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AN INVESTMENT PLANNING ANALYSIS OF THE SOUTH BEACH MOORAGE PROJECT ON YAQUINA BAY

A Report Prepared For

Port of Newport
U. S. Army Corps of Engineers

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with the assistance of
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INTRODUCTION

This paper responds to a request of the Port of Newport and the U.S. Army Corps of Engineers for answers to the following questions concerning the proposed South Beach Moorage Project on Yaquina Bay at Newport, Oregon:

1. What is the probable demand for South Beach moorage space at rates required to cover the annual costs of the new facilities?
2. How many years ahead of demand should the Port and Corps build moorage capacity?
3. What size area should the Corps dredge and protect by a breakwater?
4. What size moorage facilities (i.e., docks) should the Port initially construct?

Each of these questions is answered below.

On the basis of judgement and the data that appeared most reasonable, the following recommendations are made:

1. The Port of Newport should plan to construct the second stage of the South Beach project for opening in 1985, not in 1979 or 1980 as originally planned.
2. The Port of Newport should initially construct docks with a capacity to moor 350 (± 10%) boats.
3. The Corps of Engineers should initially dredge and construct the required breakwater(s) on a scale sufficient to permit 525 (± 10%) boats to moor at South Beach.

The paper is divided into five sections. The first section supplies background information. The second section describes the methodology used to forecast demand and develop data to answer the basic investment planning questions. The third and fourth sections develop the demand estimates, and the fifth section addresses questions concerning the appropriate size and timing of the project.

BACKGROUND

During the past two decades recreational boating has increased in popularity in Oregon as well as throughout the United States. In Oregon, coastal boat basin managements have made substantial capital investments to provide recreational boat moorages facilities, and many Oregon basin managements contemplate even larger investments to satisfy what they presume will be increasing demands for their moorage facilities during the coming decade. In fact, they presume that moorage demands will be sufficiently large, rapidly growing and price-inelastic to justify 50 to 100 percent increases or greater in boat basin capacities and user fees.

For example, the Port of Newport presently intends to construct a new recreational moorage facility at South Beach on Yaquina Bay. When completed this two-stage project would increase the Port's existing 140 recreational boat moorages to 700-800 by a total investment of $4.7 million.[1] About 50 percent will come from the federal government and the remainder from the issue of Port debt to be serviced by moorage rates 150 to 200 percent greater than the current rate of $0.65 per boat-foot per month. The Port of Newport now anticipates that the first stage of the South Beach project will fill rapidly after its scheduled opening in 1977.

Although these expectations may be correct, to date there has been no comprehensive and systematic attempt to analyze the determinants of recreational boat moorage demands on Yaquina Bay. No previous study

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[1] Skidmore, Owings & Merrill, and Corporate Financial Consultants, "Port of Newport South Beach Moorage Project: Financial Feasibility", A Report to the Port of Newport Commission, September 24, 1974.

provides the data base or demand equations needed to predict either the rate of growth in demand or the impact of higher moorage rates on demand. As a consequence, fundamental data required for good investment planning is missing, and its unavailability motivates the following analysis of the proposed South Beach project.

METHODOLOGY

This paper answers certain basic investment planning questions about the South Beach Moorage Project at Yaquina Bay. The analysis proceeds by (1) developing demand functions for South Beach moorage space, (2) predicting the rate of growth in that demand, and (3) applying the Manne-Srinivasan investment-planning model to determine the appropriate size and time-phasing of Port and Corps investments in the South Beach project.[2] This section of the paper describes the methodology and equations used in the analysis, while the following section establishes the parameters of these equations.

The methodology employed here for moorage demand estimation and projection involves analytical derivation of demand functions, extrapolative projection procedures, and extensive use of sensitivity analyses. A continuous multiplicative demand function of the following form is postulated:

$$M_t = k\ P_t^a\ e^{gt} \qquad (1)$$

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[2] Alan S. Manne (ed.), Investments for Capacity Expansion: Size, Location, and Time-Phasing (Cambridge, Mass.: The M.I.T. Press, 1967), chapters 1,2,8, and 9 especially.

where parameters k, a, and g are the constant, own-price-elasticity of demand, and annual growth rate, and the variables M, P, and t correspond to the number of boats demanding moorage space, the monthly moorage rate ($/boat ft.), and the year less 1976, respectively.

Revealed preference theory of consumer demand is applied to early 1976 data on moorage rates, use, and waiting lists on Yaquina Bay to obtain the required estimates of k and a for equation (1). Since simplifying assumptions and approximate data must be used to obtain such estimates, the results of the exercise are uncertain. Therefore, sensitivity analyses are employed to reveal how demand estimates are affected by changes in parameter size, and linear demand functions are developed to provide a check on demand estimates derived from equation (1).

To estimate parameter g in equation (1), we rely on two student studies of recent changes in moorage demand on Yaquina Bay and elsewhere along the Oregon coast, boat ownership trends in Oregon, and various coastal boating activity forecasts for Oregon.[3] These studies conclude that historical annual rates of growth in demand are unlikely to continue in the future. Prospective higher fuel prices and slower rates of growth in population and per capita real income suggest that moorage demand will grow in the late 1970s and 1980s at annual rates of 2 to 5 percent instead of the historical rates of 6 to 9 percent. The view taken here is that, although boat ownership and boating activity are income-elastic, slower

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[3] Stephen Gabriel and Patty Beeson, "A Preliminary Assessment of Moorage and Boat Repair Expansion at Toledo, Oregon," a paper presented to my public expenditure class at O.S.U., December 16, 1975; and a special analysis undertaken by Mr. Gabriel at my request during January 1976.

economic growth and relative price changes disadvantageous to boating activity in the next 15 years will probably mean slower moorage demand growth along the Oregon coast.

Once the parameters k, a, and g are determined, equation (1) becomes a simple vehicle for forecasting future moorage demands with some specified series of future moorage rates. For example, with constant moorage rates over time, equation (1) implies that demand will grow at a constant geometric rate equal to g. This feature of equation (1) is especially useful in the present context because Manne and Srinivasan have established the optimal sequence of investments in plants (subject to economies-of-scale in construction) to satisfy steadily growing demands. In particular, Srinivasan has proved that minimization of the discounted stream of construction costs, where cost as a function of plant size is of the form

$$C = cv^{-b} \quad \text{where} \quad 0 < b < 1, \qquad (2)$$

requires that plants be constructed at equally spaced points in time, the time interval between construction stages, T, also equaling the number of years of excess capacity anticipated at each stage of construction. The optimal time interval T may be determined by solving the equation

$$bg(e^{hT}-1) = h(1-e^{-gT}) \qquad (3)$$

where b is the economies-of-scale parameter, $h = r - bg > 0$, and r is the rate of discount.

The Manne-Srinivasan model is designed to provide rough estimates within which to draw a detailed proposal on the next project to be built.

[4]Manne, op. cit., Chapter 9.

It is intended only to establish the initial premises for a project which, of course, would be more strictly evaluated as its specific features became known. Since the present paper is a preliminary investment analysis of the South Beach Moorage Project, the limitations of the Manne-Srinivasan model as a means of evaluation are less important than its ability to give reasonable, preliminary answers to important planning questions raised by the Port of Newport and the Corps of Engineers.

Therefore, the analysis in this paper concludes by solving equation (3) for T twice: first, to determine how many years ahead of demand the Corps should plan its dredging and breakwater construction; and second, to determine how many years ahead of demand the Port should construct docks. Since the relevant economies-of-scale and discount rates are different for the Port and the Corps, it is not surprising that the appropriate excess capacity associated with each party's initial investment is found to be different. Finally, estimates of the appropriate-sized facilities for the Port and Corps to initially construct, M_i^*, is determined by twice solving the equation

$$M_i^* = M_o (1 + g)^{T_i + 1} \qquad (4)$$

where M_0 = estimated South Beach moorage demand in 1976, T_i = cost minimizing time interval for the Port and Corps, respectively, and $T_i + 1$ (not T_i) is the exponent because the first stage of the project will probably open in 1977.

PARAMETER ESTIMATES

This section presents the analyses and calculation procedures used to estimate the parameters of demand equation (1). These estimates are consistent with *a priori* expectations concerning their magnitudes. Linear demand equations are also developed to provide benchmark estimates for evaluating demand estimates based on equation (1).

Expectations Concerning Own-Price Elasticity

Since there is as yet no appropriate empirical study of the demand for recreational boat moorage on the Oregon coast, expectations concerning the own-price elasticity of moorage demand must be inferred from economic theory and empirical studies of the demand for goods and services used in leisure-time activities. Theory suggests, of course, that the demand for moorage derives from boat owner demands for boating activity. As a consequence, theory also suggests that the own-price elasticity of moorage demand would tend to exceed the own-price elasticity of demand for boat-purchase.[5] There are two reasons for this: (a) annual moorage expense is a relatively small fraction of total annual boating cost (on the Oregon coast perhaps 10 to 25 percent); and (b) the elasticity of substitution between moorage and other services necessary for coastal boating activity is probably low.

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[5]Theory suggests that one elasticity would only "tend to exceed" the other because the "new approach" to consumer behavior has sometimes demonstrated very reasonable exceptions to the conclusion drawn in the text. Since such counter-intuitive cases can only be uncovered and proved in complete detailed models of consumer choice, and I do not now have such a model specified for boating-related decisions, I rely on a relatively intuitive argument to reach the conclusion in the text and simply admit that I may be wrong.

The new approach to consumer behavior, of course, draws a sharp distinction between fundamental objects of choice, called commodities, and market goods. The three basic articles presenting this approach are: Gary S. Becker, "A Theory of the Allocation of Time," *Economic Journal*, 75, no. 229 (September 1965): Kelvin J. Lancaster, "A New Approach to Consumer Theory," *Journal of Political Economy*, 75, No. 2 (April 1966); and Richard Muth, "Household Production and Consumer Demand Functions," *Econometrica*, 34, No. 3 (July 1966)

Although less aggregative studies would be more appropriate, reasonable estimates of the own-price elasticity of boat-purchase demand are provided by the best recent empirical studies of demand for (1) wheel goods, sports equipment, boats, pleasure aircraft, etc. by Houthakker and Taylor, and (2) other durable goods (i.e., other than automobile, furniture, housing equipment, and housing purchases) by Weiserbs.[6] These studies suggest that the long-run own-price elasticity of boat-purchase demand would probably lie between -1.0 and -3.0. A priori it seems reasonable that boat purchases would be price-elastic, although it should be noted that Westin has recently demonstrated that price-elasticity estimates made with the Houthakker-Taylor and similar models are biased downwards.[7] Therefore, I conclude that boat-purchase demand is price-elastic, with an elasticity coefficient somewhere between -1.0 and -2.0, and moorage demand is probably price-inelastic, with a coefficient between -0.4 and -1.0.[8]

Alternative Estimates of Own-Price Elasticity

The revealed preference theory of consumer demand can provide a basis for establishing a set of conservative estimates of the own-price elasticity of moorage demand at South Beach if the following reasonable assumptions are made: (a) the form of the true moorage demand function is well-approximated

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[6] H. S. Houthakker and Lester D. Taylor, Consumer Demand in the United States, 1929-70, 2nd ed. (Cambridge, Mass: Harvard University Press, 1970), p. 125; and L. Philips, Applied Consumption Analysis (New York: North-Holland/American Elsevier, 1974), p. 195.

[7] R. B. Westin; "Empirical Implications of Infrequent Purchase Behavior in a Stock Adjustment Model," American Economic Review, LXV, No. 3 (June 1975), pp. 384-396.

[8] Houthakker-Taylor's estimate of the long-run own-price elasticity of demand for their composite commodity of leisure-related durable goods is -2.4, whereas Weiserbs' estimate is -1.5.

by equation (1); (b) present holders of moorage at the lowest rates would forego their moorage if required to pay the next higher rates currently charged for comparable moorage services; and (c) present and potential future holders of moorage would respond to higher moorage rates similarly to how present holders at the lowest rates may reasonably be postulated to respond to higher rates. Since some present holders of moorage at the lowest rates would undoubtedly be willing to pay the next higher rates if required to do so, elasticity estimates based or assumption (b) are best regarded as conservative.

Given the preceding assumptions, moorage use and rate data from Table 1 may be substituted into equation (1) and estimates of a, the price-elasticity of moorage demand, found. Columns (1) and (2) of Table 1 array the needed data on the total number of recreational boats with annual moorage at the lowest current rates on Yaquina Bay as of January 1976. The upper third of the table gives data for boats moored at the Embarcadero and the Port of Newport's existing North Side facility; these may be assumed to receive services comparable to those that the proposed South Beach facility will provide. The middle and lower thirds of Table 1 present data for all recreational boats now moored on Yaquina Bay near South Beach (i.e., those in upper third of the table) plus those moored up-river but primiarly used for ocean fishing. The $0.90 and $1.00 annual rates are estimates of the rates at which up-river moorage holders, who cross the bar 12 and 16 times per year, respectively, would be indifferent between South Beach and their present moorage locations. These rates include the current annualized moorage rate charged at River Bend for a 25 foot boat plus the estimated additional fuel and time costs associated with up-river as opposed to South

Beach moorage. (Fuel and time are valued at \$0.50 per gallon and \$5.00 per hour, and the up-river location is estimated to require three gallons more fuel and one hour more time per trip across the bar than would moorage at South Beach.)

Given the assumptions and data described above, alternative estimates of the price elasticity of moorage demand were derived using equation (1). These estimates are presented in column (3) of Table 1. To illustrate how these elasticity estimates were obtained, 1976 data from the upper third of Table 1 may be substituted in equation (1) to form the following two equations:

$$140 = k\ (1.50)^{a} e^{gt}$$

$$280 = k\ (0.65)^{a} e^{gt}$$

Solving these equations, one finds $a = -0.83$.[9] Similar equations were formed from the remaining data in Table 1 and solved for a to find the other estimates of price elasticity.

The Basic Demand Equations

Since the price elasticity estimates in Table 1 are in accord with prior expectations (though possibly more elastic than some observers of coastal boating activity might have expected), they provide the basis for our decision to develop demand equations with price elasticities of -0.6, -0.8, and -1.0 for predicting South Beach moorage demand at rates required to cover the annual costs of the proposed facility. Separate sets of demand equations at each elasticity were developed for (a) the 276 recreational boats on the Port of Newport's waiting list in January 1976, and (b) the

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[9] The term $e^{gt} = 1$ when 1976 data is used because $t = 1976 - 1976 = 0$ and $e^{0} = 1$.

TABLE 1

Moorage Rates, Use, and Estimated Own-Price Elasticities of Moorage Demand on Yaquina Bay: January 1976

	Location	Moorage Rates[a] (1)	Number of Boats (2)	Own-Price Elasticity[f] (3)
A.	Near South Beach	$1.50 0.65	140[b] 280[c]	-0.83
B.	All Yaquina Bay (1)	1.00 0.65	406[d] 546[e]	-0.69
C.	All Yaquina Bay (2)	0.90 0.65	406[d] 546[e]	-0.91

[a] Actual rates or calculated as described in text.

[b] Number at Embarcadero.

[c] Number at Embarcadero + North Side.

[d] Number at Embarcadero + Up-River Ocean Fishing Boats (as estimated by Stephen Gabriel, early February 1976).

[e] Number at Embarcadero + Up-River + North Side.

[f] Calculated as described in text.

estimated 266 recreational ocean-fishing boats currently moored up-river at Sawyer's Launching, Yaquina Marina, and River Bend Marina. The constant, k, for each equation was calculated by substituting the data in columns (1), (2), and (3) into equation (1) and solving for k. The results are presented in column (4) of Table 2.

This procedure establishes demand equations that (a) predict the observed rates and use, and (b) have the postulated own-price elasticities. As a consequence, given the assumptions underlying the basic elasticity estimates, equations with the parameters a and k given in Table 2 are appropriate for predicting moorage demand at South Beach.

Alternative Linear Demand Equations

Although the form of equation (1) was selected because of its simplicity and successful application in countless empirical demand studies, it does have one disturbing feature in the present context: it conflicts with common sense by implying positive demands at exceptionally high prices. Since equation (1) is used here to predict moorage demands at rates very significantly above current rates, it therefore seemed appropriate to develop an alternative demand function which would not imply positive demand at very high prices. A linear function of the following form was chosen for this purpose:

$$P_t = P^* + d\, M_t \qquad (5)$$

where P^* is the moorage rate at which demand, M_t, would be zero.

Separate sets of linear demand equations were developed for the 276 boats on the Port of Newport's waiting list and the estimated 266 ocean-fishing boats moored up-river. P^* was alternately assumed to equal \$2.50 and \$3.00 per boat foot, and the equations were required to predict the

TABLE 2

Parameters of Moorage Demand Equations (1) for Yaquina Bay: January 1976

Source of Potential Demand	Moorage Rates (1)	Number of Boats (2)	Parameters[a] a (3)	k (4)
A. Waiting List	$0.65	276[b]	-0.6	213.14
	0.65	276	-0.8	195.54
	0.65	276	-1.0	179.40
B. Up-River Ocean Fishing Boats	0.90[a]	266[c]	-0.6	249.70
	0.90	266	-0.8	244.50
	0.90	266	-1.0	239.40

[a] Calculated as described in text.

[b] Count made by Port of Newport staff, January 28, 1976.

[c] Estimated by Stephen Gabriel, early February 1976.

observed number of boats on the waiting list or moored up-river at the current moorage rates. That is, the slope d reported in column (4) of Table 3 for each equation was calculated by substituting the data in columns (1), (2), and (3) into equation (5) and solving for d.

Although the P^*s postulated in Table 3 are 67 to 362 percent above current moorage rates on Yaquina Bay, they are in fact comparable to rates charged in Southern California and Texas, and to assume still lower P^*s would seem unrealistic.[10] Therefore, linear demand equations with the parameters P^* and d in Table 3 may be expected to generate relatively conservative demand estimates by which to evaluate this study's principal estimates based on equation (1) with the parameters in Table 2.

MOORAGE DEMAND ESTIMATES: 1976

Given the parameters in Table 2, equation (1) may be used to estimate demand for South Beach moorage space in 1976. Table 4 presents these estimates at moorage rates of \$1.50, \$1.75, and \$2.00 per boat foot, which are alternative estimates of the moorage rate required for users to cover annual project costs. The preferred demand estimates here are those at \$1.75 per boat foot.[11]

Two observations are in order concerning the demand estimates in Table 4. First, and most importantly, Table 4 clearly reveals how very sensitive the demand estimates are with respect to changes in the moorage

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[10] See, for example, data reported in John L. Compton and Robert B. Ditton, A Feasibility, Management and Economic Study of Marinas on the Texas Gulf Coast (College Station; Texas: Texas A&M University Sea Grant Program, September 1975).

[11] Skidmore, Owings & Merrill and Corporate Financial Consultants, op. cit., estimate the required moorage rate to be \$1.50 per boat foot. Even allowing for project redesign, however, their estimate appears low in light of recent price changes.

TABLE 3

Parameters of Alternative Linear Moorage Demand
Equations for Yaquina Bay: January 1976

Source of Potential Demand	Moorage Rates (1)	Number of Boats (2)	Parameters[a] P* (3)	d (4)
A. Waiting List	$0.65	276[b]	$2.50	-0.670
	0.65	276	3.00	-0.851
B. Up-River Ocean-Fishing Boats	0.90	266[c]	2.50	-0.602
	0.90	266	3.00	-0.789

[a] Calculated as described in text.

[b] Count made by Port of Newport staff, January 28, 1976.

[c] Estimated by Stephen Gabriel, early February 1976.

TABLE 4

Basic Estimates of Demand for
South Beach Moorage Space: 1976
(Number of boats)

Moorage Rate ($/boat-ft.)	Own-Price Elasticity -0.6	-0.8	-1.0
1.50	363	318	279
1.75	331	281	239
2.00	302	253	208

Note: Estimates based on equation (1) with parameter magnitures given in Table 2.

TABLE 5

Alternative Estimates of Demand for
South Beach Moorage Space: 1976
(Number of boats)

Moorage Rate ($/boat-ft.)	P* $3.00	$2.50
1.50	366	315
1.75	305	237
2.00	244	158

Note: P* = moorage rate at which demand would be zero. The slopes of the linear demand equations used for these estimates are given in Table 3.

rate or assumed own-price elasticity. Although this senstivitity is hardly surprising, it suggests that such estimates be used cautiously in project design and investment planning. Second, the mean of the estimates in Table 4 is 286 boats, a number that closely approximates the 276 recreational boats on the Port of Newport's waiting list in January 1976. As a consequence, the demand for South Beach moorage appears substantial even at moorage rates 130 to 200 percent above the current rate of $0.65 per boat foot at the Port's North Side docks.

How realistic are the demand estimates given in Table 4? Are they simply the result of the particular functional form selected for equation (1)? Would other reasonable demand functions generate radically different demand estimates at moorage rates of $1.50 to $2.00 per boat foot? The concerns which underlie these questions are understandable given the analytical methods used to develop equation (1). Although these concerns cannot be entirely dispelled here, a second set of demand estimates does lend some credibility to the estimates in Table 4.

Table 5 presents an alternative set of demand estimates based on the linear demand equations developed in the previous section. Since these equations have the property that demand ultimately falls to zero as price increases, they tend to predict lower demands at high moorage rates than equation (1). As a consequence, the estimates in Table 5 would be expected to be more conservative than those in Table 4, and a comparison of the tables confirms this expectation. Considerably more important, however, the demand estimates at the preferred (i.e., most likely) moorage rate of $1.75 per boat foot are remarkably similar in the two tables. Therefore, the demand estimates at $1.75 per boat foot in Table 4 provide the basis for the investment planning analysis that concludes this paper.

ESTIMATES OF OPTIMAL PROJECT SIZE AND TIMING

Where economies of scale in construction exist and demand grows at a constant geometric rate, cost minimization over time requires the construction of facilities with T years of excess capacity anticipated at each stage of construction. Manne and Srinivasan have estimated how the optimal T varies with the relevant economies of scale parameter, the expected growth rate, and the investor's discount rate. This section uses their results to determine the cost-minimizing initial investments in docks and dredging for the South Beach project.

Table 6 presents estimates of the number of years ahead of demand that the Port and Corps should build the two major elements of the South Beach project in order to minimize total construction costs. These estimates were obtained by solving equation (3) after substituting the following parameter values:

Port Investment in Docks	Corps Investment in Dredging
b = 0.8 r = 0.05	b = 0.6 r = 0.06125

The economies-of-scale paramters, b, were selected after reviewing a recent study of a proposed marina by Isard, et. al.* The five percent discount rate for the Port's investment in docks equals the interest rate on Port debt to be issued for the project, while 6.125 percent is the rate that the Corps now applies to projects of this type.

*Walter Isard, et. al., Ecologic-Economic Analysis for Regional Development (New York: The Free Press, 1972), pp. 206-211.

TABLE 6

Number of Years of Excess Capacity
Appropriate for South Beach Project,
by Rate of Growth in Demand

Rate of Growth of Demand (percent)	Dredging and Breakwater	Docks
2	12	8
3	12	8
4	13	8
5	13	8

Note: Estimates calculated from equation (3) with parameter values given in text.

Three conclusions may be drawn from the estimates in Table 6. First, both the docks and the sequestered water area protected by the breakwater(s) should be oversized and constructed a significant number of years ahead of demand if costs are to be minimized. Second, although the appropriate number of years to build ahead of demand does not vary much with the rate of growth, the absolute amount of appropriate excess capacity would vary directly and more than proportionately with the rate of growth in demand. (A comparison of the estimates given in Tables 4 and 7 or 8 reveals this clearly.) The third conclusion is stated as my first recommendation.

Recommendation 1. Since dock capacity should be built about eight (8) years ahead of demand, the Port of Newport should initially plan to construct the second stage of the South Beach project for opening in 1985, not in 1979 or 1980 as originally planned.

Tables 7 and 8 present estimates of the cost-minimizing size of South Beach facilities that the Corps and Port should initially construct to minimize project costs over time. These estimates were found by solving equation (4) after setting M_0 equal to estimated moorage demands at $1.75 per boat foot (from Table 4) and T_i equal to the number of years ahead of demand that these facilities should be constructed (from Table 6). The resulting estimates clearly reveal how very sensitive the cost-minimizing size estimates for the South Beach project are with respect to changes in the projected growth rate or assumed own-price elasticity.

Recognizing the sensitivity of the estimates, as well as the multiple assumptions underlying them, recommendations concerning project size are necessarily fraught with uncertainty. Nonetheless, such recommendations are an appropriate outcome of the preceding analysis. It should be recognized, however, that the recommendations are based on a combination of both judgement

TABLE 7

Estimated Cost-Minimizing Initial Corps
Investments in Dredging and Breakwater Construction
(Number of Boats Potentially Moored)

Rate of Growth of Demand (percent)	Own-Price Elasticity		
	-0.6	-0.8	-1.0
2	428	364	309
3	486	412	351
4	573	487	414
5	655	556	473

Note: Estimates calculated from equation (4) with parameters given in Tables 4 and 6.

TABLE 8

Estimated Cost-Minimizing Initial Port
Investments in Dock Construction
(Number of Boats Potentially Moored)

Rate of Growth of Demand (percent)	Own-Price Elasticity		
	-0.6	-0.8	-1.0
2	396	315	286
3	432	367	312
4	471	400	340
5	513	436	371

Note: Estimates calculated from equation (4) with parameters given in Tables 4 and 6.

and objective facts.

Recommendation 2. Since the Port investment in the South Beach project will be very large relative to its current operating budget, the Port has a quite limited ability to bear the burdens of a mistakenly over-large investment. Therefore, I recommend that the Port estimate the future growth in demand relatively conservatively and initially construct docks with a capacity to moor 350 ($\pm$ 10%) boats. (The mean of the estimates at two and three percent growth in Table 8 is 351 boats.)

Recommendation 3. The Corps has the responsibility to view project benefits more broadly than the Port; it also has a greater capacity to absorb the risks of potentially over-sized investments. Therefore, I recommend that the Corps estimate future growth in demand less conservatively than the Port and initially dredge and construct the required breakwater(s) on a scale sufficient to permit 525 ($\pm$10%) boats to moor at South Beach. (The mean of the estimates at four and five percent gorwth in Table 7 is 526 boats.)

In conclusion I should emphasize that the preceding recommendations are based on what I regard to be reasonable expectations of the future. As the future actually unfolds, of course, it is clearly possible that the second stage of dock construction (which I now recommend for 1985) may be appropriately undertaken at an earlier or later date. Similarly, it is conceivable, though I believe very unlikely, that the Corps could justify in the foreseeable future a second major dredging project to expand the capacity of the South Beach facility beyond the recommended 525 ($\pm$ 10%) boat size. Given the physical characteristics of the South Beach site, I suspect that the appropriate ultimate development at South Beach is probably very close to the 525 ($\pm$10%) boat facility recommended above.