT Finance Division – Accounting Mgmnt.