The preliminary findings indicate the high percentage of fines in the dredged material is not desirable for a beneficial use plan. Such plans, using direct placement of that material into sites, have a high cost. Placing the material directly in disposal island 3D is more cost efficient. A beneficial use plan may be a consideration in the future using available material in disposal island 3D under another authority to benefit the environment.

Conclusion. The most cost efficient plan for disposal is to place the material into disposal island 3D. The estimated high amount of fine material to be dredged is a costly problem for placement in any other area that has no room for containment. The Tampa Harbor project needs the disposal area capacity for maintenance dredging. The material from the Big Bend dredging is necessary for dike construction to obtain a maximum elevation of 40 feet above mean low water. Based on the estimate of fines and an analysis of excavation quantities at different channel depths, not all deepening and widening plans provide sufficient suitable material for dike construction to the maximum elevation.

The Tampa Port Authority desires the first priority for use of the suitable material to be for dike construction. If dredging produces less fines than now estimated from the excavation, more suitable material would be available for use. The amount of material from the deepening and widening is also a factor in the determination of suitable material. Considering those variables, the first step is to assess the availability of suitable material for dike construction to an elevation of 40 feet above mean low water.

To determine the amount of suitable material to be derived from the dredging, a separation must occur first in a suitable area. A natural process occurs with hydraulic dredging and placement that causes most of the fine material to flow away from the discharge pipe and settle in the most distant area from that point. The suitable material settles with some of the fines nearest the discharge point. Once that natural process is complete, a determination is possible as to the quantity of suitable material for all desired uses. If sufficient suitable material is available, consideration may be possible for both dike construction and future beneficial uses.

DISPOSAL ISLAND 3D DIKING

The available capacity in disposal island 3D with the existing dikes is about 1,362,000 cubic yards (CY)in 1994. An increase in the dike elevation is possible with existing material in the southern end of that island. The amount of suitable construction material is an estimated 1,700,000 CY. That amount is sufficient for construction of a dike to an elevation of about 32 feet above mean low water. The amount of material for excavation at various channel depths and the corresponding dike requirement for that material on disposal island 3D are in table 4.

MAINTENANCE COST EVALUATION

Maintenance on the existing channel, turning basin, and berthing areas involves the removal of shoal material and work on navigation aids to keep them operating. The U.S. Coast Guard estimates the maintenance of navigation aids on the bottom configuration from model testing at $3,000 a year. Estimates of shoaling come from historical records of such work performed at local expense.

TABLE 4

ESTIMATED EXCAVATION AND DIKE QUANTITIES

DEPTH (FEET) 1/	1,000 CUBIC YARDS	DIKE			
	2/	3/	4/	5/	6/
37	1,746	1,100	23	137	
38	1,949	1,230	24	220	2,360
39	2,273	1,430	24	220	2,360
40	2,561	1,610	25	322	2,800
41	2,857	1,800	26	443	3,260
42	3,161	1,990	26	443	3,260
43	3,477	2,190	27	582	3,700
44	3,809	2.40	28	740	4,150
45	4,164	2,620	29	916	4,580

1/ Required depth of dredging or contract depth.
2/ Gross dredging excavation quantity with the required depth plus an allowable of 1 foot.
3/ Silt estimated at 45 percent of dredged material. About 37 percent estimated to settle as fines. Amount of suitable material for dike construction estimated at about 63 percent of the dredged amount.
4/ Dike elevation in feet.
5/ Quantity of material needed to increase dike height over 20 feet in 1,000 cubic yards.
6/ Capacity in 1,000 cubic yards added with only the increase in dike height above 20 feet.

The average annual shoaling from past records is an estimated 60,000 cubic yards on the existing navigation conditions. Based on that information, an expansion in the bottom area with widening increases the potential shoaling area. That quantity spread over the existing bottom area provides a depth of about 0.44 feet of uniform shoaling.

The considered plans will increase the bottom from 3,645,000 to 4,943,000 square feet. That increase in bottom area raises the annual shoaling to about 80,000 cubic yards. That higher value became the basis for future shoaling with improvement. The different depth considerations are not likely to have a significant influence on the amount of shoaling.

The cost analysis is for the removal of about 240,000 cubic yards of accumulated sediment every 3 years. The estimated cost for that removal includes mobilization and demobilization of equipment along with turbidity monitoring. Past records on maintenance of Tampa Harbor indicate the costs of shoal removal are expensive and routinely done in one area at a time. The reasons are budget and environmental windows limiting dredging and disposal operations. Combining maintenance in two areas requires a significant budget and requires a larger environmental window than available for one dredge to complete the work.

Maintenance dredging every 3 years is likely to involve mobilization and demobilization of equipment for a majority of the work during a 50 year period. The combination of maintenance work at Big Bend is at best a possibility once every third cycle. The estimated cost of maintenance every 3 years with equipment mobilization, dredging 240,000 cubic yard, turbidity monitoring, and manatee monitoring is about $2,048,000. The removal of equipment mobilization reduces the cost down to $1,033,000 for removal of 240,000 cubic yards. The price level is April 1996.

The estimated present worth value of each maintenance event every 3 years over a project life of 50 years is $7,016,700 with no equipment mobilization every third cycle. Interest and amortization of that total present worth value at an interest rate of 7.625 percent over the project life produces an average annual equivalent (AAEQ) cost of $549,000 for shoal removal.

ENVIRONMENTAL EVALUATION

An environmental assessment of the dredging area indicates no significant impact on the quality of the human environment from the considered widening and deepening plans. The terminal owners in the area provided the existing manmade navigation features for deep draft vessel movements. They maintain those features for current vessel traffic.

Manatees. They are a threatened and endangered species that do appear in the area during certain seasons. A warm water outfall from the electrical generating plant attracts the manatees in winter months. They tend to congregate in that area which has barriers to separate it from the existing navigation features. Manatees have no easy or direct access from the warm water outfall area to the navigation channels. They normally do not frequent the navigation features as no seagrasses exist in that area for food. No problem with manatees has occurred in previous dredging events. Any dredging contract will include:

- Standard Federal and State manatee protection conditions;
- Provision for a trained biologist, approved by the Fish and Wildlife Service and/or Florida Department of Environmental Protection, to be aboard the dredge;
- No dredging at night during the winter manatee window with the use of a clamshell dredge to do the excavation; and
- Placement of propeller guards on the auxiliary vessels moving supplies and personnel between the dredge and shore.

Birds. There will be no impact to migratory birds if construction takes place between 1 September and 31 January.

Cultural Concerns. The dredging poses no threat to known sites of cultural or historical significance.

TERMINAL FACILITY EVALUATION

Deepening of the channels and turning basin at Big Bend will enable the use of deeper loaded vessels. To handle those vessels, changes are necessary in the berths and terminal facilities. Those changes are non-Federal costs and are identified as associated alternatives with the deepening project. Items that go under that classification include berth deepening, bulkhead modifications, and landside equipment and terminal changes as a result of the improvements.

Phosphate Terminal. To handle deeper loaded vessels at that terminal, the berthing area needs deepening with all channel depth considerations. The bulkhead, adjacent to the berth, is at a design depth that will enable berth deepening to match the channel depths under consideration without modification. Landside equipment and terminals are adequate to handle the prospective ships and cargo with deepening alternatives.

Coal Terminal. The coal terminal will require more extensive modifications. The berthing area needs deepening with all channel depth alternatives. The bulkhead adjacent to the berthing area requires modification to enable deeper berth depths of 36 feet or more. To handle the self-propelled coal carriers in the benefit analysis, the terminal operator indicates the ladder loader needs to be replaced with a new bucket loader. The existing ladder loader was about 25 years old in 1996. The life expectancy is about 30 years. Replacement of the ladder loader is likely to occur under existing conditions in 2001.

FIRST COST ANALYSIS

To complete an economic evaluation for selection of a project depth, an analysis of first costs is necessary for channel deepening and material disposal along with the associated non-Federal costs necessary to obtain the benefits. Associated costs for the considered depths at Big Bend are necessary changes to existing berths and terminal facilities to accrue benefits from deeper loading of vessels. The depths under consideration apply to the bottom configuration in figure 7 and include berthing areas for the deeper draft ships. Quantity estimates on the amounts for excavation are from a 1994 hydrographic survey after maintenance work on the existing navigation features.

Deepening Plan. Each plan involves dredging to a certain depth and placing that material into disposal island 3D. Appendix A provides the engineering aspects considered for dredging and placing material into that island. Appendix F has the engineering aspects of raising the dikes in disposal island 3D for placement of the dredged material. The estimated cost includes the following on all depth considerations:

- Mobilization and demobilization of equipment,
- Dredging and disposal of material from navigation features and berthing areas,
- Dike construction,
- Navigation aids,
- Turbidity and manatee monitoring,
- Preconstruction engineering and design work, and
- Construction management.

Table 5 is an estimate of total first costs at April 1996 price levels for constructing different depths on the channels, turning basin, and berthing areas. The costs include one foot allowable overdepth for dredging inaccuracies. The U.S. Coast Guard provided estimates for placing and maintaining navigation aids. The costs of constructing navigation aids is the same for all depths. That cost includes new inbound and outbound ranges as well as new channel markers.

Associated Costs. The berth and terminal changes necessary for the realization of the benefits are the associated cost items for the various depth considerations. Those costs include dredging of the berthing areas, bulkhead work to enable deeper berth depths, and a replacement crane to unload coal from self-propelled ships. Information for the analysis of the bulkhead and crane replacement came from sources in the study area.

Berthing area and considered project dredging costs are together in that table under the heading of deepening plans. The estimated costs for modifying the coal terminal bulkhead is under the associated cost column heading in table 5 for each depth. The replacement crane for unloading coal from self-propelled bulk carriers was a consideration but a cost analysis indicated the bucket crane was the least cost alternative. That analysis took into account the initial and annual cost on both cranes as well as the remaining life and life expectancy of each one at a market interest rate of 9.75 percent. Unloading rates are not significantly different.

The existing ladder crane is about 25 years old with an estimated life of about 30 years. Replacement of that crane is likely to occur about the year 2001 without the considered navigation improvements. A similar crane has an estimated replacement cost of about $10-12 million. The approximate salvage value on the existing crane is about $595,000. The net cost is about $10.4 million ($11 million minus $595,000 salvage value). The present worth value of that amount from the years 2001 and 2031 to the year 1999 is about $9.16 million at an interest rate of 9.75 percent.

A replacement bucket crane has an estimated value of $5.2 million and a salvage value of $220,000. Using the salvage value of the ladder crane in 1999, the net replacement cost is $4.6 million in that year. The life of the bucket crane is about 27 years. The estimated replacement cost in 2026 is about $4.98 million. The total present worth value in 1999 for the initial and replacement bucket crane in the future is $5.01 million at 9.75 percent.

Maintenance of the two cranes involves routine and major overhaul cost over the projected life. The amounts for each are as follows:

Item	Amounts by Crane Ladder	Bucket
Routine annual maintenance ------	$ 80,500	$300,000
Major overhaul:		
Frequency (years)-	7	8
Cost per event ---	$952,000	$450,000
Average annual equivalent cost --	$172,000	$313,000

The average annual equivalent value of the first cost for the cranes needs to be added to the maintenance cost. Interest and amortization of the total present worth value for a bucket crane ($5.01 million) and ladder crane ($9.16 million) over 50 years at an interest rate of 9.75 percent is an average annual equivalent (AAEQ) value of $493,000 and $902,000, respectively. The combined AAEQ values for maintenance and first cost of the ladder ($1,074,000) and bucket ($806,000) cranes indicate the ladder crane has a higher AAEQ cost than the bucket by $268,000. A new bucket crane adds no additional cost over the without project condition with a ladder loader.

INTEREST DURING CONSTRUCTION

Interest During Construction (IDC) is on the total first cost of channel deepening with the associated costs. Calculation of IDC has several different conventions. The convention, used to calculate the IDC, involved payment at the beginning of every month with the interest (7.625 percent annually) applied at the middle of the month. Construction of the considered channel deepening plans is to be in one contract. Construction of associated items is concurrent with the channel. Interest starts to accrue during Preconstruction Engineering and Design (PED) and stops at the beginning of the base period for project life.

Period zero of the economic life is January 1999 since construction is scheduled for completion in March 1999 with the first full year of the project being the year 2000. PED will start near the end of Fiscal Year 1997 (September 1997). Appendix E provides an example of the detailed breakdown of those costs with respect to time. The distribution of those costs provide the basis for determining the IDC costs for implementation of each depth plan as summarized in table 5.

AVERAGE ANNUAL EQUIVALENT (AAEQ) COST

The total AAEQ cost on each depth plan consists of several components. The first component is the interest and amortization value of the total economic first cost on each deepening plan in table 5. The estimated maintenance of the channel and navigation aids is the second component. The third component being the added maintenance on the associated cost items. The total AAEQ costs is in table 6 for each depth under consideration.

TABLE 5

ESTIMATED TOTAL FIRST COSTS OF VARIOUS DEPTH PLANS

Depths in feet	Amounts in $1,000			
	Deepening Plan	Associated Cost 1/	IDC 2/	Total Economic Costs
37	5,217	1,333	17	6,567
38	5,733	1,467	19	7,219
39	6,270	1,600	20	7,890
40	7,217	1,733	24	8,974
41	7,789	1,867	42	9,698
42	8,229	2,000	44	10,273
43	9,215	2,133	50	11,398
44	10,264	2,266	79	12,609
45	11,382	2,400	88	13,870

1/ Bulkhead cost range from $1.2 million at a depth of 36 feet to $2.4 million at a depth of 45 feet.
2/ Interest during construction (IDC)

TABLE 6

SUMMARY COMPARISON OF BENEFITS AND COSTS BY DEPTH

ITEM	Average Annual Equivalent Amounts ($1,000) by Depth					
	37	39	40	41	42	43
Benefits	1846	2948	3406	3729	3810	3880
Costs - Economic 1/ Maintenance 2/ Total Costs	514 552 1066	617 552 1169	702 552 1254	759 552 1311	804 552 1356	892 552 1444
Net Benefits	780	1779	2152	2418	2454	2436
Benefit-to-cost ratio	1.7 to 1	2.5 to 1	2.7 to 1	2.8 to 1	2.8 to 1	2.7 to 1

1/ This is the channels (entrance, east and inner), turning basin, berths, and bulkhead modification total economic first costs amortized over a expected life of 50 years at an interest rate of 7.625 percent.
2/ Maintenance of the channel is $549,000 and navigation aids $3,000.

Total Economic First Cost. The average annual equivalent cost is over a specific period of time. That period on the deepening plans is a project life of 50 years with proper maintenance. The associated cost have an estimated life over that same period except for the replacement crane. The crane has an expected life of 27 years. The AAEQ values come from determining the interest and amortization values of the total economic first cost over the expected life of that placement with proper maintenance. The interest rate for determining the AAEQ values is 7.625 percent. The estimated values are in table 6.

Channel and Navigation Aids. The estimated cost for maintenance of the channel, turning basin, and navigation aids remains the same for each depth plan. The AAEQ cost for channel maintenance at each depth is an estimated $549,000. Maintenance of the navigation aids is an estimated $3,000 a year.

Associated Cost Items. The analysis of maintenance considered the berthing areas and bulkhead. The deeper berthing areas have no significantly increased area for accumulation of material. No additional maintenance is estimated for the berths. The modified bulkhead should not cause a significantly higher maintenance nor should there be any additional maintenance on the existing bulkheads.

DEPTH ANALYSIS

The analysis in table 6 is for the turning basin and connecting entrance, inner, and east channels. Amounts in that table are average annual equivalent (AAEQ) values for both costs and benefits over an economic project life of 50 years. The interest rate is 7.625 percent. The total present worth amount then converts to an AAEQ value using interest and amortization of that amount over the expected economic life of the deepening plan or associated item. The depth that maximizes excess AAEQ values of benefits over costs becomes the National Economic Development (NED) plan. The NED plan from table 6 is the selected depth.

Economic analysis of deeper draft ship movements provides a basis for comparing estimated benefits and costs. The estimated benefits are from transportation savings at each increment of depth in table 3. The costs are in table 6 and include annualized values for the economic first cost and maintenance. The comparison between annualized costs and benefits in table 6 is for the full length of the channels (entrance, east, and inner) and turning basin. A second analysis in table 7 and 8 is for the inner and east channels as separate increments.

All Channels and Turning Basin Combined. Table 6 provides the comparison of AAEQ values of costs and benefits at several depths for all channels and turning basin under consideration. Where benefits optimize over cost is the NED plan or the one that reasonably maximizes the net AAEQ value for benefits in excess of costs. As shown in that table, the net AAEQ benefits maximize at a considered project depth of 42 feet. Both coal and phosphate movements receive benefits with a depth of 42 feet.

Inner Channel Increment. The inner channel extends south from the turning basin shown in figures 7 and 8. Table 7 provides a summary of the average annual equivalent (AAEQ) values for benefits and costs for each depth increment along the inner channel segment. A sample of the initial cost for at a depth of 41 feet in that table and the AAEQ value is as follows:

Deepening the channel segment --------	$ 397,000
Berthing area dredging ---------------	202,000
Dikes and weirs ----------------------	169,000
Environmental monitoring -------------	3,000
Subtotal -------------------------	$ 771,000
Design and costs ---------------------	62,000
Construction management --------------	77,000
Subtotal -------------------------	$ 910,000
Terminal bulkhead modifications ------	1,866,000
Total first costs ----------------	$2,776,000
Average annual equivalent (AAEQ) value	$ 217,000

Table 7 has estimated AAEQ values of about $71,000 for dredge and disposal work as well as about $78,000 for maintenance of a project depth of 41 feet.

TABLE 7

SUMMARY COMPARISON OF BENEFITS AND COSTS INNER CHANNEL

INNER CHANNEL INCREMENTAL ANALYSIS						
ITEMS	Average annual Equivalent Amounts ($1,000) by Depth in Feet					
	37	39	40	41	42	43
Benefits	542	1438	1870	2179	2254	2324
Costs - Dredging 1/	116	125	137	149	155	169
- Bulkhead	104	125	136	146	156	167
Total costs	220	250	273	295	311	336
Net Benefits	322	1188	1597	1884	1943	1988
Benefit-to-cost ratio	1.7 to 1	5.8 to 1	6.8 to 1	7.4 to 1	7.2 to 1	6.9 to 1

1/ Dredging includes maintenance estimated to be an AAEQ value of about $78,000 at each depth.

The benefits from coal movements apply only to the inner channel. The coal benefits on that channel range from about 39 to 60 percent of total benefits at considered project depths of 37 to 43 feet, respectively. The incremental analysis in table 7 shows maximum net benefits over cost is at a depth of 43 feet. The incremental change in benefits and net benefits between 40 and 41 feet is significant (5 percent or greater) but between 41 and 42 as well as 42 to 43 they are not. Depths deeper than 41 feet do not show a significant incremental change in benefits or net benefits between depths. The selected depth for the inner channel is 41 feet which is the selected depth plan from table 6 for all the channels and turning basin.

East Channel Increment. The channel is east of the turning basin as shown in figures 7 and 8. Table 8 provides a summary of the average annual equivalent (AAEQ) values for benefits and costs at considered depth increments along that channel segment.

The incremental analysis in table 8 indicates the benefits are large in comparison with costs. The benefit-to-cost ratios for that channel are high. Comparison of costs with benefits is feasible. The table indicates the maximization of benefits over costs occurs at a depth of 42 feet. The incremental change in benefits and net benefits between depths is significant if it is 5 percent or greater. Depths deeper than 39 feet do not show a significant incremental change in benefits or net benefits between depths. The costs for the various depth increments up to 43 feet are small. The benefits are from the phosphate rock and chemicals that move only on that channel.

TABLE 8

SUMMARY COMPARISON OF BENEFITS AND COSTS EAST CHANNEL

EAST CHANNEL INCREMENTAL ANALYSIS							
ITEMS	Average Annual Equivalent Amounts ($1,000) by Depth in Feet						
	37	38	39	40	41	42	43
Benefits	1304	1439	1509	1535	1550	1556	1556
Costs 1/	132	132	136	141	151	156	169
Net Benefits	1172	1307	1373	1394	1399	1400	1387
Benefit-to-cost ratio	9.9 to 1	10.9 to 1	11.1 to 1	10.9 to 1	10.3 to 1	10.0 to 1	9.2 to 1

1/ Dredging includes maintenance estimated to be an AAEQ value of about $67,000 at each depth.

The costs in table 8 include the initial costs for dredging and disposal of material as well as maintenance. The initial cost at a project depth of 41 feet is as follows to illustrate the initial costs which provides the basis for the AAEQ values in that table:

Deepening the channel segment --------	$ 481,000
Berthing area dredging ---------------	240,000
Dikes and weirs ----------------------	186,000
Environmental monitoring -------------	4,000
Subtotal -------------------------	$ 911,000
Design and costs ---------------------	73,000
Construction management --------------	91,000
Total first costs -----------------	$1,075,000

Table 8 includes the AAEQ value of $84,000 for the estimated initial costs at a project depth of 41 feet as well as about $67,000 for maintenance of that project depth.

Disproportionate Incremental Investment. EP 1165-2-1 (15 Feb 96) 12-6c, states the following in regard to the principle of progressive development: "The Federal interest is satisfied and the regular cost sharing requirements apply where the improvement serves/benefits two or more properties having different owners or one publicly-owned property at the outset or if new properties/owners would be served immediately after project completion. A principle of progressive development also applies. Progressive development includes nominal incremental extension "end of the line" situations where part of the improvement is a last project increment serving the last non-public property or property owner. The last property/property owner served may be "at the end" in terms of length, depth, or width, necessitating some project investment in that service alone. This is treated as a multiple-owner situation unless *disproportionate incremental investment* is required."

Disproportionate can be in the form of benefits and/or costs. The channel was incrementally justified so the additional costs for construction are less than the benefits from construction. The benefit to cost ratio is 7.4 for the inner channel and 10.3 for the east channel. The entire project involves construction of approximately 17,200 feet of channel. The increments in question amount to approximately 5,600 feet which is 33 percent of the channel length for 17.5 percent of the cost. The channels pass both tests.

Accuracy of costs and benefit calculations should also be considered. The project cost estimate has a 20 percent contingency factor. The benefit calculations are based upon projections over a fifty year life. The 17.5 percent portion of this project is well within the tolerances of accuracy for both cost and benefit calculations. Further, when assessed separably, the percentage values for each segment (8.0 and 9.5) are also within the realm or margin for analytical error regarding economic analyses (estimation of base vessel operating costs by IWR, aggregation of inputs for terminal and vessel operating parameters, and forecasts of future maritime activities pertinent to project studies). In addition, when assessed in combination or as separable elements, estimated benefits as assessed in the report exceed marginal costs by a considerable margin, which is consistent with overall findings for project studies and economic justification. Finally, the percentage shares when assessed separably are reasonable equivalent given consideration of total costs, and the placement of both features represents equitable treatment to both users of the waterway.

Risk and Uncertainty Associated With Critical Assumptions

Current requirements mandate examination of potential risk and uncertainty (R&U) associated with estimates and assumptions which are critical to project justification and\or plan formulation. R&U was assessed through basic sensitivity analyses and discussion of certain variables or influences viewed as critical to project justification. Project justification is based upon a limited number of port users, notably the Tampa Electric Company (TECO) and IMC\Agrico, Incorporated.

Respective to TECO and movements of coal, review of project benefits reveals that the majority of benefits are based upon expected transportation efficiencies for waterborne transport of domestic and foreign coal for Big Bend Station. For depths greater than 40 feet mlw, efficiencies for coal transport range from 55 to 60 percent of total benefits. Related efficiencies are largely attributable to self-propelled bulk carriers for handling coal from Indonesia via the Panama Canal or from nations such as Colombia and Venezuela on the northern coast of South America.

Exclusive use of domestic coal would preclude the ability to reduce emissions without significant plant retrofit. Exclusive use of low-sulphur coal would restrict fuel to low or possibly insufficient Btu rating for economical plant operation. The cost per Btu of fuel from low-sulphur coal has been equal or less than the average cost of domestic coal which is higher in sulphur and ash content. The coal sources are a consideration of operating costs relative to power generation subject to constraints imposed for air quality. Air quality is improved through the use of scrubber systems, efficiency measures in the boilers or combustion units, the use of cleaner-burning fuels (low sulphur coal), or some combination thereof. Air quality regulations place limits on sulphur content, ash content, energy generated unit of fuel, total operating cost per unit of energy, and technology of the generating facility. Relative sulphur content tends to be the most directly related to efforts to improve air quality when using coal. Relative sulphur content reductions result in lessening of sulphur dioxide (SO_2) emissions per unit of power. The SO_2 emissions are a primary component of present and evolving air quality regulations at State and Federal levels. The alternative to significant use of low-sulphur coal includes coal blends with higher sulphur content in combination with scrubber.

The Tampa Electric Company (TECO) is in the process of deciding on whether to employ additional scrubbers at Big Bend Station. Available information indicates the construction of such measures would cost $70 to $80 million dollars or more for initial construction and approximately $1.5 million or more for maintenance and operation. Basic analysis of available information indicates channel improvements and importation of foreign-source coal on self-propelled carriers should be economically viable for the foreseeable future. The production of coal from foreign sources is expected to remain stable in availability and price as new sources such as China, South America, Australia, and Indonesia further develop the infrastructure needed to efficiently extract and transport known reserves. Proposed improvements should lower the costs of imported coal by approximately $3.60 to $4.30 per short ton which would make most imported coal from South America or Indonesia less costly than virtually all domestic sources. Even if implemented in tandem with scrubbing, available cost relationships for powerplant maintenance and operations indicate that fuel blending would still result in sufficient economic benefits for scrubber maintenance, plant operations, and fuel costs to more than offset associated costs of proposed waterway improvements.

TECO routinely employs multiple sources for fuel wherever practical to minimize dependency on one or a select few suppliers to encourage competitive pricing and limit susceptibility to price fluctuations in both domestic and foreign regional markets. TECO is expected to continue this practice.

TECO has to modify its current operations in order to achieve the benefits needed to justify the selected/NED plan. A lesser plan (37 feet) is economically justified and within current Administration policies. The Tampa Port Authority will not undertake the improvement project without the administrative and financial support from TECO and IMC/Agrico. Even if TECO has no plans to modify its current operations, a lesser channel of 37 feet could be constructed.

An element of uncertainty concerning benefits for IMC\Agrico operations is the exact time period for depletion or viability of phosphate reserves for exportation of wetrock and phosphate-related products. The period of reserve viability will be governed by market prices for phosphate products versus costs of extraction, quantity, and quality of product. Indications are that operations in the area should remain economically viable for at least 20 to 25 years beyond the project base year. Given the interest\discount rates mandated for life-cycle costing, any minor variability in the planning horizon would be of little concern.

Overall risks are small that a project would be constructed that will not realize enough benefits to cover the costs. The chances are higher that a lesser than authorized/NED plan could be constructed because the current users could realize benefits without making changes to their current operations.

Depth Summary. The entrance channel and turning basin provide access to the inner and east channels that have a separate incremental analysis. The incremental analysis of the inner and east channels is in tables 7 and 8. The overall analysis in table 6 is for all the channels (entrance, east, and inner) and the turning basin. All these tables show a maximization of benefits over costs occurs at a depth over 41 feet. However, tables 6 and 7 show the increase in benefits and net benefits between each increment of depth over 41 feet is not significant (less than 5 percent). The east channel analysis in table 8 indicates the increments of benefit between depths deeper than 39 feet is not significant. An overall depth of 41 feet is selected for all channels and turning basin in consideration of the following:

- Maximization of benefits over costs occur at depths deeper than 41 feet;

- East channel cost estimates are less than 5 percent of the overall project; and

- Maximum benefits with multiple usage is possible at a depth of 41 feet on the entrance channel and turning basin.

ADVANCED MAINTENANCE

The estimated AAEQ maintenance cost for each of the depths is a major portion of the total AAEQ costs in table 6. As mentioned in the Needs and Opportunities Section of this report, advance maintenance is a way to reduce that high annual costs. Two factors help lower the AAEQ cost:

- One is a deeper shoal depth to enable more cost efficient (lower unit cost) dredging and

- Two is an extension of time between maintenance cycles with added depth for more storage capacity to reduce the number of cycles in the 50 year economic life of a project.

The costs to mobilize and demobilize construction equipment for a project is a costly part of any maintenance work. More depth below that required for the project provides a basin for sediments. That basin increases the interval of time between each maintenance operation and reduces the number of cycles for shoal removal in a 50 year period. The advanced maintenance depth at Big Bend provides an opportunity for lower AAEQ maintenance costs.

Maintenance Data. The estimated mobilization and demobilization cost of equipment is $860,400 for each maintenance cycle. The average shoaling rate for proposed bottom configuration is 80,000 CY a year or about 0.44 feet of uniform shoaling throughout the bottom area. That rate of shoaling results in over a foot of uniform shoaling about every 3 years.

Advanced Maintenance Analysis. The analysis assumes that the channel shoaling is at a uniform rate and accumulates about 240,000 cubic yards every 3 years. Advanced maintenance provides additional depth below the selected project depth of 41 feet. The extra depth provides a basin for shoaling to accumulate before impacting the project depth. The analysis is for depths of 1, 2, 3, and 4 feet with corresponding time intervals of 6, 9, 12, and 15 years, respectively, estimated between each maintenance cycle.

Table 9 summarizes the data use to develop and compare the total average annual equivalent (AAEQ) cost for maintenance. The estimated cubic yards removed with each depth grouping provides a basis for estimating each maintenance cycle cost. The total present value of each future maintenance occurrence within the 50 year economic life of the project is the basis for estimating the AAEQ cost of that work at each depth.

Initial construction of the project includes the advance maintenance depth as required overdepth dredging. The additional first cost to provide that initial depth for advanced maintenance is in table 9. The AAEQ value of that cost at each considered depth is also a cost factor in determining the least cost alternative.

The analysis in table 9 adds the AAEQ values for maintenance and additional first cost. A comparison with the AAEQ cost of $549,000 for no advanced maintenance indicates the added depth considerations are a less costly alternative. The least cost alternative of all the considered depths is 2 feet with an estimated total AAEQ value of $325,000. That depth has an estimated maintenance cycle every 9 years after project construction.

To add 2 feet of required overdepth for advanced maintenance increases the total economic cost of the selected project depth of 41 feet by $1,700,000. This increase results in an additional AAEQ cost as shown in table 9. An increase of $133,000 in the AAEQ economic cost is more than offset with the reduction ($357,000) in AAEQ maintenance costs from $549,000 to $192,000.

TABLE 9A

COST SHARING FOR ALTERNATIVE PLANS
(1,000's)

Project Feature	37 Feet	39 Feet	40 Feet	41 Feet	42 Feet	43 Feet
Base Project + Inner Channel						
Benefits	542	1438	1870	2179	2254	2324
First Costs	5736	7008	8028	8623	9136	10094
AAEQ Costs	449	548	628	675	715	790
AAEQ O&M Costs	485	485	485	485	485	485
Sub-Total AAEQ Costs	934	1033	1113	1160	1200	1275
Net Benefits	-392	405	757	1019	1054	1049
B/C Ratio	.58	1.39	1.68	1.88	1.88	1.82
Base Project + Inner Channel + East Channel						
Benefits	1846	2948	3406	3729	3810	3880
First Costs	6567	7890	8974	9698	10273	11398
AAEQ Costs	514	617	702	759	804	892
AAEQ O&M Costs	552	552	552	552	552	552
Sub-Total AAEQ Costs	1066	1169	1254	1311	1356	1444
Net Benefits	780	1779	2152	2418	2454	2436
B/C Ratio	1.73	2.52	2.72	2.84	2.81	2.69
Advanced Maintenance						
First Costs	1323	1808	1299	1700	2336	2472
AAEQ Costs	104	141	102	133	183	193
AAEQ Maint Savings	-233	-233	-233	-233	-233	-233
Total Project						
Total Project - Benefits	1846	2948	3406	3729	3810	3880
First Costs	7890	9698	10273	11398	12609	13870
AAEQ Costs	618	758	804	892	987	1085
AAEQ O&M Costs	319	319	319	319	319	319
Sub-Total AAEQ Costs	937	1077	1123	1211	1306	1404
Net Benefits	909	1871	2283	2518	2504	2476
B/C Ratio	1.97	2.74	3.03	3.08	2.92	2.76

Left Blank Intentionally

TABLE 9

ADVANCED MAINTENANCE ANALYSIS

Items	Amounts (000) by Advanced Maintenance Depths in Feet			
	1	2	3	4
MAINTENANCE CYCLES	6 yr	9 yr	12 yr	15 yr
Per Cycle: Cubic Yards	480	720	960	1,200
Cost	$2,271	$2,388	$2,484	$2,712
Present value 1/	$3,978	$2,454	$1,703	$1,299
AAEQ cost	$311	$192	$133	$106
ECONOMIC COSTS				
Net increase 2/	$575	$1,700	$2,911	$4,172
AAEQ net increase	$45	$133	$228	$326
TOTAL AAEQ COSTS	$356	$325	$361	$432

1/ Present worth value of all the costs for estimated future maintenance work over a 50 year project life at an interest rate of 7.625 percent.

2/ Net increase determined from an estimated base economic cost in table 5 of $9,698,000 for a project depth of 41 feet with no advanced maintenance depth requirement.

SELECTED PLAN

The selected plan was derived from three evaluations. One is the bottom configuration which is the result of model simulation for safe navigation of the Big Bend Channels and Turning Basin as shown on figure 10. The second is a depth analysis that selects a depth of 41 feet over the selected bottom configuration. The third is an advanced maintenance overdepth analysis which added a required overdepth for maintenance of 2 feet. The costs include an allowable overdepth of 1-foot for dredging inaccuracies. That completes the plan selection for deep draft navigation at Big Bend. Those navigation features are the most responsive to the planning objectives and provide for the most efficient use of the area's commercial facilities while minimizing the impact to the area's environmental resources.

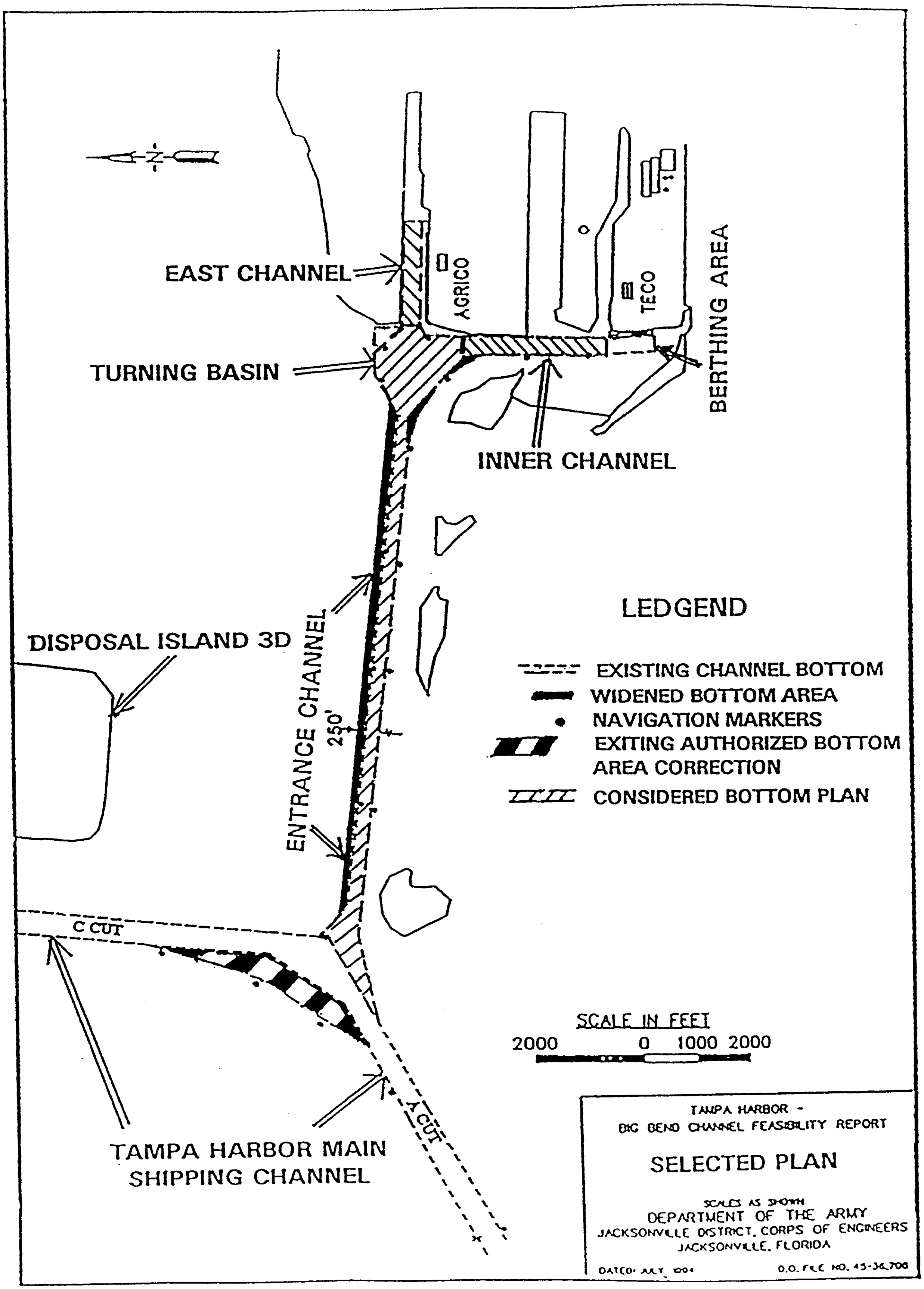
NAVIGATION PLAN FEATURES

The plan has a number of individual features that underwent separate consideration to addresses the planning objectives, needs, and opportunities set forth in earlier sections of this report. Considerations in development of those features included environmental, engineering, and economic quality to select a plan for implementation of a navigation project at Big Bend. The resulting features are in subsequent discussions.

Entrance Channel. Improvements to the entrance channel include: (1) deepening to a project depth of 41 feet and (2) widening the bottom by 50 feet on the north side. The total bottom width is 250 feet along the 1.9 miles of channel. An advanced maintenance overdepth of 2 feet makes the required dredging depth 43 feet over the entire bottom width.

Widener. The existing wideners between the entrance channel and Hillsborough Bay Channel Cuts A and C remain unchanged. The widener at the junction of the Hillsborough Bay Cuts A and C appeared to need widening which was later found to be in error. No correction is necessary in that area as the channel markers correctly show the westerly limits of the widener. The depths and widths in that area are sufficient without any dredging.

Turning Basin. The southwestern edge of the turning basin needed expansion to turn the larger ships. The turning diameter in the basin is 1,200 feet. The depth in the basin is to be 41 feet with 2 feet of advanced maintenance to make the total required depth for dredging 43 feet. The expansion provides a safer transition for larger ships from the entrance to the inner channel.



EAST CHANNEL
AGRICO
TECO
BERTHING AREA
TURNING BASIN
INNER CHANNEL
LEDGEND
EXISTING CHANNEL BOTTOM
WIDENED BOTTOM AREA
NAVIGATION MARKERS
EXITING AUTHORIZED BOTTOM AREA CORRECTION
CONSIDERED BOTTOM PLAN
DISPOSAL ISLAND 3D
ENTRANCE CHANNEL
250'
C CUT
A CUT
SCALE IN FEET
2000 0 1000 2000
TAMPA HARBOR MAIN SHIPPING CHANNEL
TAMPA HARBOR -
BIG BEND CHANNEL FEASIBILITY REPORT
SELECTED PLAN
SCALES AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Figure 10

Inner Channel. The inner channel bottom width of 200 feet remains the same but at a deeper project depth of 41 feet. An advanced maintenance overdepth of 2 feet makes the required depth 43 feet over that bottom width.

East Channel. The channel extends from the turning basin eastward at a project depth of 41 feet over a bottom width of 200 feet. An advanced maintenance overdepth of 2 feet makes the required depth 43 feet over that bottom area.

Berthing Areas. The existing berthing areas are 100 feet wide for coal and phosphate products and require deepening to fully utilize the entrance channel, turning basin, and inner channel project depths of 41 feet. The berthing area dredging is in the estimated cost for a project but is not a navigation feature included for cost sharing. The project sponsor is responsible for the costs to deepen the berths.

DESIGN

Project design involves the gathering of all necessary information related to an engineeringly safe, economically justified, and environmentally acceptable plan. Current laws and regulations provide environmental and economical guidelines which coupled with engineering experience enable plan formulation for an implementable project.

In the design for safety, vessel characteristics underway were a main consideration along with the channel bottom material. An analysis of existing and prospective vessel fleets helped identify potential usage problems or limitations with current conditions. Coordination with the sponsor, pilots, and local interests identified existing problems areas based on experience with navigating existing vessels on the waterway. Considering the existence of rock in the channel bottom and future vessel usage, the need for a ship simulation study was evident to aid in the design process and possibly reduce construction costs.

Model Simulation Studies. The Waterways Experiment Station (WES) did model simulation studies during 1993 and 1994 to consider the need for widening. The model conditions took into account the mean tidal range in the area of 1.8 feet and winds which impact primarily light-loaded vessels. Currents were a minimal consideration.

Design Vessels. The model results were for two design vessels. One was an integrated tug and barge (ITB) with a length overall of 760 feet, beam of 78 feet, loaded draft of 32 feet, and light draft of 12 feet. The other was a bulk carrier with a length overall of 740 feet, beam of 105.75 feet, and a loaded