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EXECUTIVE SUMMARY

General

- The Financing Scheme, Financial Analysis, and Management Arrangements Study (FFMS) is one of a series of component studies undertaken for the Commission for the Study of Alternatives to the Panama Canal (CAS).
- On July 24, 1992, CAS selected two of four alternatives for further study: a High-Rise Lock Canal with a 150,000- or 200,000-DWT maximum ship size and a Single-Lane Sea-Level Canal following Route 10 with a 250,000-DWT maximum ship size. Both options presuppose continued use of the existing Canal as modified by the Culebra Cut widening.
- The FFMS assignment required that five principal tasks be performed for each of the Canal alternatives:
  - Review alternative toll policies and systems and develop a recommended toll policy and system for each Canal alternative,
  - Formulate the most appropriate management arrangement and structure,
  - Define the most appropriate financing configuration or scheme,
  - Measure the financial viability of each Canal alternative, and
  - Recommend the preferred Canal alternative from a financial point of view.
- Projections of traffic and transits for each alternative were obtained from The WEFA Group, *Final Report, Commodity and Traffic Projections Study*, May 7, 1993.
- Capital cost estimates of the alternatives were obtained from Yachiyo Engineering Co., Ltd., *Final Report, Phase 2: Preliminary Engineering and Cost Estimates*, April 1993.

Toll Policy Issues and Formulation of Optimal Toll Structure and Rates

- Nathan Associates reviewed toll policy in theory and in practice. On the basis of past studies we evaluated the current Panama Canal toll policy, structure, and rates. A comparative analysis of tolls at other waterways was conducted. Alternative toll structure and rates were analyzed for each Canal alternative and optimal structure and rates were identified, specified, and recommended.

- On the basis of the historical analysis of Panama Canal tolls and the comparative analysis of tolls at the Suez Canal and the St. Lawrence Seaway, Nathan Associates specified and analyzed alternatives that included
  - — The current earning-capacity–based schedule, with rates increased 50 and 100 percent; and
  - — A modified earning-capacity–based schedule for which rates varied by ship type and, within a ship type, by increment of earning capacity (similar to the Suez Canal).
- For each toll schedule, toll revenues and traffic diversions were estimated and analyzed. All traffic diversion decisions were based on total transportation cost per ton of cargo carried. With the imposition of a Panama Canal toll, the total transportation cost per ton of cargo carried through the Canal increases. Traffic for which the cost per ton via the Canal exceeded the cost per ton via the least costly alternative route was diverted to the alternative route.
- The formulation of an optimal toll structure and rates was based on maximizing revenue subject to the following constraints:
  - – Minimum traffic diversions (a minimum number of diverted transits),
  - – Toll rate increases capped at 100 percent,[1]
  - – Minimum disruption to the traffic and cargo bases (maintaining the existing diversity of vessel and cargo types to avoid traffic specialization),
  - – Tolls distributed equitably by ability to pay, and
  - – An administratively simple and practical structure.
- The optimal toll system that was developed is based on vessel-earning capacity. It differs from the existing Panama Canal toll structure by differentiating among ship types and, within ship types, by size.

[1]A number of toll rate increases up to 100 percent were examined. Toll increases are justified under the Panama Canal Treaty of 1977 when used to cover the costs of capital improvements. Toll increases up to 100 percent are feasible as the Canal remains the least cost alternative route for a majority of shippers, and a significant transportation cost saving will be associated with the improvements. In no iteration were tolls increased by more than 100 percent. According to a review of past increases and supporting documentation and the informed opinions of all study team members, a toll rate increase exceeding 100 percent would be poorly received and indeed viewed with alarm by the shipping community.

Analysis of Management Arrangements Models[2]

- Five models for managing the Canal alternative were defined and evaluated against a comprehensive set of criteria that addressed a range of political, financial, managerial, commercial, personnel, and international issues relevant to the alternative canal's efficient management and operation. The management arrangement models evaluated were as follows.
  - **Government department**. The Canal alternative would be established as a government department and operated as a regular agency under civil service administration.
  - **Public authority.** The Canal alternative would be set up as an independent authority by Panamanian legislation (Authority Act).
  - **International public entity**. The Canal alternative would be set up by treaty or international agreement as an international public body, created for the express purpose of managing and operating the Canal alternative asset.
  - **Special purpose corporation**. The Panamanian government or one of its agencies would grant the Canal alternative—under a long-term concession agreement and operating contract—to a special purpose corporation (SPC), whose role would be to manage and operate the asset.
  - **Private company**. Operation of the Canal alternative would be fully privatized, with all functions auctioned off to one or more private firms. The entities in question would likely include a consortium of foreign private and Panamanian private corporations.
- All the models for management arrangements for the Canal alternative assume that a single entity will be established to manage and operate the existing Canal and the Canal alternative.
- Neither the private company nor government department management arrangement appears suitable to the situation in Panama. The international public entity is somewhat less risky in terms of both perception and operating stability but poses practical difficulties in terms of operating efficiency and its likely inability to incorporate other trans-isthmian commercial activities.

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[2]The management models, selection criteria, and recommendations discussed in this report pertain to a future Canal alternative, not to the existing Panama Canal. The management models analyzed were chosen and examined for their relevance to the Canal alternatives, not to the existing Panama Canal. An in-depth review of the management and operation of the existing Panama Canal was not conducted for this study.

- A Panama Canal Authority has been identified as the preferred management arrangement suitable to handle the political, financial management, and operating efficiency requirements of the Canal alternative. A strong Authority Act could be drafted to preserve all the necessary characteristics for effective operation and development of the Canal alternative in a competitive environment: financial integrity, insulation from political influence, management flexibility, labor productivity, and others.
- From a Panamanian political point of view, the Panama Canal Authority is probably a more easily comprehensible and thus acceptable formula for organizing Panama's relationship to the Canal alternative. A Panama Canal Authority may well prove to be most similar organizationally to the form of institution that succeeds the present Panama Canal Commission after December 31, 1999. This similarity would ensure a smooth transition into the new pattern of activity featuring the simultaneous, integrated operations of the existing Canal and the eventual Canal alternative.
- The Panama Canal Authority model has the additional advantage of an ability to evolve toward being a special purpose corporation (SPC). If over time the ownership and operating characteristics of an SPC presented clear benefits for the development and management of the Canal alternative, the authority could easily establish and even invest in an SPC and contract out day-to-day operation and management of the Canal alternative to that entity.

Specification of Optimal Financing Scheme

- The total cost of each alternative and the duration of design and construction are presented below.

Canal Alternative	*Capital Cost (US$ billion)*	*Construction Period (years)*
150,000-DWT High-Rise Lock Canal	7.4	10
200,000-DWT High-Rise Lock Canal	8.5	11
Sea-Level Canal, Case A	13.5	15

- A panel of senior international financing experts (SIFE) was assembled for the development and selection of optimum financing schemes for the Canal alternatives. The panel was composed of financial practitioners with global project financing expertise in both public and private sector settings.
- To identify potential financing sources and likely terms and conditions, it was assumed that the Canal alternatives were financially viable. Thus the sources of financing selected and the assumed terms and conditions used are considered to be those that would be most favorable for the financing of the Canal

alternatives. The interest rates used represent anticipated long-term interest rates under favorable economic conditions and for a project that is considered a medium investment-grade risk. This implies that the entity operating the existing Panama Canal will be financially sound at the time financing for the alternative canal is sought and that a track record of solid operational and management performance has been established.

- A wide range of possible sources of financing was explored, including traditional and nontraditional sources. Traditional sources of project financing include governmental export-import banks for financing of plant and equipment; international development lending institutions such as the World Bank and the Inter-American Development Bank; large investment houses in the United States, Japan, and Europe for access to private bond and equity markets; and equity participation by individual countries. Nontraditional financing sources include possible equity participation by major users of the alternative canal or equity participation by multinational governmental institutions such as the United Nations or the Organization of American States.
- A critical component of the financing scheme is the establishment and preservation of a trust fund that will be endowed with net income generated from Canal tolls after Panama acquires control of the Canal in 2000. It is assumed that Panama Canal tolls could be increased nominally from 2000 through 2019 to generate resources for the trust fund, especially since the toll increase will be associated with a capital improvement project. Panama's financial equity contribution to the Canal alternative will be taken from the trust fund, and a balance of $500 million will be maintained to assure creditors of the Canal alternative's financial solvency.
- The optimal financing scheme consists of a mix of nine financing sources:
  - Capital costs for construction and other equipment are financed equally by export-import banks in the United States and Japan—up to 80 percent of the equipment cost.
  - The remaining 20 percent of equipment cost is financed by equipment suppliers (5 percent) and capital from the toll reserve trust fund (15 percent).
  - Other construction costs and indirect costs are financed by development banks (27 percent); foreign bonds (34 percent, split between U.S. and Japanese private markets); commercial bank loans (5 percent); ODA loans (4 percent); and capital from the toll revenue trust fund (30 percent).

Financial Analysis

- The financial analysis of each of the Canal alternatives was prepared for three scenarios of alternative toll revenue estimates. These toll revenue estimates are
  - Existing Panama Canal toll structure and rates,
  - Existing Panama Canal toll structure and rates increased by 50 percent, and
  - The optimal toll system developed by Nathan Associates that differentiates toll rates by the type and size of vessel.
- The financing scheme and financial analysis of each Canal alternative were evaluated using the following criteria:
  - Is the toll reserve trust fund balance always positive?
  - Is the minimum debt service coverage ratio on a current basis greater than 1.3, and on an overall basis (including the trust fund balance) greater than 1.5 to 2.0?
  - Is the financial internal rate of return (FIRR) of the incremental cash flow *before* financing greater than 8 percent in order to encourage international development institutions and agencies to participate in the project?
  - Is the FIRR of the incremental cash flow *after* financing greater than 12 percent in order to encourage private investors and commercial banks to participate in the project?
  - Are the net present values of the incremental cash flow *before* and *after* financing positive values?[3]
  - Is the debt-to-equity ratio below 4.0?
  - Does the alternative remain financially viable under the various sensitivity analyses that include interest rates increased by 25 percent, capital costs increased by 25 percent, operation and maintenance costs increased by 25 percent, and status quo Canal toll rates increased by 50 percent?
- On the basis of the evaluation criteria, the 150,000-DWT High-Rise Lock Canal is financially viable under the optimal toll system scenario.

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[3]A discount rate of 8 percent was used for the net present value calculations. This reflects the SIFE panel consensus of the interest rate that could be obtained on a low-risk corporate bond.

	Existing Tolls	*Tolls Increased 50 Percent*	*Optimal Tolls*
Trust fund balance always positive?	No	Yes	Yes
FIRR before financing (percent)	–3.2	4.6	10.1
FIRR after financing (percent)	–5.6	3.4	18.0
Net present value before financing (US$ million)	–4,314	–1,591	951
Net present value after financing (US$ million)	–3,806	–1,285	1,069

- The 200,000-DWT High-Rise Lock Canal is not financially viable under any of the toll system scenarios analyzed.

	Existing Tolls	*Tolls Increased 50 Percent*	*Optimal Tolls*
Trust fund balance always positive?	No	No	Yes
FIRR before financing (percent)	–3.1	3.7	8.4
FIRR after financing (percent)	–5.4	2.3	9.8
Net present value before financing (US$ million)	–4,882	–2,337	193
Net present value after financing (US$ million)	–4,308	–1,952	391

- The Sea-Level Canal, Case A, under all toll scenarios analyzed is not financially viable. The toll reserve trust fund balance in all scenarios remains negative for extended periods.

	Existing Tolls	*Tolls Increased 50 Percent*	*Optimal Tolls*
Trust fund balance always positive?	No	No	No
FIRR before financing (percent)	–5.1	1.3	4.5
FIRR after financing (percent)	–7.6	–0.5	3.3
Net present value before financing (US$ million)	–6,803	–4,648	–2,608
Net present value after financing (US$ million)	–6,014	–4,019	–2,130

- To test the robustness of the base case financial results, a series of sensitivity analyses was conducted. The sensitivity analyses were designed to include factors considered likely to affect the evaluation of the Canal alternatives and to address concerns of potential investors and financing institutions. Sensitivity analyses were conducted for
  - Interest rates increased by 25 percent,
  - Capital costs of all Canal alternatives increased by 25 percent,
  - Capital costs of all Canal alternatives decreased by 25 percent,
  - Operation and maintenance costs of the Status Quo Canal and all Canal alternatives increased by 25 percent,
  - The combination of interest rates increased by 25 percent and capital costs decreased by 25 percent,
  - Tolls for the Status Quo Canal increased by 50 percent,
  - A Special Purpose Corporation as the management arrangement, and
  - Capital costs on a unit-cost basis for the 150,000-DWT High-Rise Lock Canal as presented by Yachiyo Engineering.
- The 150,000-DWT High-Rise Lock Canal under an optimal toll system remained financially feasible under six of the eight sensitivity analyses.
- The 200,000-DWT High-Rise Lock Canal, which was not feasible under the base case results, improves in two scenarios—decreased capital costs by 25 percent and the combination of decreased capital costs and increased interest rates. However, it should be noted that these results are still less favorable than those for the 150,000-DWT High-Rise Lock Canal.
- The Sea-Level Canal, Case A, remains not financially feasible under all of the sensitivity analyses. The net present value before and after financing are negative and the balance of the trust fund turns negative for extended periods.

Conclusion

- The 150,000-DWT High-Rise Lock Canal operated by a Panama Canal Authority and using an optimal toll system is recommended as the most attractive Canal alternative and management arrangement from a financing scheme and financial viability perspective.
- This alternative provides a financial internal rate of return commensurate with estimated requirements of public and private financing and has a positive net present value before and after financing. The balance of the toll reserve trust fund is always positive and is adequate during construction to cover substantial cost overruns.
- The sensitivity analyses indicate that the 150,000-DWT High-Rise Lock Canal under the optimal toll scenario is sufficiently robust to remain financially viable if either interest rates or operation and maintenance costs are increased 25 percent.

1. INTRODUCTION

General

- The Financing Scheme, Financial Analysis, and Management Arrangements Study (FFMS) is one of a series of component studies undertaken for the Commission for the Study of Alternatives to the Panama Canal (CAS).
- Nathan Associates and its associated firms were given Notice to Proceed with the study November 23, 1992.
- A Draft Final Report was submitted June 12, 1993, and reviewed in Panama June 17–18, 1993.[1]
- In this Final Report, we present the findings and results of the toll system and revenue studies, the management arrangements review, and the financing scheme and financial analysis for each of the proposed alternative canals.

Alternatives to be Studied

- On July 24, 1992, CAS selected two of four alternatives for further study:
  - The High-Rise Lock Canal with a 150,000- or 200,000-DWT maximum ship size, an option under which the new facility would generally follow the alignment of the existing Canal, with new sets of larger locks constructed adjacent to the existing locks and widening and deepening of the channel to accommodate larger vessels. Bypass canals would be constructed at Gatun and Miraflores, connecting the new lane of locks to the existing Canal. The water level of Gatun Lake would be maintained at 85 feet. Capital cost estimates include the excavation cost only for a second lane of new locks as construction of the second set of locks is deferred beyond the study period.
  - The Single-Lane Sea-Level Canal following Route 10 with a 250,000-DWT maximum ship size, which calls for the excavation and construction of a new facility on a path to be approximately 16 km west of and generally parallel to the existing Canal. The Sea-Level Canal would consist of a

[1]An Annex to the Draft Final Report was submitted July 23, 1993. The annex presented the results of the financing scheme and financial analyses using reduced engineering cost estimates of a single-lane Culebra Cut for the High-Rise Lock Canal alternatives and a single-lane Atlantic approach channel for the Single-Lane Sea-Level Canal alternative.

single lane across the isthmus with two-lane approaches on the Pacific and Atlantic sides. Three cases were prepared for comparison. For tidal control, Case A, which employs tidal locks with three parallel lock chambers to be located about 5 km from the Pacific shoreline, was used for the financial analysis.

- Both options presuppose continued use of the existing Canal as modified by the Culebra Cut widening.

Objectives of the FFMS

- To evaluate the Canal alternatives, CAS requested that the FFMS provide advice on which alternative appears most financially advantageous. Accordingly, the FFMS assignment required that five principal tasks be performed:
  - Define the most appropriate financing configuration or scheme for each of the two proposed Canal alternatives.
  - Review alternative toll policies and systems and develop a recommended toll policy and system for each of the Canal alternatives.
  - Formulate the most appropriate management arrangement and structure for each of the Canal alternatives.
  - Measure the financial viability of each alternative, demonstrating the alternatives' respective detailed financial characteristics.
  - Recommend the preferred Canal alternative from a financial point of view.

Key Inputs Obtained from Other CAS Component Studies

- Projections of traffic and transits for each alternative were obtained from The WEFA Group, *Final Report, Commodity and Traffic Projections Study*, May 7, 1993. Several of the trade routes for which traffic projections were presented by The WEFA Group were disaggregated for purposes of the toll analyses. These disaggregations are discussed in Section 3 of this report.
- Capital cost estimates of the alternatives were obtained from Yachiyo Engineering Co., Ltd., *Final Report, Phase 2: Preliminary Engineering and Cost Estimates*, April 1993. As discussed in Section 4,

for purposes of the financial analysis, these cost estimates were converted to an annual financial cash flow basis by Stone & Webster and TAMS Consultants Inc.

- Estimates of the operation and maintenance costs of each of the alternatives were obtained from Yachiyo Engineering Co., Ltd., *Final Report, Phase 2: Preliminary Engineering and Cost Estimates*, and adjusted by Nathan Associates to reflect costs that would not be incurred after the transfer of the existing Panama Canal to the Republic of Panama on December 31, 1999. These adjustments are discussed in Section 4.

2. TOLL POLICY ISSUES AND ANALYSIS

General Approach

- The general approach consisted of four steps (see Figure 2-1, p. 2-12). First, Nathan Associates reviewed toll policy theory and concepts. Second, on the basis of past studies we evaluated the theoretical dimensions and performance of the current Panama Canal toll policy, structure, and rates. Third, we conducted a comparative analysis of toll policies and rate schedules at facilities similar to the Panama Canal. Finally, we specified and analyzed alternative Panama Canal toll structures and rates and developed the optimal structures and rates.

Toll Policy: A Conceptual Overview

- A toll policy represents a set of principles underlying the objectives to be achieved by a given toll rate structure. Basic objectives include
  - Revenues expected to be generated by the toll rates and traffic volume;
  - Equity or fairness, which can be measured by whether the toll rates reflect the
    - Cost of providing service through the waterway,
    - Value of service to the user, and
    - User's ability to pay, which can be measured by cubic cargo capacity, quantity of cargo, and value of cargo;
  - Promotion of traffic growth;
  - Efficiency or capacity utilization of the waterway; and
  - Administrative simplicity.

Current Panama Canal Toll Policy and Rate Structure

Policy

- Revenue requirement
  - Tolls are required to be set at rates calculated to produce revenues to cover, as nearly as practicable, all costs of maintaining and operating the canal and related facilities and appurtenances and to provide capital for plant replacement, expansion, and improvements.
- Equity
  - Tolls will be assessed on the earning capacity of the ship. Earning capacity is the cubic cargo-carrying capacity of the ship. It equals the total enclosed space (gross tonnage) of the ship minus the spaces used for operating the ship—the spaces required for the engine room, fuel tanks, and crew quarters. At the Panama Canal, a ship's earning capacity is referred to as its Panama Canal net tons.

Structure

- The structure of the toll structure at the Panama Canal does not vary by merchant ship type or by ship size. It does, however, differentiate between laden and ballast merchant vessels.

Rates

- The toll on merchant vessels, army and navy transports, hospital ships, supply ships, and yachts is
  - $2.01 per Panama Canal net ton when carrying passengers or cargo (laden) and
  - $1.60 per Panama Canal net ton when not carrying passengers or cargo (in ballast).
- The toll on other floating craft is $1.12 per displacement ton.

Achievement of Underlying Objectives

- Revenue generation
  - Tolls have been increased only six times during the Panama Canal's 80-year life—twice during the past decade (1983 and 1989).
  - There is moderate potential to generate significant additional revenues by increasing tolls because the current toll structure does not directly differentiate among ship types, ship sizes, commodity types, and tons carried.
- Equity or fairness
  - Based on cost of service, small vessels pay less than the marginal cost of providing Canal service and a disproportionately small share of fixed cost; large vessels pay more than the marginal cost of service and a disproportionately large share of fixed cost. The marginal cost of providing service is the cost that varies with the number of transits or the size of the vessel. In contrast, the fixed cost of providing service does not vary with traffic. It is a sunk cost incurred to make the Canal available to shippers. In a 1970 study, Arthur Andersen & Co. estimated that marginal and fixed costs of the Canal accounted for 35 percent and 65 percent of total cost, respectively. In addition, 80 percent of the marginal cost of providing Canal service is related to the number of vessel transits and only 20 percent is related to vessel size.[1] Consequently, the marginal cost of service is about the same for a wide range of vessel sizes. Canal tolls, however, are assessed at a constant rate per unit of vessel size. As a result, larger vessels pay tolls higher than the marginal cost of providing service and smaller vessels pay tolls lower than the marginal cost of service. In addition, relative to their share of total transits, larger vessels contribute disproportionately more to fixed costs; smaller vessels contribute disproportionately less.
  - Tolls are not necessarily proportional to the value of service provided by the Canal. Value of service is directly related to the degree that shippers need to use the Canal. For shippers who have no economically attractive alternative to the Canal to move cargo from supply sources to demand destinations, the value of the Canal is high. The cost they pay—the toll—should be relatively high to reflect this value. However, when commodities can be purchased from

[1]Arthur Andersen & Co., *The Panama Canal Company: A Report on Development and Evaluation of Tolls Policies and Alternative Systems*, Chicago, IL, 1970.

numerous alternative sources of supply or when they can be transported by several different modes of transportation or in larger vessels, shippers have more transportation alternatives available to them, some of which are likely to be an economically attractive alternative to the Canal. In these cases, the value of service provided by the Canal is relatively low and shippers should be charged a lower toll to encourage their continued use of the Canal. The existing Canal toll structure, however, does not vary. All shippers pay the same rate. As a result, larger vessels, which, because of economies of scale, have more routing alternatives than do smaller vessels, pay a toll not necessarily proportional to the value of service they receive from the Canal. And, for some commodities, tolls are not proportional to the value of Canal service. Previous studies have found that shippers of nonferrous ores and iron and steel manufactures benefit significantly from using the Canal but pay effective tolls that are among the lowest.[2] At the other extreme are shipments of bananas. Effective tolls paid on banana shipments have been among the highest, yet the value of using the Canal to transport bananas to the destinations served by these shipments is relatively low. Alternative sources of supply could serve these demand destinations without the need to transit the Canal.

  - The current structure reflects ability to pay on the basis of earning capacity. Only indirectly, through a toll differential on laden versus ballast movements, does the structure reflect ability to pay on the basis of the quantity of cargo carried. Only coincidentally—when dense cargoes are of low value—does the current structure reflect ability to pay on the basis of cargo value. Iron and steel, however, are dense, high-value Canal cargoes for which the current toll structure does not reflect ability to pay on the basis of cargo value.

- Traffic growth could be curtailed by significant toll increases.
- Efficiency is not promoted by the current Canal toll structure. It encourages use by small ships and discourages use by large ships. As a result, it discourages use by those who contribute most to recovery of fixed cost.
- The current structure presents little, if any, administrative complexity and thereby minimizes the administrative cost.

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[2]See Arthur Andersen & Co. cited above and Stanford Research Institute, *Analysis of Panama Canal Traffic and Revenue Potential*, Palo Alto, CA, 1967.

Toll Policies, Structures, and Rates at Comparable Facilities

Suez Canal

- Policy
  - The Suez Canal Authority, a government entity of the United Arab Republic of Egypt, is responsible for running, managing, maintaining, and improving the Suez Canal.
  - Tolls are set by the Authority. Revenue—US$1.8 billion in 1992—is turned over to the government. A portion of Canal toll revenue—15 percent—is set aside for Canal improvements.
  - The primary policy objective is to maximize cargo tonnage moving through the Canal.
- Structure
  - The Suez Canal toll rate structure is based on vessel earning capacity. It differs from the Panama Canal toll structure by differentiating among ship types, cargo carried by the ship, and, within a ship-type and cargo combination, size intervals of the ship's earning capacity.
- Rates
  - As shown in Table 2-1 (p. 2-13), the toll rate per Suez Canal net ton declines as the ship's earning capacity increases.[3] Suez Canal tolls are expressed in Standard Drawing Rights (SDR), the unit of currency of the International Monetary Fund. Because the SDR represents a basket of currencies, Suez Canal rates fluctuate when converted to U.S. dollars.

[3]The system of measurement of the Suez Canal net ton differs from that of the Panama Canal net ton. Although both have the objective of measuring the earning capacity of a vessel, the system of net ton measurement is unique to each canal. The Suez Canal system of measurement was specified by the International Commission held at Constantinople in 1873. The system of measurement for the Panama Canal Commission net ton is specified in Title 35, Parts 133 and 135, of the U.S. Code of Federal Regulations. Both systems of measurement are extremely detailed and complex and differ in their treatment of vessel space to be included in the net ton calculation.

St. Lawrence Seaway

- Policy
  - The toll policy and rate schedule for the St. Lawrence Seaway are determined jointly by the U.S. and Canadian governments.
  - The St. Lawrence Seaway Development Corporation, a wholly owned U.S. government corporation created in 1954 within the Department of Transportation, is responsible for the development, seasonal operation, and maintenance of the seaway between Montreal and Lake Erie and within the territorial limits of the United States.
  - The St. Lawrence Seaway Authority, which is a parent Crown corporation, was established in 1954 to construct and operate a deep waterway between the Port of Montreal and Lake Erie, together with works and other property deemed necessary.
  - Tolls are determined by the amount needed to cover operating and maintenance costs and maximize traffic.
  - Total toll revenue (including lockage fees) was $69 million in 1991.
- Structure
  - The St. Lawrence Seaway toll rate structure comprises a primary component based on cargo carried and a secondary component based on vessel earning capacity.
  - The primary component differentiates among cargo types but not among cargo tonnage intervals. The rate charged per metric ton remains constant regardless of the total tons carried on any transit.
  - Like the Panama Canal toll and unlike the Suez Canal toll, the St. Lawrence Seaway's secondary toll component, which is based on ship earning capacity, does not differentiate among vessel types or sizes. It is charged on the basis of the ship's gross registered tons.
- Rates (see Table 2-2, p. 2-14)

Development of Optimal Panama Canal Toll Structure and Rates

Treaties of 1977 and Toll Policy Implications

- Beginning in 1903, the U.S.–Panama Treaty of 1903 and subsequent amendments have governed Canal operations since the construction of the waterway. Under the treaty, the United States had total control of Canal operations and the Canal Zone.
- The Panama Canal Treaty and the Treaty Concerning the Permanent Neutrality and Operation of the Panama Canal, signed September 7, 1977, changed the relationship between the United States and Panama. These treaties provide for the transfer of all rights to and operation of the Canal to Panama by December 31, 1999. In addition, the goals of the treaties were to ensure that the Canal would be efficiently operated and would remain secure, neutral, and open to all nations.
- Article I of the Panama Canal Treaty of 1977 provides that "The Republic of Panama declares that the Canal, as an international transit waterway, shall be permanently neutral in accordance with the regime established in this Treaty. The same regime of neutrality shall apply to any other international waterway that may be built either partially or wholly in the territory of the Republic of Panama."
- Article III, Paragraph 1(c), of the 1977 Treaty Concerning the Permanent Neutrality and Operation of the Panama Canal provides that for purposes of the security, efficiency, and proper maintenance of the Canal "tolls and other charges for transit and ancillary services shall be just, reasonable, equitable and consistent with the principles of international law."
- During ratification of the treaties, the U.S. Senate introduced an "Understanding" to the neutrality treaty, which reads as follows:

> "(1) Paragraph 1(c) of Article III of the Treaty shall be construed as requiring, before any adjustment in tolls for use of the Canal, that the effects of any such toll adjustment on the trade patterns of the two Parties shall be given full consideration, including consideration of the following factors in a manner consistent with the regime of neutrality:
>
> (A) the costs of operating and maintaining the Panama Canal;
>
> (B) the competitive position of the use of the Canal in relation to other means of transportation;
>
> (C) the interests of both Parties in maintaining their domestic fleets;
>
> (D) the impact of such an adjustment on the various geographic areas of each of the two Parties; and
>
> (E) the interests of both Parties in maximizing their international commerce."

- On September 30, 1979, the Panama Canal Company was terminated and the Panama Canal Commission (PCC) was established according to the Panama Canal Treaty of 1977 by P.L. 96–70. Chapter 6 of the law is concerned with tolls for use of the Panama Canal.
  - Section 1602(b) of Chapter 6 stipulates that "tolls shall be prescribed at rates calculated to produce revenues to cover as nearly as practicable all costs of maintaining and operating the Panama Canal, together with the facilities and appurtenances related thereto, including unrecovered costs incurred on or after the effective date of this Act, interest, depreciation, payments to the Republic of Panama pursuant to paragraph 5 of Article III and paragraph 4(a) and (b) of Article XIII of the Panama Canal Treaty of 1977,[4] and capital for plant replacement, expansion, and improvement. Tolls shall not be prescribed at rates calculated to produce revenue sufficient to cover payments to the Republic of Panama pursuant to paragraph 4 (c) of Article XIII of the Panama Canal Treaty of 1977."
- Undertaking one of the Canal alternatives requires an increase in toll rates in order to aid in the alternative's financing. It is clear from a reading of the treaty that the Panama Canal must remain neutral and nondiscriminatory, but it is less clear how much the treaty actually inhibits the ability to raise tolls. The treaty does offer the opportunity to raise tolls and to cover costs, including those associated with financing capital improvements. This opportunity is reiterated in P.L. 96–70, which states that "tolls shall be prescribed at rates calculated to produce revenues to cover as nearly as practicable all costs of ... capital for plant replacement, expansion, and improvement." However, the treaty also states that "the effects of any such toll adjustment on the trade patterns of the two Parties shall be given full consideration...." This and similar language could be interpreted to prohibit increases in Canal tolls, since most likely it could be shown that an increase in tolls would adversely affect a particular region.
- Despite the language on the regional impact of tolls, there appears to be sufficient justification to raise tolls because it will help finance one of the alternatives to the Canal, which will help maximize world trade. In addition, our analysis of transportation costs shows that by phasing in the optimal toll structure, the effect of the toll increase on most trade routes will be relatively small compared with total transportation costs. A modification to the 1977 Treaty Concerning the Permanent Neutrality

[4]Articles III and XIII are concerned with payments to Panama. According to the Treaty, Panama shall receive "the sum of ten million United States dollars ($10,000,000) per annum for the foregoing services... and in the event Canal operating revenues in any year do not produce a surplus sufficient to cover this payment, the unpaid balance shall be paid from operating surpluses in future years...."

and Operations of the Panama Canal or a Letter of Understanding between the Republic of Panama and the United States would be needed to further clarify the uncertainty in the language of the treaty in order to attract the required financing.

Criteria

- The optimal Panama Canal toll structure and rates were developed in an iterative process of specification, analysis, and respecification. The optimal schedule and rates should maximize revenue subject to the following constraints:
  - Minimum traffic diversions (a minimum number of diverted transits),
  - Toll rate increases capped at 100 percent,
  - Minimum disruption to the traffic and cargo bases (maintain the existing diversity of vessel and cargo types to avoid traffic specialization),
  - Tolls should be distributed equitably based on ability to pay, and
  - The schedule must be administratively simple and practical.
- A number of toll rate increases up to 100 percent were examined. As discussed earlier, toll increases are justified under the Treaty Concerning the Permanent Neutrality and Operations of the Panama Canal when used to cover the costs of capital improvements. In addition, toll increases up to 100 percent are feasible while the Canal remains the least cost alternative route for a majority of shippers, and significant transportation cost savings will be associated with the improvements. Further, even with toll rates increased 100 percent, the average increase in total transportation cost per ton is 5 percent (p. 3-14) and represents an even lower percentage increase in the average delivered price of goods transported through the Canal.
- In no iteration were tolls increased by more than 100 percent. On the basis of a review of past increases and supporting documentation and the informed opinions of all study team members, a toll rate increase exceeding 100 percent would be poorly received and indeed viewed with alarm by the shipping community. Because international shipping is expected to remain a highly competitive business, a perception of future toll increases (even if not implemented) is sufficient to drive international shippers to seek transportation alternatives. For example, one shipping company recently commissioned a new class of container vessels capable of accommodating 4,800 TEUs to

serve the Far East to U.S. East Coast trade via the land-bridge, thus dispensing with its liner service through the Panama Canal.

Specification of Alternative Structures and Rates

- On the basis of the historical analysis of Panama Canal tolls and the comparative analysis of tolls at the Suez Canal and the St. Lawrence Seaway, Nathan Associates specified and analyzed alternatives that included
  - — The current earning-capacity–based schedule, with rates increased 50 and 100 percent;
  - — A modified earning-capacity–based schedule for which rates varied by ship type and, within a ship type, by increment of earning capacity (similar to the Suez Canal); and
  - — A combination cargo- and earning-capacity–based schedule for which the cargo-based toll varied by cargo type and the earning-capacity–based toll remained the same for all ship types and capacity intervals (similar to the St. Lawrence Seaway).

Analysis

- Toll revenues and traffic diversions were estimated and analyzed. All traffic diversion decisions were based on total transportation cost per ton of cargo carried. With the imposition of a Panama Canal toll, the total transportation cost per ton of cargo carried through the Canal increases. Traffic for which the cost per ton via the Canal exceeded the cost per ton via the least costly alternative route was diverted to the alternative route.
- The ability and willingness of shippers to reroute cargoes depend on several factors in addition to transportation cost per ton. Scheduling, safety, and weather conditions, among other factors, can determine choice of route. Yet, as the cost advantage of an alternative route increases, it becomes more likely that traffic will be rerouted. Conversely, traffic might not be rerouted until the cost saving from using the alternative route reaches some minimal amount.
- To test the sensitivity of traffic diversions to transportation cost saving, diversions were estimated on the assumption that traffic would divert to the least costly route whenever imposition of the Panama Canal toll raised the total transportation cost per ton by way of the Canal above the cost

per ton by way of the alternative route (i.e., whenever the alternative route was less costly than the Panama Canal route).

Formulation of Optimal Toll Structure and Rates

- The optimal toll structure and rates were developed from respecifications of alternative schedules and rates. The process, which began with small rate increases under the current schedule, generated a new type of schedule with more rate-setting flexibility and new rates.
- Initially toll revenues and traffic diversions were estimated for the current schedule with rates increased 50 percent.
- Subsequent iterations considered combination cargo- and earning-capacity–based schedules with rates set comparable with current St. Lawrence Seaway tolls. However, this type of schedule would be administratively complex and costly to implement for the Panama Canal. Whereas the St. Lawrence Seaway tracks 4 major commodity groups and 22 commodities, the Panama Canal monitors 15 major commodity groups and 115 commodities.[5] Further, the volume of transits and traffic, the diversity of trade routes, the number of ship types are all substantially greater for the Panama Canal. As such, a combination cargo- and earning-capacity–based schedule was not considered optimal for the Panama Canal.
- In additional iterations, Nathan Associates specified and analyzed the current schedule with rates increased 100 percent and then respecified rates to recapture diverted traffic while maximizing toll revenues. Rates were varied by vessel type and size.
- The detailed methodology used to specify the optimal toll structure and rates is presented in Section 3.

[5]Panama Canal Commission, Annual Report for FY 1991, Table 7, and St. Lawrence Seaway Development Corporation, Traffic Summary 1991, Table 1T.

Figure 2-1. General Approach of Toll Policy Analysis

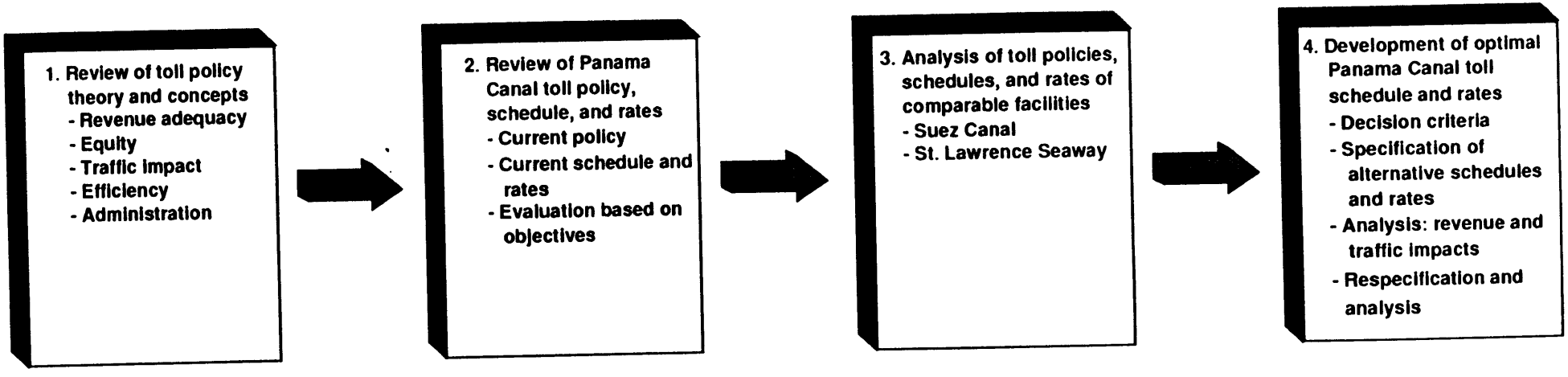

Table 2-1. Suez Canal Toll Structure, 1993 (Special Drawing Rights per Suez Canal Net Ton)

	Suez Canal Net Tons Interval											
	First 5,000		Next 5,000		Next 10,000		Next 20,000		Next 50,000		Remaining	
Vessel and Cargo Types	Laden	Ballast	Laden	Ballast	Laden	Ballast	Laden	Ballast	Laden	Ballast	Laden	Ballast
Tankers of crude oil	7.21	6.13	4.02	3.42	3.61	3.07	1.55	1.32	1.55	1.32	1.34	1.14
Tankers of petroleum products	7.21	6.13	4.02	3.42	3.66	3.07	2.06	1.32	2.06	1.32	2.06	1.14
Dry bulk carriers	7.21	6.13	4.02	3.42	2.88	2.45	1.03	0.88	0.98	0.83	0.98	0.83
Combined carriers												
Crude oil only	7.21	—	4.02	—	3.61	—	1.55	—	1.55	—	1.34	—
Petroleum products only	7.21	—	4.02	—	3.66	—	2.06	—	2.06	—	2.06	—
More than one kind of cargo	7.21	—	4.02	—	3.66	—	2.06	—	2.06	—	2.06	—
Dry bulk cargo only	7.21	—	4.02	—	2.88	—	1.03	—	0.98	—	0.98	—
In ballast	—	6.13	—	3.42	—	3.07	—	1.32	—	1.32	—	1.14
Containerships and car carriers	7.21	6.13	4.02	3.42	3.30	2.80	2.37	2.02	2.37	2.02	2.37	2.02
Con-bulker vessels												
Dry bulk cargo	7.21	—	4.02	—	2.88	—	1.03	—	0.98	—	0.98	—
Containerized cargo	7.21	—	4.02	—	3.30	—	2.37	—	2.37	—	2.37	—
Bulk and containerized	7.21	—	4.02	—	3.30	—	2.37	—	2.37	—	2.37	—
In ballast	—	6.13	—	3.42	—	2.45	—	0.88	—	0.83	—	0.83
Empty containers	—	6.13	—	3.42	—	2.80	—	2.02	—	2.02	—	2.02
Other, including gas carriers	7.21	6.13	4.02	3.42	3.66	3.11	2.58	2.19	2.58	2.19	2.58	2.19

Note: Dashes indicate data not applicable. US$1.36887 per Special Drawing Right (SDR) in 1992.
Source: Nathan Associates Inc.

Table 2-2. St. Lawrence Seaway Toll Structure, 1993 (US$)

Charge Type	Between Montreal and Lake Ontario	Between Lake Ontario and Lake Erie
Vessel charge per gross registered ton	0.11	0.13
Cargo charge per metric ton		
Bulk	1.10	0.55
Containerized	1.10	0.55
Feed grains	0.68	0.55
Food grains	0.68	0.55
General	2.66	0.88
Lock charge		
Per passenger per lock	1.88	1.88
Per cargo vessel per Welland Canal trip		
Laden per lock	—	440.00
In ballast per lock	—	325.00

Note: Dashes indicate data not applicable.
Source: Nathan Associates Inc.

3. ESTIMATION OF OPTIMAL TOLL STRUCTURE AND RATES

- Estimates of toll revenues under alternative toll policies and systems are a critical input for the financial analysis of the Canal alternatives. In this section we discuss both the methodology used to estimate toll revenues and the development of an optimal toll schedule and rates, and present estimates of toll revenues for each Canal alternative under a variety of toll schedules and rates.
- Development of an optimal Panama Canal toll structure and rates occurred in two phases. During the first phase, preliminary modifications were made to The WEFA Group's traffic forecast. The process of specifying and analyzing alternative toll schedules and rates and identifying the optimal schedule and rates occurred during the second phase. Each phase consisted of several tasks (See Figure 3-1, p. 3-17).

Phase 1: Preliminary Data Modifications

- The primary database, provided by The WEFA Group, consisted of a "no-tolls" Panama Canal traffic forecast for 2020 and 2060 for each Canal alternative. The WEFA Group forecast transits, tons carried, average ship DWT, and Panama Canal net tons by trade route, ship type, and ship DWT size interval. Transportation costs per ton carried by way of the Panama Canal—excluding Panama Canal tolls—and by way of the least costly alternative route were provided by The WEFA Group for the average ship size within each size interval.

Review, Analyze, Verify, and Reformat WEFA Data

- Data from The WEFA Group were entered into database files and analyzed to verify that the data matched those published in The WEFA Group Final Report *Commodity and Traffic Projections Study*, Volume IV, May 7, 1993, pp. 3-1 to 10-8. The report and data provided by The WEFA Group were then reviewed and analyzed to understand the key assumptions and the traffic mix projected for 2020 and 2060. The basic approach employed by The WEFA Group included
  - Application of forecast commodity- and trading-partner–specific global growth rates for 1990–2020 and 2020–2060 to 1990 Panama Canal baseline data.
  - Distribution of projected commodity trade flows onto vessels available from a projection of the world fleet,

- Examination of all bypass routes for potential shifts away from the Canal, using a least costly alternative approach and without inclusion of a Panama Canal toll, and
- Examination of forecast bypass traffic for potential shifts away from the Canal, using a least costly alternative approach and without inclusion of a Panama Canal toll.

- Key assumptions made by The WEFA Group included
  - No change in traffic patterns;
  - Continued world stability, or no major wars or political instability,
  - No change in current environmental policies of any nation or group of nations, such as the European Community or the Commonwealth of Independent States;
  - Population growth based on the UN's forecast through 2025 and extended to 2060 using the UN's fertility and mortality assumptions without regard to short-term fluctuations in employment (no cyclical behavior);
  - Continued long-term trends toward greater efficiency in production and toward a greater share of consumption by services (resulting in a downward curvature in the ratio of total world trade to world GDP) and diffusion of technology to undeveloped countries, which will allow per capita GDP to converge without an accelerated strain on the earth's resources;
  - Fixed ranking of countries or regions by per capita GDP but some convergence of standard of living because the developing world will grow faster than the developed world;
  - Progress of emerging world trading blocs toward freer trade;
  - Rise in real terms of wage and fuel costs as components of transportation costs;
  - No dramatic changes in shipping technology;
  - Increased self-sufficiency of countries in goods as the technological and labor cost advantages of the newly industrialized countries wane;
  - Slower growth in energy consumption resulting from greater energy efficiency, growth in non-fossil fuel sources, and shifts away from heavy industry;
  - Significant slowdown in agricultural trade because of slow productivity growth and technology transfer to less productive developing countries; and
  - Significant depletion of major natural resources (coal, natural gas, and oil) by 2060.

- For some ship types and trade routes included in The WEFA Group's transit files, transportation costs by vessel size were not available. For purposes of the toll revenue analyses, transits (and tons carried) with incomplete cost data were excluded. The number of transits thus excluded was insignificant, ranging from 13 in the 2060 status quo scenario to 27 in the 2060 150,000-DWT scenario.
- Traffic forecasts were analyzed in three general steps: first, to determine the impact of each Canal alternative on transits and tonnage in 2020 and 2060; second, to determine the impact on types of ships and commodities; and third, to determine the impact on ship size. (See Figures 3-2 and 3-3 and Tables 3-1 and 3-2, pp. 3-18 to 3-23.) General conclusions drawn by The WEFA Group are as follows.
  - An increase in the size of the Canal would bring few additional transits; however, it would bring additional tonnage because larger ships would be able to move through the Canal, thus allowing for increased revenue generation. Also, by 2060, the number of transits projected exceeds the capacity of the status quo Canal and thus will become a severe constraint on shipping.
  - The major ship types in terms of transits for the Canal throughout the study period will be container/breakbulk, dry bulk carriers, full container ships, and refrigerated ships. There will be some increase in transits by refrigerated ships, full container ships, and dry bulk carriers.
  - The cargo base of the Canal consists of general cargo, containerized cargo, major bulk, and minor bulk. Traffic increases forecast for 2020 and 2060 occur mostly for major bulk commodities, including coal and iron ore.
  - Only dry bulk carriers, full container ships, and oil tankers will be of sizes (150,000 DWT or greater) requiring the additional capacity provided by the Canal alternatives.

Disaggregate Key Trade Routes

- Traffic and cost data provided by The WEFA Group were analyzed further to identify modifications that could be made to enhance the analysis of Panama Canal tolls. In some cases, routes likely to be important in the analysis were not specified separately in The WEFA Group's database. For trade routes of particular importance and when the detail of the underlying data permitted, transits and transportation costs were disaggregated from those for The WEFA Group trade routes. For instance, The WEFA Group's traffic projections for dry bulk traffic from the east coast of South

America to Asia were presented as a single trade route. However, this traffic, which is projected to total between 19 and 26 million tons in 2020, consists of several distinct commodities and origin–destination pairs. Because of the significantly different transportation characteristics and costs of these movements, for purposes of the toll revenue analysis it was necessary to examine the distinct major trade flows contained within this trade route. A discussion of trade routes that were disaggregated follows.

- Dry bulk transits from the east coast of South America to Asia for vessels larger than 100,000 DWT were disaggregated into the following separate movements using cost information and distributions of tonnage by vessel interval, Canal alternative, and year in The WEFA Group's May 7 Final Report (see Chapter 5 of the report for cost information and table below for projected tonnage in millions).

	2020			*2060*		
	150,000 DWT	*200,000 DWT*	*250,000 DWT*	*150,000 DWT*	*200,000 DWT*	*250,000 DWT*
Colombia to Far East (coal)	0.3	0.3	0.3	0.4	0.4	0.4
Northern Brazil to Far East (iron ore)	14.9	14.9	21.4	6.7	6.7	18.5
Venezuela to Far East (iron ore)	1.8	1.8	1.8	0.6	1.2	1.2

- Container transits from Asia to the east coast of the United States and from the east coast of the United States to Asia.
  - The two routes total approximately 29.0 million tons in 2020, or about 8 percent of all tonnage projected for 2020. In 2060, they total approximately 34.8 million tons, or about 7 percent of all tonnage projected for 2060.
  - Application of The WEFA Group's transportation costs for this route results in diversion of all container traffic to the land-bridge alternative—even without a Panama Canal toll. However, The WEFA Group forecasts that some transits on these routes will continue to be via the Canal. The reason for this apparent discrepancy lies in the use of an average value of

containerized cargo of $10,000 per ton, rather than a distribution of higher- and lower-value traffic. Lower-value traffic would continue moving through the Canal. Higher-value traffic would divert to the land-bridge alternative.

- The inventory cost per ton at an average value of $10,000 per ton was calculated by The WEFA Group for the Panama Canal and the least costly alternative route using the following formula:

  [(interest rate * average value per ton) / 365 days] * total transit time

- At an interest rate of 8.5 percent and with total transit times of 37 days for the Panama Canal and 15 days for the land-bridge alternative route, the inventory carrying cost is $86.14 per ton via the Canal and $34.92 per ton via the land-bridge alternative.

- Nathan Associates disaggregated these movements by differentiating between low value ($5,000 per ton) and high value ($14,000) per ton, recomputing inventory carrying costs for each, and recomputing total transportation cost per ton for each. The table below shows the calculation of new costs for a representative vessel of 48,000 DWT transiting the Canal from Asia to the east coast of the United States in 2020.

	US$		
	Inventory Cost Per Ton Carried	*Transport Cost Per Ton Carried*	*Total Cost Per Ton Carried*
The WEFA Group			
Panama Canal	86.14	198.93	285.07
Land-bridge	34.92	241.11	276.03
Nathan Associates			
High value - Panama Canal	120.62	198.93	319.55
- Land-bridge	48.90	241.11	290.01
Low value - Panama Canal	43.07	198.93	242.00
- Land-bridge	17.46	241.11	258.57

- In effect, two routes were created, one for low-value cargoes and one for high-value cargoes. Low-value cargo was assumed to account for 40 percent of the projected total container transits on these routes, and high-value cargo accounted for the remaining 60 percent of transits.

Identify Fleet Distributions by Type and Size of Ship for Least Costly Alternative Routes

- The WEFA Group specified the ship type and DWT size interval for all forecast Panama Canal transits. They did not, however, specify the distribution of transits by ship type and size for the least costly alternative route. Transit and tonnage data prepared by The WEFA Group for the 250,000-DWT Sea-Level Canal alternative were used to develop fleet distributions for each least costly alternative route in 2020 and 2060. These data approximate world fleet distributions because they are virtually unconstrained and because they embody all assumptions that were made by The WEFA Group in constructing the forecasts. Appendix F presents the distribution of tonnage carried by ship type, vessel size interval, and trade route for the least costly alternative route.

Compute Weighted Average Transportation Costs

- Nathan Associates' analysis of toll revenues and traffic diversions was based on weighted average total transportation costs per ton.
  - For each ship type and trade route, transits and tons carried were provided for different ship size intervals.
  - For each interval, the transportation cost per ton for the interval's average ship size was provided.
  - Distributions of cargo tons carried on transits within each ship size interval were used to weight the transportation costs per ton for the average size ship in each interval.
- Distributions were computed for forecast transits for 2020 and 2060 for each Canal alternative.
- For 2020 and 2060, weighted average transportation costs were computed for each Panama Canal ship type and trade route and for the least costly alternative route for each Canal alternative.

Analyze and Estimate "No Tolls" Diversions

- For some ship types and trade routes, the weighted average transportation cost via the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded from further analyses of Panama Canal traffic data. The number of transits excluded ranged from 934 in the 2060 status quo scenario to 2,536 in the 2060 150,000-DWT scenario.
- Many of the diverted transits were for trade routes that logically would not use the Panama Canal, such as Africa to Europe and Asia to Africa. A list of the diverted transits under a "no toll" scenario by year, scenario, ship type, and trade route is given in Appendix G.
- A number of additional possible reasons why transits have been included in The WEFA Group's traffic projections but excluded from our "no-toll" analysis are detailed below.
  - The WEFA Group included these transits in their "no-toll" traffic projections as they were contained in the 1990 PCC database. These transits indicate that factors other than transportation costs enter into the determination of some Canal traffic. However, although these transits occurred under 1990 PCC tolls, it is impossible to determine whether the transits would continue with increased Panama Canal tolls. Thus, for purposes of the toll revenue analyses, which are premised on a least-transportation cost approach, these transits were excluded from the traffic base used for revenue estimation.
  - These transits may have occurred because The WEFA Group constructed its forecasts on the basis of bilateral trading pairs and then aggregated to regional trading pairs. The aggregation causes a masking of the different bilateral trading patterns, which results in a loss of flexibility.
  - For our analysis, the regional trade data were further aggregated by weighting the transportation costs across DWT size interval within a ship type and trade route, whereas The WEFA Group compared total costs for each ship size interval within a particular ship type and trade route.
  - As discussed earlier, Nathan Associates developed and used fleet distributions for the least costly alternative route. These distributions yield a set of transportation costs for the alternative routing different from those used by The WEFA Group.
    - For example, for the 150,000-DWT Canal, The WEFA Group projected that dry bulk carriers moving from Brazil to Asia would account for 14.9 million tons in 2020. However, in Nathan Associates' analysis, when the weighted average transportation cost of $18.50 per ton

carried for the 150,000-DWT Canal was compared with $18.14 per ton carried for the least-cost alternative route, the least-cost alternative route was less costly.[1] Vessels moving on the least-cost alternative route can realize significant economies of scale. On the least-cost alternative route, 30 percent of the tonnage is in vessels whose cost per ton carried is $15.80 and almost 50 percent is in vessels whose cost per ton carried is $18.40. The following table details the effect of using weighted average costs.

	The WEFA Group's Cost per Ton Carried, by Thousand DWT Interval (US$)			*Nathan Associates' Weighted Average Cost per Ton Carried (US$)*	
	100–150	*150–200*	*200–250*	*Before New Alternative Vessel Distribution*	*After New Alternative Vessel Distribution*
Panama Canal	18.50	16.20	13.90	18.50	18.50
Alternative route	21.10	18.40	15.80	21.10	18.14

[1]For this movement, The WEFA Group used a round-trip voyage to estimate transportation costs, believing that it most accurately reflected actual shipping conditions. We have used The WEFA Group's assumption in our analyses.

Phase 2: Specification, Analysis, and Development of Optimal Toll Structure and Rates

- Initially Nathan Associates estimated the total consumer surplus of all forecast Panama Canal traffic to determine the theoretical maximum Panama Canal toll revenues (see Appendix A); Nathan Associates determined that the amount of consumer surplus is significant. Subsequent steps were taken to determine the amount of surplus likely to be captured through increases in Panama Canal tolls and changes in the Panama Canal toll structure.

Methodology

- The general method consisted of the following steps (see Figure 3-1, p. 3-17).
  - Computing the weighted average total transportation cost per ton by ship type and trade route.
    - Toll rates per Panama Canal net ton were applied to the average ship size in each ship size interval. A fee of $0.40 per Panama Canal net ton was included to account for charges such as handling and agency fees incurred when a ship is transiting the Canal. These charges were used only to determine whether traffic would divert from the Canal by adding it to the cost per ton carried and the Panama Canal toll. The revenues associated with these handling charges are not included in the toll revenue estimates, but are presented separately in Section 6.
    - Toll rates for the representative ship were multiplied by the number of transits within the ship size interval to compute total toll revenue from transits by ships within the interval.
    - The forecast tons carried for the interval were not used in computing the toll per ton carried. Instead, total tons carried were calculated for the interval on the basis of utilization rates provided by The WEFA Group. These were representative of each ship type according to normal industry practices. These utilization rates were also used by The WEFA Group in calculating total transportation costs. See Table 3-3 on page 3-24 for a list of cargo assumptions.

- Total toll revenues from all transits within the interval were divided by the previously calculated total tonnage carried by transits within the interval to compute the effective toll per ton carried.
- The effective toll per ton carried by transits within the interval was multiplied by the interval's share of cargo tonnage carried on transits in all vessel size intervals.
- Weighted effective tolls per ton carried in all ship size intervals were summed to compute the weighted average effective toll.
- The weighted average effective toll was added to the transportation cost per ton and the handling charges to compute total Panama Canal transportation cost per ton.

– Comparing the Panama Canal weighted average total transportation cost per ton and the weighted average cost via the least costly alternative route.

– Identifying traffic diversions to the least costly alternative route, based on any transportation cost saving.

– Computing toll revenues collected on remaining Canal traffic and the applicable toll structure.

– Estimating revenues from ballast transits for each ship type. Because The WEFA Group's projections of ballast transits were not prepared by trade route and no transportation costs for ballast transits were presented, the least-costly transportation analysis was not conducted. Instead, revenues for ballast transits by ship type were estimated in relation to the impact of alternative toll rates on corresponding laden transits by ship type.

– Considering source competition and other factors resulting in additional diversions of Canal traffic. With large increases in toll rates, it was considered possible that traffic could be diverted to alternative sources of supply not requiring a Panama Canal transit. However, under the optimal toll system, source competition did not result in any further Canal traffic diversions. For instance, banana traffic from the west coast of Central America to Europe was considered susceptible to source competition from the east coast of Central America. However, the toll increase under the optimal toll system results in an increased cost of less than two-tenths of a cent per pound of bananas and will not cause a diversion of traffic.[2]

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[2]For this movement, a $2.01 increase in tolls per Panama Canal net ton is equivalent to an increase of $3.30 per ton of bananas carried, or US$0.00165 (0.165 cents) a pound.

- Respecifying the toll structure and rates, if necessary, to maximize Canal revenue and minimize traffic diversions.

Specification and Analysis of Alternative Toll Structure and Rates

- Initially we specified and analyzed the current Panama Canal toll structure and rates (see Tables 3-4 through 3-11, pp. 3-25 to 3-32, and Appendix B for a more detailed presentation). The resulting revenues for laden plus ballast transits, in millions of 1990 U.S. dollars, are given in the following table.

	Canal Alternative			
Year	*Status Quo*	*150,000-DWT*	*200,000-DWT*	*250,000-DWT*
2020	482	612	630	637
2060	591	869	895	908

  - For the status quo Canal,
    - Revenues will be $482 million in 2020 and climb to $591 million by 2060.
    - In 2020, diverted transits and tons are approximately 5 percent of total transits and tons. By 2060 diversions as a percentage of total traffic decline to virtually zero.
    - Revenue losses are defined as the difference between toll revenues for a particular toll structure if no traffic had been diverted and the estimated toll revenues after diversion is considered. Revenue losses in 2020 are about 6 percent of the maximum revenues that would be generated under this structure if toll rates could be adjusted by trade route to eliminate all diversions.
    - Ship types most sensitive to Panama Canal tolls are primarily full container ships and tankers.
  - For other Canal alternatives, revenues increase slightly but vary little among alternatives.
    - In 2020, revenues will be $612 million for the 150,000-DWT Canal, $630 million for the 200,000-DWT Canal, and $637 million for the 250,000-DWT Canal (Sea-Level Canal).

- By 2060, revenues for the Canal alternatives will range between $869 million and $908 million.

- The first respecification increased current toll rates 50 percent (see Tables 3-12 through 3-19, pp. 3-33 to 3-40, and Appendix C for a more detailed presentation). The resulting revenues for laden plus ballast transits, in millions of 1990 U.S. dollars, are given in the following table.

	Canal Alternative			
Year	*Status Quo*	*150,000-DWT*	*200,000-DWT*	*250,000-DWT*
2020	702	904	904	938
2060	861	1,279	1,319	1,335

  - For the status quo Canal,
    - A 50 percent increase in toll rates generates a 46 percent increase in 2020 revenues ($702 million) and a 46 percent increase in 2060 revenues ($861 million).
    - With a 50 percent increase in toll rates, diverted transits as a percentage of total transits increase from 4.9 percent to 7.6 percent in 2020 and from almost zero percent to 2.3 percent in 2060.
  - For all three other Canal alternatives, a 50 percent increase in toll rates generates approximately 45 percent more in revenues in 2020 and 2060. Revenues will be approximately $900 million in 2020 and $1.3 billion in 2060.

- The second respecification increased current toll rates 100 percent (see Tables 3-20 through 3-27, pp. 3-41 to 3-48, and Appendix D for a more detailed presentation). The resulting revenues for laden plus ballast transits, in millions of 1990 U.S. dollars, are as follows.

Year	Canal Alternative			
	Status Quo	*150,000-DWT*	*200,000-DWT*	*250,000-DWT*
2020	934	1,123	1,169	1,215
2060	1,110	1,638	1,732	1,754

  - For the status quo Canal,
    - A 100 percent increase in toll rates generates a 94 percent increase in 2020 revenues ($934 million) and an 88 percent increase in 2060 revenues ($1.1 billion).
    - With a 100 percent increase in toll rates, diverted transits as a percentage of total transits increase from 4.9 percent to 7.8 percent in 2020 and from almost zero percent to 3.8 percent in 2060.
  - In all three other Canal alternatives, a 100 percent increase in toll rates generates approximately 85 percent more in revenues in 2020 and 2060. Revenues will be approximately $1.2 billion in 2020 and $1.7 billion in 2060.

- A third respecification introduced a cargo-based toll structure similar to the structure found on the St. Lawrence Seaway. Because of the diverse cargo base of the Panama Canal and the administrative complexity of even a simple cargo-based toll system, this structure was not considered optimal and was not analyzed further.

Optimal Toll Structure and Rates

- Further respecifications introduced a toll structure in which rates varied across ship types and across ship size intervals.
  - Toll rates were examined for vessel types that had diversions of more than 10 percent of that vessel type's total transits or for which diversions accounted for 25 percent of total diversions of all vessel types.
  - Next it was determined whether particular trade routes accounted for a majority of the diversions within each vessel type. For these trade routes, a toll sensitivity analysis was conducted to

determine whether adjustments to the toll rate by vessel size interval would recapture the diverted traffic and the impact on toll revenues was assessed.

  - If traffic could not be recaptured without significant loss of revenue, the rates were not changed. However, if reducing rates recaptured transits and either increased revenue or did not significantly decrease revenue, the toll rate was increased until revenue was maximized.

- Such toll rate variations generated higher revenues and recapture of traffic diverted under previous specifications. Examples of traffic for which toll rate reductions were able to recapture diversions are
  - Dry bulk carriers projected for the 200,000-DWT Canal alternative in 2020
    - With a 100 percent increase in current Panama Canal tolls, only 10 percent of dry bulk transits were diverted, but they accounted for more than one-half of all diverted transits.
    - Most diversions were on two trade routes: west coast of South America to Europe, and Oceania to east coast of United States.
    - To preserve market share and recapture diversions, rates were decreased to $1.51 per Panama Canal net ton for laden vessels equal to or greater than 70,000 Panama Canal net tons. As a result, 24 percent of the diverted laden movements that occurred with a 100 percent increase were diverted back to the Canal and revenue from laden dry bulk transits increased by nearly 3 percent.
  - Tankers projected for each Canal alternative in 2020
    - With a 100 percent increase in current Panama Canal tolls, one-third were diverted.
    - Most diversions were on two trade routes: east coast of South America to Asia, and east coast of South America to west coast of Central America.
    - To preserve market share and recapture diversions, rates were decreased to $3.30 per Panama Canal net ton for laden vessels equal to or greater than 70,000 Panama Canal net tons.
    - For the 150,000-DWT Canal alternative, 78 percent of the diverted laden movements that occurred with a 100 percent increase were recaptured by the Canal and revenue from laden tanker transits increased by nearly 94 percent. For the 200,000-DWT and 250,000-DWT

Canal alternatives, 62 percent of diversions were recaptured and revenues increased by 7 percent.[3]

- The resulting toll structure and rates maximized revenue and minimized traffic diversions. From these results, as well as other decision criteria that guided our methodology, the resulting toll structure and rates were considered optimal.
- The optimal toll structure and rates are presented in Table 3-28 (p. 3-49) for 2020 and 2060 by project scenario. Container-breakbulk, chemical tankers, full container ships, general cargo ships, liquid gas carriers, passenger ships, refrigerated ships, RORO s, and vehicle carriers are assessed a toll of $4.02 per Panama Canal net ton, without variation across size intervals, and $3.20 in ballast. All other ships pay tolls at rates that vary depending on the year, Canal alternative, ship type, and size interval. All ballast movements are charged a toll based on the increase in toll rates realized on each ship type's laden transits and maintaining the proportion of ballast transits to laden transits.
- The optimal toll structure and rates are different between 2020 and 2060. In 2060, all vessels are assessed a toll of $4.02 per Panama Canal net ton, without variation across size intervals, and $3.20 in ballast. Toll revenue is optimized while minimizing traffic diversions and ensuring that no vessel type incurs more than a 100 percent increase in toll rates. The respecification of tolls for ship types that was required to recapture Canal traffic in 2020 is not required in 2060 because large vessels represent a greater percentage of the 2060 vessel mix, and the resulting lower average transportation costs offset the impact of the toll increase.[4]
- Toll rate increases per Panama Canal net ton under the optimal structure do not exceed 100 percent of the current rate on any ship type.
- Total transportation cost per ton increases under the optimal toll structure as follows:
  - Maximum: 17 percent (general cargo ships from west coast of Central America to east coast of Central America)

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[3]Please note that with the 200,000-DWT and 250,000-DWT Canal alternatives, diversions under a 100 percent toll increase were about one-half of those for the 150,000-DWT Canal, before the toll rate respecification.

[4]The entity operating the Canal alternative will regularly monitor the toll structure and rates and, as conditions warrant, will revise the optimal toll system consistently with its toll policy objectives.

- Average: 5 percent

- Toll revenues generated by the optimal structure and rates in 2020 and 2060 for each project scenario are presented in Tables 3-29 through 3-36 (pp. 3-50 to 3-57), and a more detailed presentation is given in Appendix E. The resulting revenues for laden plus ballast transits, in millions of 1990 U.S. dollars, are shown below.

	Canal Alternative			
Year	*Status Quo*	*150,000-DWT*	*200,000-DWT*	*250,000-DWT*
2020	934	1,175	1,186	1,221
2060	1,110	1,638	1,732	1,754

- Revenues generated by the optimal toll are compared with revenues generated by the alternative structures and rates in Table 3-37 (p. 3-58). The optimal schedule generates 25 to 30 percent more revenue than a 50 percent increase in current rates without losing additional traffic. In addition, for the Canal alternatives, where traffic could be recaptured, the optimal schedule generates revenues 1 to 5 percent higher revenues than does a 100 percent increase with less traffic diverted. Recapture of dry bulk carriers and tankers was achieved by the optimal toll structure and rates.

- Although an almost infinite number of different toll structures and rates could be developed for the Panama Canal, the optimal structure and rates developed here conform to the decision criteria that guided this analysis.

- The optimal structure and rates maximize revenue subject to the following constraints.
  - Minimum total traffic diversions;
  - No toll rate increases exceeding 100 percent of the current rates;
  - Maintenance of a diversity of ship types to avoid traffic specialization;
  - Equitable distribution of tolls, by the cost of providing service and the ability to pay, as reflected in vessel-earning capacity and measured currently by Panama Canal net tons;
  - Whether tolls encourage efficient use of the Canal; and
  - A practical and administratively simple structure.

Figure 3-1. Methodology for Determining Optimal Toll Schedule and Rates

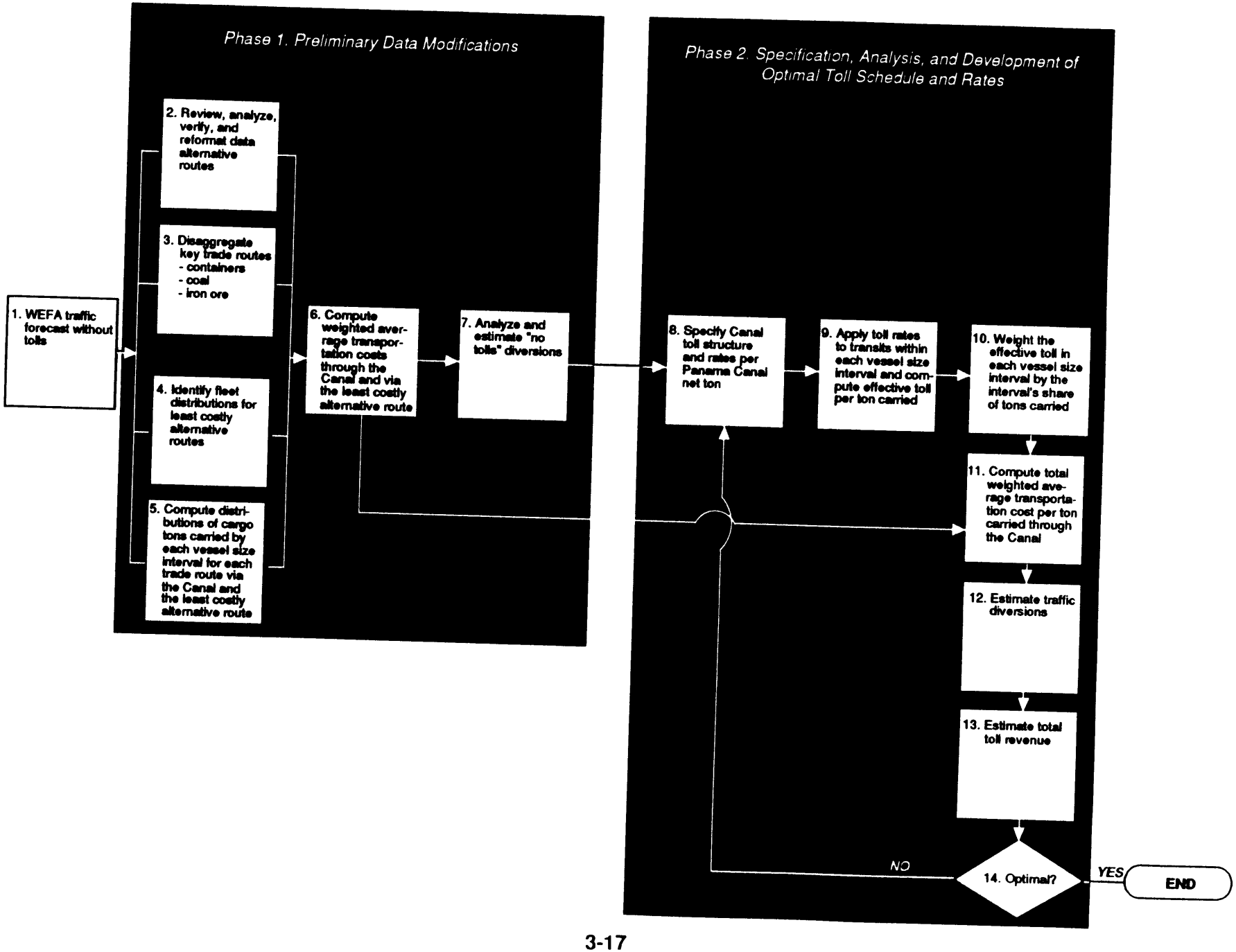
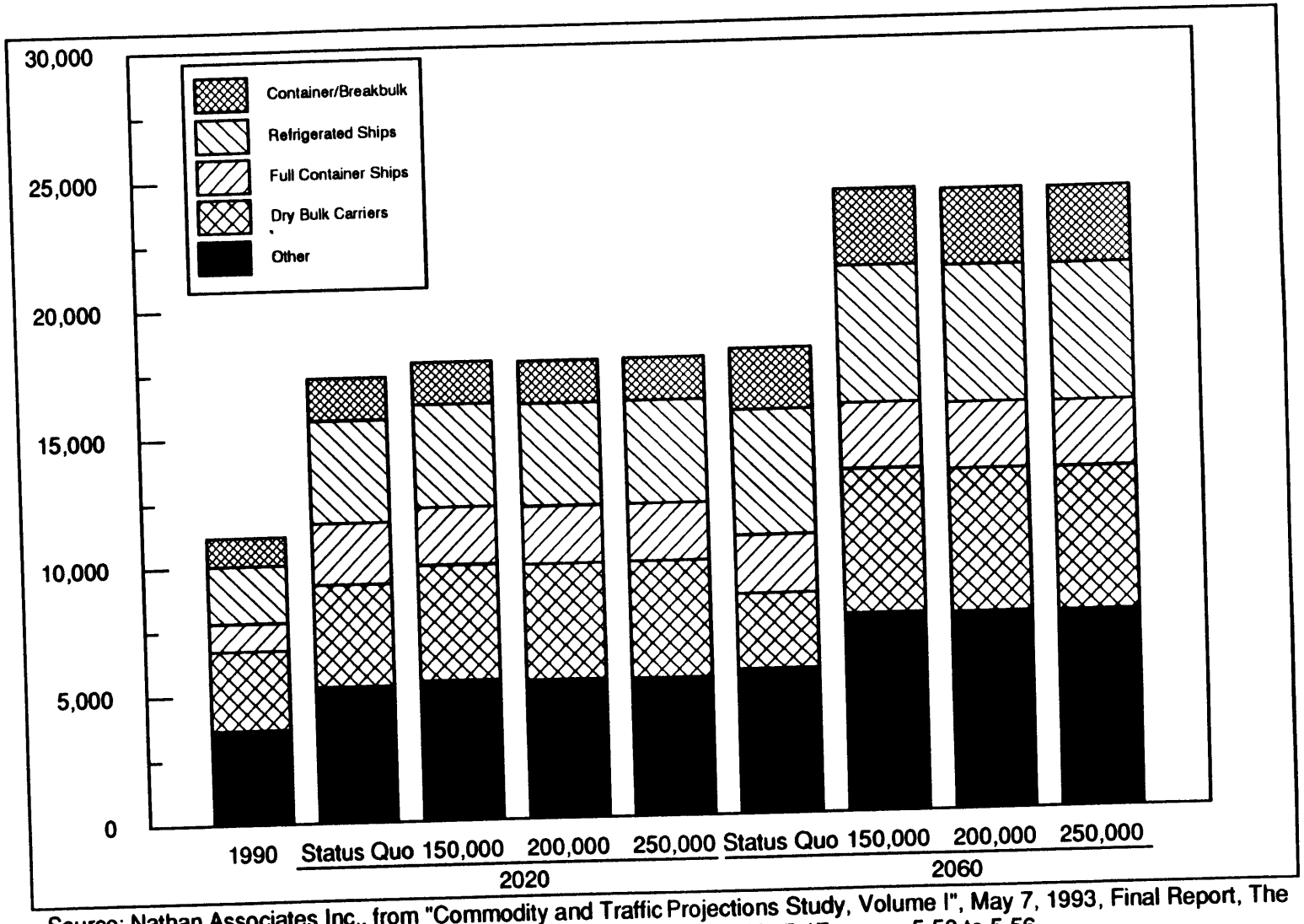
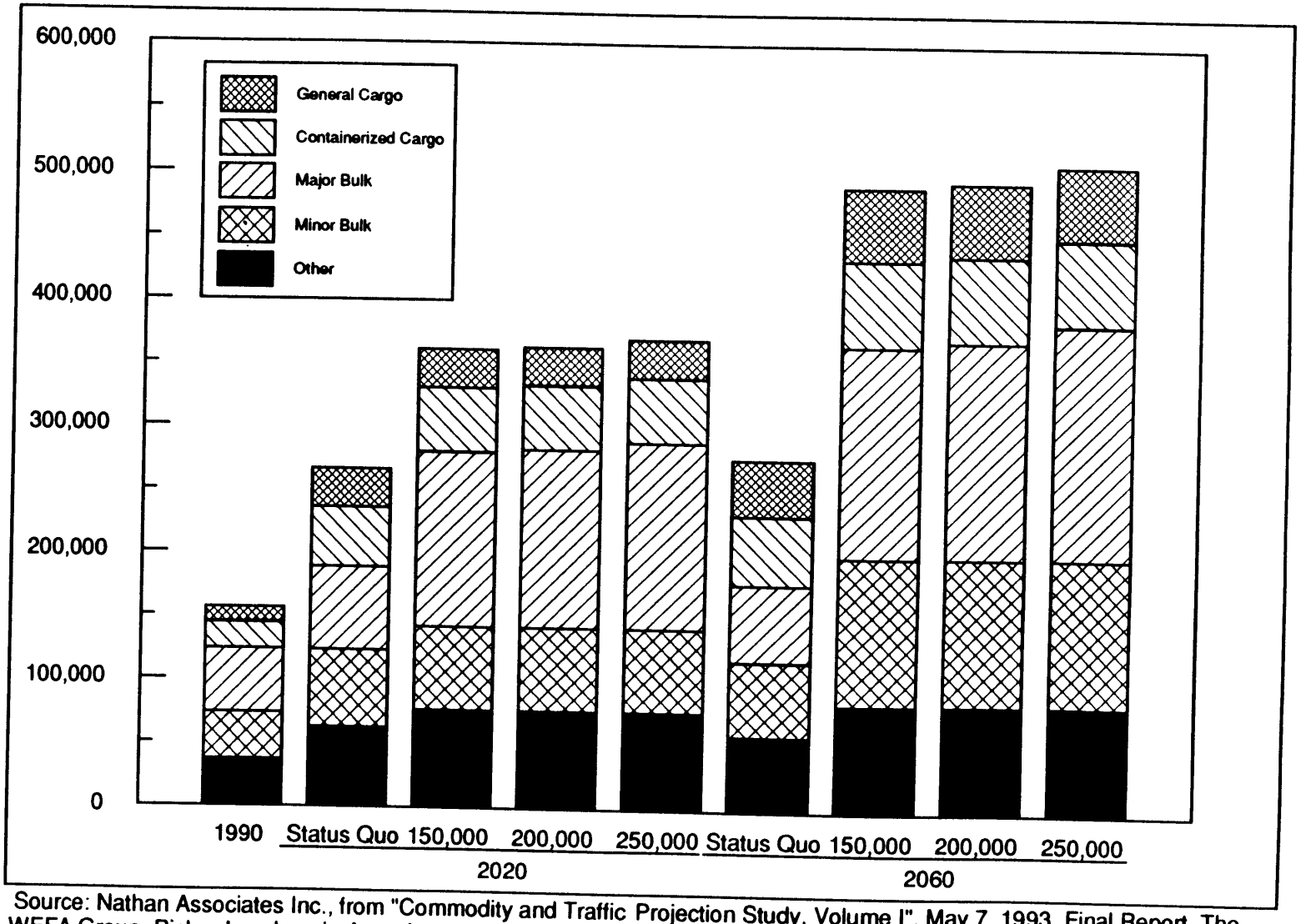


Figure 3-2. The WEFA Group Forecast of "No Tolls" Ballast and Laden Transits by Project Scenario, Ship Type, and Year



Source: Nathan Associates Inc., from "Commodity and Traffic Projections Study, Volume I", May 7, 1993, Final Report, The WEFA Group, Richardson Lawrie Associates, and BST Associates, Table 5.17, pages 5-53 to 5-56.

Figure 3-3. The WEFA Group Forecast of "No Tolls" Cargo Tonnage by Commodity, Project Scenario, and Year (thousands of tons)



Source: Nathan Associates Inc., from "Commodity and Traffic Projection Study, Volume I", May 7, 1993, Final Report, The WEFA Group, Richardson Lawrie Associates, and BST Associates, Table 5.16, pages 5-51 to 5-52.

Table 3-1. The WEFA Group Forecast of "No Tolls" Ballast and Laden Transits by Project Scenario, Ship Type, and Year

	1990			2020				2060			
	Ballast	Laden	Total	Ballast	Laden	Total	Annual Percent Change from 1990	Ballast	Laden	Total	Annual Percent Change from 1990
Status Quo a/											
Container-Breakbulk	27	1,106	1,133	41	1,620	1,661	1.3%	58	2,328	2,386	1.1%
Dry Bulk Carriers	344	2,748	3,092	376	3,609	3,985	0.8%	318	2,604	2,922	(0.1%)
Chemical Tankers	40	444	484	81	1,061	1,142	2.9%	94	1,204	1,298	1.4%
Full Container Ships	5	1,070	1,075	9	2,380	2,389	2.7%	5	2,272	2,277	1.1%
General Cargo Ships	126	783	909	140	893	1,033	0.4%	223	1,394	1,617	0.8%
Liquid Gas Carriers	69	110	179	128	221	349	2.3%	65	105	170	(0.1%)
Refrigerated Ships	522	1,717	2,239	933	3,082	4,015	2.0%	953	3,938	4,891	1.1%
Roll-on Roll-off	20	186	206	31	263	294	1.2%	55	405	460	1.2%
Oil Tankers	306	661	967	331	753	1,084	0.4%	125	267	392	(1.3%)
Vehicle Carriers	280	450	730	383	640	1,023	1.1%	440	743	1,183	0.7%
Passenger Ships	4	148	152	11	337	348	2.8%	51	435	486	1.7%
Total	1,743	9,423	11,166	2,464	14,859	17,323	1.5%	2,387	15,695	18,082	0.7%
150,000 DWT											
Container-Breakbulk	27	1,106	1,133	41	1,620	1,661	1.3%	68	2,910	2,978	1.4%
Dry Bulk Carriers	344	2,748	3,092	401	4,117	4,518	1.3%	343	5,273	5,616	0.9%
Chemical Tankers	40	444	484	81	1,061	1,142	2.9%	127	1,312	1,439	1.6%
Full Container Ships	5	1,070	1,075	9	2,242	2,251	2.5%	6	2,573	2,579	1.3%
General Cargo Ships	126	783	909	140	893	1,033	0.4%	275	1,700	1,975	1.1%
Liquid Gas Carriers	69	110	179	128	221	349	2.3%	957	138	1,095	2.6%
Refrigerated Ships	522	1,717	2,239	933	3,081	4,014	2.0%	1,069	4,276	5,345	1.3%
Roll-on Roll-off	20	186	206	31	263	294	1.2%	58	486	544	1.4%
Oil Tankers	306	661	967	427	802	1,229	0.8%	305	620	925	(0.1%)
Vehicle Carriers	280	450	730	383	640	1,023	1.1%	441	745	1,186	0.7%
Passenger Ships	4	148	152	11	337	348	2.8%	51	435	486	1.7%
Total	1,743	9,423	11,166	2,585	15,277	17,862	1.6%	3,700	20,468	24,168	1.1%

(Continued)

Table 3-1 (Continued)

	1990			2020				2060			
	Ballast	Laden	Total	Ballast	Laden	Total	Annual Percent Change from 1990	Ballast	Laden	Total	Annual Percent Change from 1990
200,000 DWT											
Container-Breakbulk	27	1,106	1,133	41	1,620	1,661	1.3%	68	2,910	2,978	1.4%
Dry Bulk Carriers	344	2,748	3,092	418	4,104	4,522	1.3%	409	5,158	5,567	0.8%
Chemical Tankers	40	444	484	81	1,061	1,142	2.9%	127	1,312	1,439	1.6%
Full Container Ships	5	1,070	1,075	9	2,242	2,251	2.5%	6	2,573	2,579	1.3%
General Cargo Ships	126	783	909	140	893	1,033	0.4%	275	1,700	1,975	1.1%
Liquid Gas Carriers	69	110	179	128	221	349	2.3%	957	138	1,095	2.6%
Refrigerated Ships	522	1,717	2,239	933	3,081	4,014	2.0%	1,069	4,276	5,345	1.3%
Roll-on Roll-off	20	186	206	31	263	294	1.2%	58	486	544	1.4%
Oil Tankers	306	661	967	392	780	1,172	0.6%	289	597	886	(0.1%)
Vehicle Carriers	280	450	730	383	640	1,023	1.1%	441	745	1,186	0.7%
Passenger Ships	4	148	152	11	337	348	2.8%	51	435	486	1.7%
Total	1,743	9,423	11,166	2,567	15,242	17,809	1.6%	3,750	20,330	24,080	1.1%
250,000 DWT											
Container-Breakbulk	27	1,106	1,133	41	1,620	1,661	1.3%	68	2,910	2,978	1.4%
Dry Bulk Carriers	344	2,748	3,092	420	4,139	4,559	1.3%	343	5,227	5,570	0.8%
Chemical Tankers	40	444	484	81	1,061	1,142	2.9%	127	1,312	1,439	1.6%
Full Container Ships	5	1,070	1,075	9	2,242	2,251	2.5%	6	2,573	2,579	1.3%
General Cargo Ships	126	783	909	140	893	1,033	0.4%	275	1,700	1,975	1.1%
Liquid Gas Carriers	69	110	179	128	221	349	2.3%	957	138	1,095	2.6%
Refrigerated Ships	522	1,717	2,239	933	3,081	4,014	2.0%	1,069	4,276	5,345	1.3%
Roll-on Roll-off	20	186	206	31	263	294	1.2%	58	485	543	1.4%
Oil Tankers	306	661	967	382	766	1,148	0.6%	279	584	863	(0.2%)
Vehicle Carriers	280	450	730	383	640	1,023	1.1%	441	745	1,186	0.7%
Passenger Ships	4	148	152	11	337	348	2.8%	51	435	486	1.7%
Total	1,743	9,423	11,166	2,559	15,263	17,822	1.6%	3,674	20,385	24,059	1.1%

Note: Some of the numbers will not match those shown in The WEFA Group's Final Report because they contained some typographical errors and have since been corrected.

a/ Status Quo is a 65,000 DWT Scenario.

Source: Nathan Associates Inc., from "Commodity and Traffic Projections Study, Volume I", May 7, 1993,Final Report, The WEFA Group, Richardson Lawrie Associates, and BST Associates, Table 5.17, pages 5-53 to 5-56.

Table 3-2. The WEFA Group Forecast of "No Tolls" Tonnage by Commodity, Project Scenario, and Year (thousands of tons, except as noted)

Project Scenario and Commodity	Cargo Flows			Annual Growth Rate		
	1990	2020	2060	1990-2020	2020-2060	1990-2060
Status Quo a/						
Bauxite/Alumina	2,906	9,489	281	4.0%	(8.4%)	(3.3%)
Bulk Chemicals	6,967	22,920	32,161	4.0%	0.9%	2.2%
Bulk Grains	23,528	44,356	56,607	2.1%	0.6%	1.3%
Coal & Coke	10,978	5,507	3,419	(2.3%)	(1.2%)	(1.7%)
Containerized Cargo	20,840	46,835	54,313	2.7%	0.4%	1.4%
Crude Petroleum	9,621	5,008	459	(2.2%)	(5.8%)	(4.3%)
Fertilizers	13,009	8,229	8,595	(1.5%)	0.1%	(0.6%)
General Cargo	11,980	30,477	44,251	3.2%	0.9%	1.9%
Iron Ore	581	1,362	202	2.9%	(4.7%)	(1.5%)
Minor Bulks	36,806	57,404	49,802	1.5%	(0.4%)	0.4%
Oils and Fats	729	1,449	1,996	2.3%	0.8%	1.4%
Petroleum Products	12,490	16,995	4,140	1.0%	(3.5%)	(1.6%)
Refrigerated Cargo	5,389	13,614	18,496	3.1%	0.8%	1.8%
Vehicles	1,647	2,317	1,807	1.1%	(0.6%)	0.1%
Total	157,471	265,962	276,529	1.8%	0.1%	0.8%
150,000 DWT						
Bauxite/Alumina	2,906	9,489	5,407	4.0%	(1.4%)	0.9%
Bulk Chemicals	6,967	22,920	33,857	4.0%	1.0%	2.3%
Bulk Grains	23,528	44,356	66,902	2.1%	1.0%	1.5%
Coal & Coke	10,978	63,818	82,772	6.0%	0.7%	2.9%
Containerized Cargo	20,840	50,611	67,180	3.0%	0.7%	1.7%
Crude Petroleum	9,621	19,008	16,548	2.3%	(0.3%)	0.8%
Fertilizers	13,009	8,229	19,674	(1.5%)	2.2%	0.6%
General Cargo	11,980	30,477	57,245	3.2%	1.6%	2.3%
Iron Ore	581	20,302	11,071	12.6%	(1.5%)	4.3%
Minor Bulks	36,806	57,404	96,078	1.5%	1.3%	1.4%
Oils and Fats	729	1,449	2,549	2.3%	1.4%	1.8%
Petroleum Products	12,490	16,995	8,311	1.0%	(1.8%)	(0.6%)
Refrigerated Cargo	5,389	13,614	21,223	3.1%	1.1%	2.0%
Vehicles	1,647	2,317	1,829	1.1%	(0.6%)	0.1%
Total	157,471	360,989	490,646	2.8%	0.8%	1.6%

(Continued)

Table 3-2. (Continued)

Project Scenario and Commodity	Cargo Flows			Annual Growth Rate		
	1990	2020	2060	1990-2020	2020-2060	1990-2060
200,000 DWT						
Bauxite/Alumina	2,906	9,489	5,407	4.0%	(1.4%)	0.9%
Bulk Chemicals	6,967	22,920	33,857	4.0%	1.0%	2.3%
Bulk Grains	23,528	44,356	66,902	2.1%	1.0%	1.5%
Coal & Coke	10,978	63,818	82,772	6.0%	0.7%	2.9%
Containerized Cargo	20,840	50,611	67,180	3.0%	0.7%	1.7%
Crude Petroleum	9,621	19,008	16,548	2.3%	(0.3%)	0.8%
Fertilizers	13,009	8,229	19,674	(1.5%)	2.2%	0.6%
General Cargo	11,980	30,477	57,245	3.2%	1.6%	2.3%
Iron Ore	581	22,624	15,150	13.0%	(1.0%)	4.8%
Minor Bulks	36,806	57,404	96,078	1.5%	1.3%	1.4%
Oils and Fats	729	1,449	2,549	2.3%	1.4%	1.8%
Petroleum Products	12,490	16,995	8,311	1.0%	(1.8%)	(0.6%)
Refrigerated Cargo	5,389	13,614	21,223	3.1%	1.1%	2.0%
Vehicles	1,647	2,317	1,829	1.1%	(0.6%)	0.1%
Total	157,471	363,311	494,725	2.8%	0.8%	1.6%
250,000 DWT						
Bauxite/Alumina	2,906	9,489	5,407	4.0%	(1.4%)	0.9%
Bulk Chemicals	6,967	22,920	33,857	4.0%	1.0%	2.3%
Bulk Grains	23,528	44,356	66,902	2.1%	1.0%	1.5%
Coal & Coke	10,978	63,818	82,772	6.0%	0.7%	2.9%
Containerized Cargo	20,840	50,611	67,180	3.0%	0.7%	1.7%
Crude Petroleum	9,621	19,008	16,548	2.3%	(0.3%)	0.8%
Fertilizers	13,009	8,229	19,674	(1.5%)	2.2%	0.6%
General Cargo	11,980	30,477	57,245	3.2%	1.6%	2.3%
Iron Ore	581	29,145	28,951	13.9%	0.0%	5.7%
Minor Bulks	36,806	57,404	96,078	1.5%	1.3%	1.4%
Oils and Fats	729	1,449	2,549	2.3%	1.4%	1.8%
Petroleum Products	12,490	16,995	8,311	1.0%	(1.8%)	(0.6%)
Refrigerated Cargo	5,389	13,614	21,223	3.1%	1.1%	2.0%
Vehicles	1,647	2,317	1,829	1.1%	(0.6%)	0.1%
Total	157,471	369,832	508,526	2.9%	0.8%	1.7%

a/ Status Quo is a 65,000 DWT Scenario.

Source: Nathan Associates Inc., from "Commodity and Traffic Projections Study, Volume I", May 7, 1993, Final Report, The WEFA Group, Richardson Lawrie Associates, and BST Associates, Table 5.16, pages 5-51 and 5-52.

Table 3-3. Cargo Assumptions by Ship Type

Ship Type and DWT Size Interval	Cargo Assumption Expressed as a Percentage of Ship Deadweight
Container-Breakbulk	65.0%
Dry Bulk Carriers	90.0%
Chemical Tankers	90.0%
Full Container Ships	
5,510 DWT	32.3%
20,700 DWT	32.3%
32,700 DWT	38.8%
36,400 DWT	39.3%
48,080 DWT	38.5%
56,000 DWT	38.5%
90,000 DWT	38.5%
148,000 DWT	35.1%
General Cargo Ships	90.0%
Liquid Gas Carriers	
5,270 DWT	33.0%
18,900 DWT	63.0%
45,120 DWT	71.0%
Refrigerated Ships	50.0%
Roll-On Roll-Off	32.0%
Oil Tankers	95.0%
Vehicle Carriers	
8,290 DWT	22.5%
14,500 DWT	21.7%
28,570 DWT	20.2%

Source: Nathan Associates Inc., data provided by The WEFA Group.

Table 3-4. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, Status Quo Scenario, 2020, by Ship Type

Ship Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,317	7	1,325	0.56	20,424	95	20,519	0.46	36,989	48	37,037	0.13
Dry Bulk Carriers	3,399	79	3,477	2.26	121,159	2,240	123,399	1.82	145,078	1,767	146,845	1.20
Chemical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	26,730	90	26,819	0.33
Full Container Ships	969	338	1,307	25.88	17,176	5,363	22,539	23.79	52,808	15,375	68,183	22.55
General Cargo Ships	757	1	758	0.14	7,489	10	7,499	0.13	13,179	5	13,184	0.04
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	5,739	0	5,739	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	6,145	0	6,145	0.00
Refrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	54,985	398	55,382	0.72
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	8,635	108	8,743	1.23
Tankers	523	170	693	24.52	13,759	6,310	20,068	31.44	18,551	9,044	27,595	32.77
Vehicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	48,505	14	48,519	0.03
Total	12,116	628	12,744	4.93	219,065	14,285	233,349	6.12	417,343	26,848	444,191	6.04

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2098 transits and 35979616 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by the WEFA Group.

Table 3-5. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, 150,000-DWT Scenario, 2020, by Ship Type

ıip Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
›ntainer-Breakbulk	1,317	7	1,325	0.56	20,424	95	20,519	0.46	36,989	48	37,037	0.13
:y Bulk Carriers	3,807	74	3,881	1.90	184,013	2,240	186,253	1.20	214,087	2,811	216,898	1.30
›emical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	26,730	90	26,819	0.33
ıll Container Ships	1,251	0	1,251	0.00	24,619	0	24,619	0.00	76,708	0	76,708	0.00
›neral Cargo Ships	757	1	758	0.14	7,489	10	7,499	0.13	13,179	5	13,184	0.04
iquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	5,739	0	5,739	0.00
assenger Ships	336	0	336	0.00	0	0	0	0.00	6,145	0	6,145	0.00
efrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	54,985	398	55,382	0.72
oll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	8,635	108	8,743	1.23
ankers	702	49	751	6.48	32,248	1,967	34,216	5.75	39,772	2,339	42,111	5.55
ehicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	48,505	14	48,519	0.03
Total	12,987	163	13,150	1.24	307,852	4,579	312,431	1.47	531,473	5,812	537,284	1.08

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total f 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2111 ransits and 51867350 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons ere excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. he extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-6. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, 200,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,317	7	1,325	0.56	20,424	95	20,519	0.46	36,989	48	37,037	0.13
Dry Bulk Carriers	3,923	74	3,997	1.84	201,198	2,240	203,439	1.10	231,856	2,811	234,666	1.20
Chemical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	26,730	90	26,819	0.33
Full Container Ships	1,251	0	1,251	0.00	24,619	0	24,619	0.00	76,708	0	76,708	0.00
General Cargo Ships	757	1	758	0.14	7,489	10	7,499	0.13	13,179	5	13,184	0.04
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	5,739	0	5,739	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	6,145	0	6,145	0.00
Refrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	54,985	398	55,382	0.72
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	8,635	108	8,743	1.23
Tankers	680	49	728	6.68	32,248	1,967	34,216	5.75	39,772	2,339	42,111	5.55
Vehicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	48,505	14	48,519	0.03
Total	13,080	163	13,243	1.23	325,037	4,579	329,616	1.39	549,241	5,812	555,053	1.05

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 transits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-7. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, 250,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
ıip Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
ɔntainer-Breakbulk	1,317	7	1,325	0.56	20,424	95	20,519	0.46	36,989	48	37,037	0.13
ɛy Bulk Carriers	3,957	74	4,030	1.83	207,720	2,240	209,960	1.07	238,514	2,811	241,325	1.16
ıemical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	26,730	90	26,819	0.33
ıll Container Ships	1,251	0	1,251	0.00	24,619	0	24,619	0.00	76,708	0	76,708	0.00
ɜneral Cargo Ships	757	1	758	0.14	7,489	10	7,499	0.13	13,179	5	13,184	0.04
ıquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	5,739	0	5,739	0.00
ɜssenger Ships	336	0	336	0.00	0	0	0	0.00	6,145	0	6,145	0.00
ɜfrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	54,985	398	55,382	0.72
ɔll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	8,635	108	8,743	1.23
ɜnkers	666	49	715	6.81	32,248	1,967	34,216	5.75	39,772	2,339	42,111	5.55
ɜhicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	48,505	14	48,519	0.03
Total	13,100	163	13,263	1.23	331,558	4,579	336,138	1.36	555,899	5,812	561,711	1.03

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total ɛ 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 ɾansits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons ɜre excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. ɜe extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-8. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, Status Quo Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
hip Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
ontainer-Breakbulk	2,310	0	2,310	0.00	34,316	0	34,316	0.00	64,410	0	64,410	0.00
y Bulk Carriers	2,552	0	2,552	0.00	112,337	0	112,337	0.00	130,296	0	130,296	0.00
emical Tankers	1,183	0	1,183	0.00	32,247	0	32,247	0.00	37,096	0	37,096	0.00
ll Container Ships	1,498	0	1,498	0.00	28,061	0	28,061	0.00	85,542	0	85,542	0.00
neral Cargo Ships	1,381	2	1,383	0.13	13,345	13	13,357	0.10	23,527	35	23,561	0.15
iquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	3,148	0	3,148	0.00
assenger Ships	435	0	435	0.00	0	0	0	0.00	6,694	0	6,694	0.00
efrigerated Ships	3,897	0	3,897	0.00	15,828	0	15,828	0.00	90,982	0	90,982	0.00
oll-On Roll-Off	397	0	397	0.02	2,929	0	2,929	0.01	15,542	3	15,545	0.02
ankers	266	0	266	0.00	6,016	0	6,016	0.00	8,263	0	8,263	0.00
ehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	56,272	42	56,314	0.07
Total	14,747	3	14,750	0.02	248,977	16	248,993	0.01	521,772	80	521,852	0.02

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total f 13 transits and 219227 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 934 ransits and 22985287 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons ere excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. he extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-9. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, 150,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
hip Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
ontainer-Breakbulk	2,465	0	2,465	0.00	36,996	0	36,996	0.00	68,785	0	68,785	0.00
ry Bulk Carriers	4,972	72	5,044	1.43	271,004	3,196	274,199	1.17	299,723	3,912	303,635	1.29
hemical Tankers	1,224	0	1,224	0.00	32,988	0	32,988	0.00	38,182	0	38,182	0.00
ull Container Ships	1,460	10	1,470	0.70	31,607	179	31,786	0.56	99,139	109	99,249	0.11
eneral Cargo Ships	1,462	2	1,464	0.15	13,971	20	13,991	0.14	25,195	43	25,239	0.17
iquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	3,148	0	3,148	0.00
assenger Ships	435	0	435	0.00	0	0	0	0.00	6,694	0	6,694	0.00
efrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	91,800	926	92,726	1.00
oll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	15,542	188	15,730	1.19
ankers	589	0	589	0.00	27,821	0	27,821	0.00	33,397	0	33,397	0.00
ehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	56,272	42	56,314	0.07
Total	17,770	134	17,904	0.75	437,183	3,751	440,934	0.85	737,878	5,220	743,099	0.70

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total f 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2536 ransits and 56215466 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons ere excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. he extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-10. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, 200,000-DWT Scenario, 2060, by Ship Type

Ship Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,465	0	2,465	0.00	36,996	0	36,996	0.00	68,785	0	68,785	0.00
Dry Bulk Carriers	4,871	115	4,986	2.30	275,435	9,530	284,965	3.34	318,118	7,507	325,625	2.31
Chemical Tankers	1,224	0	1,224	0.00	32,988	0	32,988	0.00	38,182	0	38,182	0.00
Full Container Ships	1,460	10	1,470	0.70	31,607	179	31,786	0.56	99,139	109	99,249	0.11
General Cargo Ships	1,462	2	1,464	0.15	13,971	20	13,991	0.14	25,195	43	25,239	0.17
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	3,148	0	3,148	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	6,694	0	6,694	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	91,800	926	92,726	1.00
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	15,542	188	15,730	1.19
Tankers	567	0	567	0.00	27,821	0	27,821	0.00	33,393	0	33,393	0.00
Vehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	56,272	42	56,314	0.07
Total	17,646	176	17,822	0.99	441,614	10,086	451,699	2.23	756,269	8,816	765,085	1.15

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-11. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure and Rates, 250,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,465	0	2,465	0.00	36,996	0	36,996	0.00	68,785	0	68,785	0.00
Dry Bulk Carriers	4,988	69	5,057	1.37	295,921	2,844	298,765	0.95	339,155	3,622	342,777	1.06
Chemical Tankers	1,224	0	1,224	0.00	32,988	0	32,988	0.00	38,182	0	38,182	0.00
Full Container Ships	1,460	10	1,470	0.70	31,607	179	31,786	0.56	99,139	109	99,249	0.11
General Cargo Ships	1,462	2	1,464	0.15	13,971	20	13,991	0.14	25,195	43	25,239	0.17
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	3,148	0	3,148	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	6,694	0	6,694	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	91,800	926	92,726	1.00
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	15,542	188	15,730	1.19
Tankers	553	0	553	0.00	27,821	0	27,821	0.00	33,393	0	33,393	0.00
Vehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	56,272	42	56,314	0.07
Total	17,748	131	17,879	0.73	462,101	3,399	465,499	0.73	777,306	4,930	782,236	0.63

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-12. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, Status Quo Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	55,315	194	55,509	0.35
Dry Bulk Carriers	3,082	395	3,477	11.36	109,510	13,889	123,399	11.26	197,280	21,978	219,259	10.02
Chemical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	40,095	90	40,184	0.22
Full Container Ships	957	350	1,307	26.81	17,031	5,508	22,539	24.44	78,627	15,849	94,476	16.78
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	19,695	88	19,783	0.45
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	8,608	0	8,608	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	9,217	0	9,217	0.00
Refrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	82,477	398	82,875	0.48
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	12,953	108	13,060	0.82
Tankers	521	172	693	24.84	13,672	6,396	20,068	31.87	27,690	9,165	36,855	24.87
Vehicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	72,758	14	72,771	0.02
Total	11,780	964	12,744	7.56	207,112	26,238	233,349	11.24	604,714	47,884	652,598	7.34

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2098 transits and 35979616 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by the WEFA Group.

Table 3-13. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, 150,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
hip Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
ontainer-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	55,315	194	55,509	0.35
ry Bulk Carriers	3,606	275	3,881	7.08	176,352	9,901	186,253	5.32	307,668	14,843	322,511	4.60
hemical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	40,095	90	40,184	0.22
ull Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	114,477	474	114,951	0.41
eneral Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	19,695	88	19,783	0.45
iquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	8,608	0	8,608	0.00
assenger Ships	336	0	336	0.00	0	0	0	0.00	9,217	0	9,217	0.00
efrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	82,477	398	82,875	0.48
oll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	12,953	108	13,060	0.82
ankers	700	51	751	6.77	32,162	2,054	34,216	6.00	59,522	2,460	61,982	3.97
ehicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	72,758	14	72,771	0.02
Total	12,766	384	13,150	2.92	299,887	12,544	312,431	4.02	782,784	18,668	801,452	2.33

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2111 transits and 51867350 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-14. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, 200,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	55,315	194	55,509	0.35
Dry Bulk Carriers	3,600	396	3,997	9.91	176,815	26,624	203,439	13.09	308,406	37,453	345,859	10.83
Chemical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	40,095	90	40,184	0.22
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	114,477	474	114,951	0.41
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	19,695	88	19,783	0.45
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	8,608	0	8,608	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	9,217	0	9,217	0.00
Refrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	82,477	398	82,875	0.48
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	12,953	108	13,060	0.82
Tankers	678	51	728	6.98	32,162	2,054	34,216	6.00	59,521	2,460	61,981	3.97
Vehicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	72,758	14	72,771	0.02
Total	12,738	505	13,243	3.81	300,349	29,267	329,616	8.88	783,521	41,278	824,799	5.00

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 transits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-15. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, 250,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	55,315	194	55,509	0.35
Dry Bulk Carriers	3,744	287	4,030	7.12	198,202	11,758	209,960	5.60	341,408	17,350	358,758	4.84
Chemical Tankers	992	2	994	0.22	22,841	84	22,925	0.37	40,095	90	40,184	0.22
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	114,477	474	114,951	0.41
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	19,695	88	19,783	0.45
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	8,608	0	8,608	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	9,217	0	9,217	0.00
Refrigerated Ships	2,819	29	2,847	1.00	10,116	151	10,266	1.47	82,477	398	82,875	0.48
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	12,953	108	13,060	0.82
Tankers	664	51	715	7.11	32,162	2,054	34,216	6.00	59,521	2,460	61,981	3.97
Vehicle Carriers	623	0	623	0.05	2,423	1	2,424	0.04	72,758	14	72,771	0.02
Total	12,867	396	13,263	2.98	321,737	14,401	336,138	4.28	816,523	21,175	837,698	2.53

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 transits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-16. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, Status Quo Scenario, 2060, by Ship Type

Ship Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,310	0	2,310	0.00	34,316	0	34,316	0.00	96,615	0	96,615	0.00
Dry Bulk Carriers	2,552	0	2,552	0.00	112,337	0	112,337	0.00	195,445	0	195,445	0.00
Chemical Tankers	1,183	0	1,183	0.00	32,247	0	32,247	0.00	55,643	0	55,643	0.00
Full Container Ships	1,171	327	1,498	21.86	22,363	5,698	28,061	20.31	103,231	23,125	126,356	18.30
General Cargo Ships	1,377	6	1,383	0.42	13,319	38	13,357	0.28	35,145	197	35,343	0.56
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	4,722	0	4,722	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	10,041	0	10,041	0.00
Refrigerated Ships	3,897	0	3,897	0.00	15,828	0	15,828	0.00	136,473	0	136,473	0.00
Roll-On Roll-Off	397	0	397	0.02	2,929	0	2,929	0.01	23,313	3	23,316	0.01
Tankers	266	0	266	0.00	6,016	0	6,016	0.00	12,394	0	12,394	0.00
Vehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	84,408	42	84,450	0.05
Total	14,416	334	14,750	2.27	243,253	5,739	248,993	2.30	757,432	23,367	780,799	2.99

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 13 transits and 219227 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 934 transits and 22985287 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by the WEFA Group.

Table 3-17. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, 150,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,460	4	2,465	0.17	36,908	88	36,996	0.24	102,915	226	103,141	0.22
Dry Bulk Carriers	4,676	368	5,044	7.30	259,308	14,891	274,199	5.43	429,058	26,620	455,678	5.84
Chemical Tankers	1,224	0	1,224	0.00	32,988	0	32,988	0.00	57,274	0	57,274	0.00
Full Container Ships	1,460	10	1,470	0.70	31,607	179	31,786	0.56	148,709	109	148,818	0.07
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	37,649	206	37,854	0.54
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	4,722	0	4,722	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	10,041	0	10,041	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	137,700	926	138,627	0.67
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	23,313	188	23,501	0.80
Tankers	562	27	589	4.63	26,815	1,006	27,821	3.62	48,297	1,609	49,906	3.22
Vehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	84,408	42	84,450	0.05
Total	17,438	466	17,904	2.60	424,368	16,566	440,934	3.76	1,084,086	29,926	1,114,012	2.69

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2536 transits and 56215466 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-18. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, 200,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,460	4	2,465	0.17	36,908	88	36,996	0.24	102,915	226	103,141	0.22
Dry Bulk Carriers	4,592	393	4,986	7.89	263,612	21,353	284,965	7.49	456,646	26,406	483,053	5.47
Chemical Tankers	1,224	0	1,224	0.00	32,988	0	32,988	0.00	57,274	0	57,274	0.00
Full Container Ships	1,460	10	1,470	0.70	31,607	179	31,786	0.56	148,709	109	148,818	0.07
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	37,649	206	37,854	0.54
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	4,722	0	4,722	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	10,041	0	10,041	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	137,700	926	138,627	0.67
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	23,313	188	23,501	0.80
Tankers	539	27	567	4.82	26,815	1,006	27,821	3.62	48,291	1,609	49,900	3.23
Vehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	84,408	42	84,450	0.05
Total	17,331	491	17,822	2.75	428,672	23,028	451,699	5.10	1,111,668	29,712	1,141,380	2.60

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-19. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 50 Percent Increase in Rates, 250,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,460	4	2,465	0.17	36,908	88	36,996	0.24	102,915	226	103,141	0.22
Dry Bulk Carriers	4,698	359	5,057	7.09	282,153	16,612	298,765	5.56	485,174	27,338	512,512	5.33
Chemical Tankers	1,224	0	1,224	0.00	32,988	0	32,988	0.00	57,274	0	57,274	0.00
Full Container Ships	1,460	10	1,470	0.70	31,607	179	31,786	0.56	148,709	109	148,818	0.07
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	37,649	206	37,854	0.54
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	4,722	0	4,722	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	10,041	0	10,041	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	137,700	926	138,627	0.67
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	23,313	188	23,501	0.80
Tankers	526	27	553	4.94	26,815	1,006	27,821	3.62	48,291	1,609	49,900	3.23
Vehicle Carriers	723	1	724	0.10	2,828	3	2,831	0.10	84,408	42	84,450	0.05
Total	17,423	456	17,879	2.55	447,212	18,287	465,499	3.93	1,140,196	30,644	1,170,840	2.62

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-20. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, Status Quo Scenario, 2020, by Ship Type

Ship Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,073	404	3,477	11.61	109,208	14,191	123,399	11.50	262,281	22,753	285,034	7.98
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,451	97	53,548	0.18
Full Container Ships	957	350	1,307	26.81	17,031	5,508	22,539	24.44	104,837	15,849	120,686	13.13
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,477	0	11,477	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,289	0	12,289	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	519	175	693	25.19	13,620	6,448	20,068	32.13	36,797	9,290	46,086	20.16
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,873	1,040	96,913	1.07
Total	11,756	988	12,744	7.76	206,731	26,619	233,349	11.41	804,056	50,033	854,090	5.86

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2098 transits and 35979616 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by the WEFA Group.

Table 3-21. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, 150,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,487	394	3,881	10.16	169,946	16,307	186,253	8.76	395,765	29,634	425,399	6.97
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,451	97	53,548	0.18
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	152,636	474	153,110	0.31
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,477	0	11,477	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,289	0	12,289	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	509	242	751	32.27	13,620	20,596	34,216	60.19	36,726	44,876	81,602	54.99
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,873	1,040	96,913	1.07
Total	12,442	708	13,150	5.39	274,912	37,519	312,431	12.01	985,269	77,126	1,062,395	7.26

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2111 transits and 51867350 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-22. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, 200,000-DWT Scenario, 2020, by Ship Type

Ship Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,481	516	3,997	12.90	170,408	33,030	203,439	16.24	396,749	52,244	448,993	11.64
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,451	97	53,548	0.18
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	152,636	474	153,110	0.31
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,477	0	11,477	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,289	0	12,289	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	590	139	728	19.06	27,767	6,448	34,216	18.85	66,688	14,571	81,259	17.93
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,873	1,040	96,913	1.07
Total	12,517	726	13,243	5.48	289,522	40,095	329,616	12.16	1,016,215	69,431	1,085,646	6.40

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 transits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-23. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, 250,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,624	406	4,030	10.08	191,796	18,164	209,960	8.65	440,751	32,141	472,892	6.80
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,451	97	53,548	0.18
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	152,636	474	153,110	0.31
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,477	0	11,477	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,289	0	12,289	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	576	139	715	19.42	27,767	6,448	34,216	18.85	66,688	14,571	81,259	17.93
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,873	1,040	96,913	1.07
Total	12,646	617	13,263	4.65	310,909	25,229	336,138	7.51	1,060,217	49,328	1,109,545	4.45

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 transits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-24. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, Status Quo Scenario, 2060, by Ship Type

Ship Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,310	0	2,310	0.00	34,316	0	34,316	0.00	128,820	0	128,820	0.00
Dry Bulk Carriers	2,552	0	2,552	0.00	112,337	0	112,337	0.00	260,593	0	260,593	0.00
Chemical Tankers	1,183	0	1,183	0.00	32,247	0	32,247	0.00	74,191	0	74,191	0.00
Full Container Ships	960	538	1,498	35.93	18,154	9,906	28,061	35.30	102,941	59,655	162,596	36.69
General Cargo Ships	1,377	6	1,383	0.42	13,319	38	13,357	0.28	46,860	197	47,058	0.42
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,897	0	3,897	0.00	15,828	0	15,828	0.00	181,965	0	181,965	0.00
Roll-On Roll-Off	397	0	397	0.02	2,929	0	2,929	0.01	31,084	3	31,087	0.01
Tankers	266	0	266	0.00	6,016	0	6,016	0.00	16,526	0	16,526	0.00
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,614	1,982	112,596	1.76
Total	14,192	557	14,750	3.78	239,015	9,977	248,993	4.01	973,279	61,837	1,035,116	5.97

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 13 transits and 219227 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 934 transits and 22985287 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by the WEFA Group.

Table 3-25. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, 150,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,459	6	2,465	0.23	36,883	113	36,996	0.31	137,143	297	137,439	0.22
Dry Bulk Carriers	4,628	416	5,044	8.26	257,525	16,674	274,199	6.08	567,577	30,934	598,511	5.17
Chemical Tankers	1,223	1	1,224	0.10	32,940	48	32,988	0.15	76,249	104	76,353	0.14
Full Container Ships	1,438	33	1,470	2.24	31,321	465	31,786	1.46	196,721	1,704	198,425	0.86
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	50,198	206	50,404	0.41
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	183,600	926	184,527	0.50
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	31,084	188	31,272	0.60
Tankers	394	195	589	33.12	9,634	18,187	27,821	65.37	25,612	42,174	67,786	62.22
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,614	1,982	112,596	1.76
Total	17,184	720	17,904	4.02	405,015	35,918	440,934	8.15	1,398,483	78,514	1,476,997	5.32

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2536 transits and 56215466 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-26. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, 200,000-DWT Scenario, 2060, by Ship Type

Ship Type	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,459	6	2,465	0.23	36,883	113	36,996	0.31	137,143	297	137,439	0.22
Dry Bulk Carriers	4,515	471	4,986	9.44	260,009	24,956	284,965	8.76	599,994	34,530	634,524	5.44
Chemical Tankers	1,223	1	1,224	0.10	32,940	48	32,988	0.15	76,249	104	76,353	0.14
Full Container Ships	1,438	33	1,470	2.24	31,321	465	31,786	1.46	196,721	1,704	198,425	0.86
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	50,198	206	50,404	0.41
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	183,600	926	184,527	0.50
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	31,084	188	31,272	0.60
Tankers	471	95	567	16.79	23,684	4,137	27,821	14.87	55,340	10,411	65,751	15.83
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,614	1,982	112,596	1.76
Total	17,148	674	17,822	3.78	421,549	30,150	451,699	6.67	1,460,629	50,347	1,510,975	3.33

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-27. Laden Transits, Tons Carried, and Toll Revenue, Current Toll Structure with 100 Percent Increase in Rates, 250,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,459	6	2,465	0.23	36,883	113	36,996	0.31	137,143	297	137,439	0.22
Dry Bulk Carriers	4,621	436	5,057	8.62	278,550	20,215	298,765	6.77	638,032	35,462	673,493	5.27
Chemical Tankers	1,223	1	1,224	0.10	32,940	48	32,988	0.15	76,249	104	76,353	0.14
Full Container Ships	1,438	33	1,470	2.24	31,321	465	31,786	1.46	196,721	1,704	198,425	0.86
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	50,198	206	50,404	0.41
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	183,600	926	184,527	0.50
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	31,084	188	31,272	0.60
Tankers	458	95	553	17.21	23,684	4,137	27,821	14.87	55,340	10,411	65,751	15.83
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,614	1,982	112,596	1.76
Total	17,240	639	17,879	3.57	440,090	25,410	465,499	5.46	1,498,666	51,278	1,549,944	3.31

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transitting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-28. Optimal Toll Structure and Rates (1990 US$)

Project Year, Scenario, and Ship Type	Laden	Ballast
2020		
Status Quo		
All Vessels	4.02	3.20
150,00 DWT		
Tankers less than 40,000 Panama Canal Net Tons	4.02	3.20
Tankers larger than or equal to 40,000 Panama Canal Net Tons	3.30	2.63
All Other Vessels	4.02	3.20
200,00 DWT		
Dry Bulk Carriers less than 70,000 Panama Canal Net Tons	4.02	3.20
Dry Bulk Carriers larger than or equal to 70,000 Panama Canal Net Tons	1.51	1.20
Tankers less than 40,000 Panama Canal Net Tons	4.02	3.20
Tankers larger than or equal to 40,000 Panama Canal Net Tons	3.30	2.63
All Other Vessels	4.02	3.20
250,00 DWT		
Tankers less than 40,000 Panama Canal Net Tons	4.02	3.20
Tankers larger than or equal to 40,000 Panama Canal Net Tons	3.30	2.63
All Other Vessels	4.02	3.20
2060		
Status Quo		
All Vessels	4.02	3.20
150,000 DWT		
All Vessels	4.02	3.20
200,000 DWT		
All Vessels	4.02	3.20
250,000 DWT		
All Vessels	4.02	3.20

Source: Nathan Associates Inc.

Table 3-29. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, Status Quo Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,073	404	3,477	11.61	109,208	14,191	123,399	11.50	262,280	22,753	285,033	7.98
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,450	97	53,547	0.18
Full Container Ships	957	350	1,307	26.81	17,031	5,508	22,539	24.44	104,837	15,849	120,686	13.13
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,478	0	11,478	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,290	0	12,290	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	519	175	693	25.19	13,620	6,448	20,068	32.13	36,796	9,290	46,086	20.16
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,874	1,040	96,914	1.07
Total	11,756	988	12,744	7.76	206,731	26,619	233,349	11.41	804,056	50,033	854,089	5.86

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2098 transits and 35979616 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-30. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, 150,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,487	394	3,881	10.16	169,946	16,307	186,253	8.76	395,764	29,634	425,398	6.97
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,450	97	53,547	0.18
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	152,636	474	153,111	0.31
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,478	0	11,478	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,290	0	12,290	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	698	53	751	7.10	32,110	2,106	34,216	6.16	71,179	2,584	73,763	3.50
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,874	1,040	96,914	1.07
Total	12,631	519	13,150	3.95	293,402	19,030	312,431	6.09	1,019,721	34,834	1,054,555	3.30

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2111 transits and 51867350 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-31. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, 200,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,590	406	3,997	10.16	185,274	18,164	203,439	8.93	407,003	32,141	439,144	7.32
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,450	97	53,547	0.18
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	152,636	474	153,111	0.31
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,478	0	11,478	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,290	0	12,290	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	675	53	728	7.32	32,110	2,106	34,216	6.16	71,179	2,584	73,763	3.50
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,874	1,040	96,914	1.07
Total	12,712	531	13,243	4.01	308,730	20,886	329,616	6.34	1,030,960	37,341	1,068,301	3.50

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 transits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-32. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, 250,000-DWT Scenario, 2020, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	1,314	10	1,325	0.79	20,365	155	20,519	0.75	73,753	194	73,947	0.26
Dry Bulk Carriers	3,624	406	4,030	10.08	191,796	18,164	209,960	8.65	440,750	32,141	472,891	6.80
Chemical Tankers	991	2	994	0.24	22,838	87	22,925	0.38	53,450	97	53,547	0.18
Full Container Ships	1,239	12	1,251	0.97	24,474	145	24,619	0.59	152,636	474	153,111	0.31
General Cargo Ships	755	3	758	0.42	7,476	22	7,499	0.30	26,260	88	26,348	0.33
Liquid Gas Carriers	172	0	172	0.00	1,947	0	1,947	0.00	11,478	0	11,478	0.00
Passenger Ships	336	0	336	0.00	0	0	0	0.00	12,290	0	12,290	0.00
Refrigerated Ships	2,813	35	2,847	1.21	10,110	156	10,266	1.52	109,768	614	110,383	0.56
Roll-On Roll-Off	211	1	213	0.67	1,731	31	1,762	1.78	17,270	108	17,378	0.62
Tankers	661	53	715	7.46	32,110	2,106	34,216	6.16	71,179	2,584	73,763	3.50
Vehicle Carriers	615	8	623	1.24	2,405	19	2,424	0.76	95,874	1,040	96,914	1.07
Total	12,732	531	13,263	4.00	315,251	20,886	336,138	6.21	1,064,707	37,341	1,102,048	3.39

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 18 transits and 179803 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 1981 transits and 37003606 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-33. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, Status Quo Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,310	0	2,310	0.00	34,316	0	34,316	0.00	128,821	0	128,821	0.00
Dry Bulk Carriers	2,552	0	2,552	0.00	112,337	0	112,337	0.00	260,594	0	260,594	0.00
Chemical Tankers	1,183	0	1,183	0.00	32,247	0	32,247	0.00	74,191	0	74,191	0.00
Full Container Ships	1,124	374	1,498	24.97	21,117	6,943	28,061	24.74	119,423	48,440	167,862	28.86
General Cargo Ships	1,377	6	1,383	0.42	13,319	38	13,357	0.28	46,859	232	47,091	0.49
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,897	0	3,897	0.00	15,828	0	15,828	0.00	181,965	0	181,965	0.00
Roll-On Roll-Off	397	0	397	0.02	2,929	0	2,929	0.01	31,084	3	31,087	0.01
Tankers	266	0	266	0.00	6,016	0	6,016	0.00	16,526	0	16,526	0.00
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,615	1,982	112,596	1.76
Total	14,356	393	14,750	2.67	241,978	7,014	248,993	2.82	989,762	50,657	1,040,419	4.87

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 13 transits and 219227 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 934 transits and 22985287 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-34. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, 150,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,459	6	2,465	0.23	36,883	113	36,996	0.31	137,143	297	137,440	0.22
Dry Bulk Carriers	4,628	416	5,044	8.26	257,525	16,674	274,199	6.08	567,575	30,934	598,509	5.17
Chemical Tankers	1,223	1	1,224	0.10	32,940	48	32,988	0.15	76,249	104	76,353	0.14
Full Container Ships	1,438	33	1,470	2.24	31,321	465	31,786	1.46	196,721	1,704	198,425	0.86
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	50,197	240	50,438	0.48
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	183,600	926	184,527	0.50
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	31,084	188	31,272	0.60
Tankers	394	195	589	33.12	9,634	18,187	27,821	65.37	25,611	42,174	67,785	62.22
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,615	1,982	112,596	1.76
Total	17,184	720	17,904	4.02	405,015	35,918	440,934	8.15	1,398,481	78,548	1,477,030	5.32

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2536 transits and 56215466 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-35. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, 200,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,459	6	2,465	0.23	36,883	113	36,996	0.31	137,143	297	137,440	0.22
Dry Bulk Carriers	4,515	471	4,986	9.44	260,009	24,956	284,965	8.76	599,991	34,530	634,521	5.44
Chemical Tankers	1,223	1	1,224	0.10	32,940	48	32,988	0.15	76,249	104	76,353	0.14
Full Container Ships	1,438	33	1,470	2.24	31,321	465	31,786	1.46	196,721	1,704	198,425	0.86
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	50,197	240	50,438	0.48
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	183,600	926	184,527	0.50
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	31,084	188	31,272	0.60
Tankers	471	95	567	16.79	23,684	4,137	27,821	14.87	55,340	10,411	65,751	15.83
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,615	1,982	112,596	1.76
Total	17,148	674	17,822	3.78	421,549	30,150	451,699	6.67	1,460,625	50,382	1,511,007	3.33

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-36. Laden Transits, Tons Carried, and Toll Revenue, Using Optimal Toll Structure and Rates, 250,000-DWT Scenario, 2060, by Ship Type

	Transits				Tons Carried(thousands)				Revenue(1990 US$thousands)			
Ship Type	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Diverted	Total	Diverted as a Percent of Total	Canal	Lost a/	Total	Lost as a Percent of Total
Container-Breakbulk	2,459	6	2,465	0.23	36,883	113	36,996	0.31	137,143	297	137,440	0.22
Dry Bulk Carriers	4,621	436	5,057	8.62	278,550	20,215	298,765	6.77	638,029	35,462	673,490	5.27
Chemical Tankers	1,223	1	1,224	0.10	32,940	48	32,988	0.15	76,249	104	76,353	0.14
Full Container Ships	1,438	33	1,470	2.24	31,321	465	31,786	1.46	196,721	1,704	198,425	0.86
General Cargo Ships	1,458	6	1,464	0.43	13,946	45	13,991	0.32	50,197	240	50,438	0.48
Liquid Gas Carriers	104	0	104	0.00	1,071	0	1,071	0.00	6,296	0	6,296	0.00
Passenger Ships	435	0	435	0.00	0	0	0	0.00	13,389	0	13,389	0.00
Refrigerated Ships	3,937	46	3,983	1.15	15,968	292	16,260	1.80	183,600	926	184,527	0.50
Roll-On Roll-Off	397	3	400	0.70	2,929	61	2,990	2.05	31,084	188	31,272	0.60
Tankers	458	95	553	17.21	23,684	4,137	27,821	14.87	55,340	10,411	65,751	15.83
Vehicle Carriers	711	13	724	1.84	2,799	33	2,831	1.15	110,615	1,982	112,596	1.76
Total	17,240	639	17,879	3.57	440,090	25,410	465,499	5.46	1,498,663	51,313	1,549,976	3.31

Notes: These calculations do not include all transits and tons carried forecast by the WEFA Group. For some ship-type and trade-route combinations (accounting for a total of 27 transits and 291695 tons), vessel costs were not available for every DWT size interval. As a result, these transits and tons were excluded. In addition, for 2480 transits and 49528628 tons, the cost by way of the Panama Canal without a toll was higher than the least costly alternative route. As a result, these transits and tons were excluded. The recommended toll structure uses a vessel type and size differentiated earning capacity based toll. A fee of $0.40 per Panama Canal net ton has also been included to account for charges such as handling and agency fees incurred when transiting the Canal. The extra fee is only used to determine diversion status by adding it to cost per ton carried and is not included in the revenue calculations.

a/ Revenue lost from diversions is measured as the revenue generated by the maximum, nondiverting toll rate increase.

Source: Nathan Associates Inc., based on forecasts of traffic and transportation costs provided by The WEFA Group.

Table 3-37. Summary of Estimated Revenues from Laden and Ballast Transits by Project Scenario, Toll Structure, and Year (1990 US$millions)

Toll Structure	2020				2060			
	Status Quo a/	150,000 DWT	200,000 DWT	250,000 DWT	Status Quo a/	150,000 DWT	200,000 DWT	250,000 DWT
Current Toll Structure and Rates	482	612	630	637	591	869	895	908
Current Toll Structure with a 50 Percent Increase in Rates	702	904	904	938	861	1,279	1,319	1,335
Current Toll Structure with a 100 Percent Increase in Rates	934	1,123	1,169	1,215	1,110	1,638	1,732	1,754
Optimal Toll Structrure and Rates	934	1,175	1,186	1,221	1,110	1,638	1,732	1,754

a/ Status Quo is a 65,000 DWT Scenario. Toll structure and rates were not optimized for the Status Quo Canal but were maintained at the 100 percent increase level.

Source: Nathan Associates Inc., based on "no toll" forecasts of traffic and transportation costs provided by The WEFA Group.

4. PANAMA CANAL ALTERNATIVES AND ANNUAL COSTS

Alternatives to be Studied

- On July 24, 1992, CAS selected two of four alternatives for further study:
  - The High-Rise Lock Canal with a 150,000- or 200,000-DWT maximum ship size.
  - The Single-Lane Sea-Level Canal following Route 10 with a 250,000-DWT maximum ship size.
- Both options presuppose continued use of the existing Canal as modified by the Culebra Cut widening.
- The High-Rise Lock Canal would include construction of a lane of larger, two-lift locks at Gatun and Miraflores, and widening and deepening of the canal waterway elsewhere. Bypass canals would be constructed at Gatun and Miraflores, connecting the new lane of locks to the existing Canal. The water level of Gatun Lake would be maintained at 85 feet. Capital cost estimates include the excavation cost only for a second lane of new locks as the construction of the second set of locks is deferred beyond the study period.
- The Sea-Level Canal would consist of a single lane across the isthmus, with two-lane approaches on the Pacific and Atlantic sides. For tidal control, Case A was used for the financial analysis, which employs tidal locks with three parallel lock chambers to be located about 5 km from the Pacific shoreline.[1]

Preliminary Engineering and Cost Estimates

- Cost estimates for each of the Canal alternatives were presented in Yachiyo Engineering Co., Ltd. *Final Report, Phase 2: Preliminary Engineering and Cost Estimates*, April 1993. Summaries of the cost estimates for the 150,000-DWT and 200,000-DWT High-Rise Lock Canal are presented in Tables 4-1 and 4-2 (pp. 4-10 and 4-11), respectively. Cost estimates for the Sea-Level Canal are presented in Table 4-3 (p. 4-12).

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[1]Two other subalternatives containing tidal control measures are presented in the Yachiyo Engineering Co., Ltd., *Final Report, Phase 2: Preliminary Engineering and Cost Estimates*, April 1993. In Case B, tidal gates would be located on both the Pacific and Atlantic sides. In Case C, tidal locks would be located on the Pacific side and a tidal gate would be constructed on the Atlantic side. However, the engineering costs of these subalternatives are of a similar order of magnitude as those of Case A used in the financial analysis.

- The total cost of each alternative and the duration of design and construction are presented below.[2]

Canal Alternative	*Capital Cost (US$ billion)*	*Construction Period (years)*
150,000-DWT High-Rise Lock Canal	7.4	10
200,000-DWT High-Rise Lock Canal	8.5	11
Sea-Level Canal, Case A	13.5	15

- Cost differences between the 150,000-DWT and 200,000-DWT High-Rise Lock Canal alternatives include
  - $465 million additional for canal excavation
  - $237 million additional for a new dam on the Indio River
  - $136 million additional for lock construction
  - $123 million additional for gate leaves
  - $51 million additional for a new canal crossing
- Cost differences between the 150,000-DWT High-Rise Lock Canal and the Sea-Level Canal, Case A, include
  - $3,232 million additional for canal excavation
  - $1,046 million additional for lock construction
  - $402 million for additional breakwaters
  - $494 million for additional barrier dams
  - $149 million additional for supporting construction

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[2]Yachiyo Engineering Company, Ltd. also estimated Phase 2 project costs to be incurred during 2055-2059 for each of the Canal alternatives (Yachiyo Engineering Co., Ltd. *Final Report, Phase 2: Preliminary Engineering and Cost Estimates*, April 1993, pp. S-39 and S-40). Phase 2 construction consists primarily of additional Canal crossings, dam and pump stations, and related facilities. These Phase 2 cost estimates totaled $1,407 million, $1,350 million, and $1,717 million for the 150,000-DWT High-Rise Lock Canals, 200,000-DWT High-Rise Lock Canal, and Sea-Level Canal, Case A, respectively. Because Phase 2 construction will not be completed until 2060, the estimates were not included in the financial analyses.

- $132 million additional for navigation support system
- $101 million additional for placing area
- $75 million additional for diversion scheme
- $229 million less for new canal crossings

Estimates of Costs on an Equipment Acquisition Cost Basis

- The foregoing Yachiyo Engineering cost estimates were prepared on a unit-cost basis that allocates all costs to discrete physical work elements. For example, the costs of equipment acquisition (e.g., for a bulldozer) were estimated on a depreciated unit-cost basis and allocated along with labor materials and other costs to estimate excavation costs per cubic meter. The unit-cost approach, which is consistent with guidelines by the Fédération Internationale des Ingénieurs-Conseils (FIDIC), is based on the premise that contractors will be fully responsible for acquiring the necessary equipment to complete the construction.
- Under such an arrangement, the contractor will be responsible for obtaining the financing necessary to acquire equipment and will negotiate terms directly with equipment suppliers. The project owner will provide payments to the contractors with funds that have been generated from other sources of financing.
- Because construction equipment and other equipment represent more than 30 percent of the total capital costs (p. 4-4), sources of equipment finance such as export-import banks and suppliers' credits are important potential sources for overall project financing.
- For the foregoing reasons, the financing scheme contemplated the use of export-import banks and suppliers' credits as sources of financing for construction equipment, gate leaves, and other equipment to be used in operating the alternative Canal. In order to estimate the amount of such financing that could be obtained, the financial analysis required estimates of the acquisition costs of such construction equipment and other equipment to be disaggregated from total construction costs.
- The FIDIC unit cost approach adopted by Yachiyo Engineering, however, does not permit the disaggregation of equipment acquisition costs needed for the financing scheme analysis. Accordingly, CAS requested that Stone & Webster prepare these estimates on the basis of the Yachiyo Engineering data.

- Stone & Webster recast the capital costs for both high-rise alternatives and the Sea-Level Canal, Case A, alternative using Yachiyo Engineering data on
  - The amount and type of construction and other equipment required annually,
  - Estimates of the economic operating lifetime for each type of equipment, and
  - Estimated cost for equipment acquisition including freight (C.I.F.) in Panama.
- The resulting estimates of project costs on an equipment acquisition basis for the 150,000-DWT High-Rise Lock Canal, the 200,000-DWT High-Rise Lock Canal, and the Sea-Level Canal, Case A, are presented in Tables 4-4, 4-5, and 4-6 (pp. 4-13 to 4-18), respectively.
- The total project costs for each of the alternatives are unchanged from the estimates prepared by Yachiyo Engineering; however, the presentation of annual project costs differs because of the introduction of major construction equipment and other equipment acquisition in the Stone & Webster estimates.
- Construction equipment and other equipment costs represent a significant portion of the total capital cost of each Canal alternative, as follows:

Canal Alternative	*Equipment Cost (US$ million)*	*Percentage of Capital Costs*
150,000-DWT High-Rise Lock Canal	2,348	31.8
200,000-DWT High-Rise Lock Canal	2,564	30.0
Sea-Level Canal, Case A	4,002	29.6

- Major types of equipment for the High-Rise Lock Canal alternatives include gate leaves, locomotives and rail, electrical equipment, cutters, dump trucks, bulldozers, barges, tugs, launches, and trailers.
- Major types of equipment for the Sea-Level Canal alternatives include gate leaves, spillway gates, locomotives and rail, electrical equipment, cutters, dump trucks, bulldozers, barges, tugs, launches, and trailers.

Revisions to Annual Project Costs to Reflect Annual Payments to Contractors

- The financing scheme and financial analyses use estimates of annual project financial cash flows to determine the amounts of financing required each year and to calculate financial evaluation ratios such as the return on equity and the financial rate of return. On a large-scale construction project, such as the Canal alternatives, several factors associated with the use of construction contractors commonly affect the overall project cash flow:
  - Advance payments to contractors for mobilization purposes.
  - Retainages by the project of payments due the contractor as part of a performance guarantee.
- TAMS Consultants Inc. reviewed the annual project cost estimates for each of the alternatives prepared by Yachiyo Engineering and Stone & Webster and recommended the following adjustments to the Stone & Webster estimates to reflect typical cash flow elements of payments to construction contractors.
  - An amount of 3.0 percent of total construction cost (which includes civil works and equipment but excludes contingencies) was taken to reflect advance payments to be made in equal parts in the first 2 years of construction.
  - Each annual construction cost figure was reduced by 3.0 percent to account for the extraction of amounts for advances. The resulting figures were further reduced by 5.0 percent to reflect retainages to be held for one year.
  - For indirect costs, advance payments of 10 percent of total costs for administration, headquarters, and construction supervision were allocated equally over the first 3 years in which those services are to be performed (i.e., 3.33 percent each for project Years 1 to 3). The annual cost figures were reduced by 10.0 percent to account for the extraction of amounts for advances. The resulting figures were further reduced by 5.0 percent to reflect retainages to be held for one year.
- The resulting estimates of project costs to reflect annual payments to contractors for the 150,000-DWT High-Rise Lock Canal, the 200,000-DWT High-Rise Lock Canal, and the Sea-Level Canal, Case A, are presented in Tables 4-7, 4-8, and 4-9 (pp. 4-19 to 4-21), respectively.
- The total project costs for each alternative are unchanged from the estimates prepared by Yachiyo Engineering; however, the presentation of annual project costs differs because of the introduction of contractor payment cash flow items discussed earlier.

- A comparison of the annual project costs estimated by Yachiyo Engineering (on a unit-cost basis) and those estimated by TAMS Consultants (reflecting cash flow implications for equipment acquisition costs and payments to contractors) is presented for each Canal alternative in Table 4-10 (p. 4-22) and illustrated in Figure 4-1 (p. 4-23).
- For both High-Rise Lock Canal alternatives the TAMS Consultants' estimates yield a flatter, smoother "bell-shaped" annual project cost schedule than the preliminary cost estimates prepared by Yachiyo Engineering.
- For the Sea-Level Canal, Case A, the TAMS Consultants' estimates substantially reduce a sharp spike in project costs in Year 5; however, the costs for Years 6 to 15 remain rather stable, ranging from $0.9 to $1.3 billion annually.

Estimates of Other Revenues

- The financing scheme and financial analyses require projections of the annual revenues from tolls and other sources that will be generated by the Panama Canal and the alternative canals during the 2000–2060 period. Projected toll revenues were the subject of detailed investigations, and estimates under alternative toll systems were presented in Section 3.
- The financial results of the Panama Canal Commission during Fiscal Years 1980–1991 were reviewed to identify the sources and amounts of Canal annual operating revenues from tolls and other sources. Table 4-11 (p. 4-24) presents a summary of the PCC's Statement of Operations for Fiscal Years 1980–1991.
- During this period total operating revenues increased from $369 million in FY 1980 to $506 million in FY 1991. Generally toll revenues accounted for 75 percent of total revenues, with other revenues contributing 25 percent. In FY 1991, toll revenues were $374.6 million (74 percent) and other revenues were $137.7 million (26 percent).
- PCC operating revenues other than tolls are separated into three categories: transit operations, supporting services, and administrative and general. However, only the first two categories have significant revenues. Table 4-12 (p. 4-25) presents estimates of the amount and the composition of revenue that was expected to be generated in each of these categories for FY 1992. For FY 1992, these revenues were estimated at $121.7 million.

- Transit operations provide $80.0 million, or nearly two-thirds of the "other revenue," mostly generated by fees for towing and assisting ships, handling ships' lines, and other navigation. Revenues from security and protection services are also significant items under transit operations.
- Supporting services provide $41.5 million, the remaining one-third of other operating revenues. Revenues from the power system ($25.6 million) and the water system ($12.4 million) are the most significant items.
- For purposes of the financial analyses, it was assumed that services and revenues generated under the category of "supporting services," particularly those associated with utility systems for power and water, would be taken over by the Republic of Panama after 2000 and would not accrue to the entity operating the Canal (Table 4-12). Other revenues from transit operations were assumed to remain under the control of the Canal-operating entity and were projected to increase with forecasted transits from 1991 to 2060.

Estimates of Operation and Maintenance Costs

- Estimates of the annual operation and maintenance costs for the status quo Canal and for each of the Canal alternatives are needed for the financing scheme and financial analyses.
- Nathan Associates conducted a review of the PCC annual operation and maintenance expenses for FY 1980–1991 to enhance our understanding of the PCC's financial performance and to serve as a basis for reviewing projections of future Canal operation and maintenance costs. The PCC's operating expenses for FY 1980–1991 are presented as part of the summary of PCC's Statement of Operations in Table 4-11.
- During FY 1980–1991, operating expenses increased from $366.7 million to $502.8 million. In FY 1991, the largest expense categories were PCC payments to the Republic of Panama ($87.6 million), navigation services and control ($86.2 million), general and administrative ($78.6 million), and lock operations ($53.8 million). Expenses under these four categories totaled $306.2 million, representing 61 percent of PCC's total operating expenses.
- As part of their work on the preliminary engineering and costs estimates, Yachiyo Engineering prepared estimates of the operation and maintenance costs for the existing Canal and each Canal alternative. The Yachiyo Engineering estimates for 2020 and 2060 are presented in Tables 4-13 and 4-14 (pp 4-26 and 4-27), respectively. All costs are in constant 1990 U.S. dollars.

- Upon the return of the Canal to the Republic of Panama on December 31, 1999, certain expenses, estimated to total $50 million in 1990, will be divested from the administration of the Canal. Such expenses include
  - Cost of the special retirement program established in the 1977 Treaty
  - Reimbursement to the U.S. Department of Defense for health and education benefits paid on behalf of Canal employees and their families who are U.S. citizens
  - Employer's contribution to Federal Employees Compensation Act and Health Benefit Act
  - Housing subsidies for U.S. employees as authorized residents of PCC housing
  - Employment costs for U.S. employees, including home leave expense, repatriation expense, and shipping of employee vehicles
  - Other statutory employment costs, including FEGLI, FICA, FERS, Medicare, and unemployment compensation
- The Yachiyo Engineering estimates of operation and maintenance costs for the status quo Canal and each Canal alternative were reduced accordingly by $50 million to reflect the foregoing expenses that will be divested from the Canal administration.
- The Yachiyo Engineering projections of expenses exclude payments to the Republic of Panama and interest on investments. Nathan Associates has prepared separate estimates of these items; they are included in the financing scheme and financial analyses presented in Section 6.
- Estimated operation and maintenance expenses for the status quo Canal in 2020 are $371 million, representing a nominal 9.4 percent increase over the comparable 1990 expense base. The nominal increase reflects Yachiyo Engineering analyses of the degree to which individual operation and maintenance expense items vary with increased transits and the fact that many of the expense items are relatively fixed.
- The projected operation and maintenance costs for the Canal alternative are higher because of the increased costs of operating and maintaining the additional facilities and the increased number of transits projected. The total projected operation and maintenance costs for the status quo Canal and each of the Canal alternatives inclusive of current Canal operating costs for 2020 and 2060 are presented below.

Canal Alternative	*1990 US$ million*	
	2020	*2060*
Status Quo Canal	371.2	419.2
150,000-DWT High-Rise Lock Canal	475.1	583.0
200,000-DWT High-Rise Lock Canal	483.4	591.3
Sea-Level Canal, Case A	525.8	625.0

Table 4-1. High-Rise Lock Canal - 150,000 DWT: Project Costs by Year (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	Total
I. CONSTRUCTION COSTS											
(A) Civil works:											
1 Canal excavation	--	--	--	753.0	496.9	496.9	496.9	496.9	271.1	--	3,011.7
2 Placing area	--	--	--	21.9	13.2	8.8	8.8	21.9	13.2	--	87.8
3 Lock construction	--	--	--	--	247.7	208.2	208.2	208.2	118.9	--	991.2
5 New dams	--	--	--	--	--	--	--	--	--	--	--
6 Pump station	--	--	--	--	--	--	--	--	--	--	--
7 New permanent roads	--	--	--	--	--	--	--	--	5.5	3.3	8.8
8 New canal crossing	--	--	--	112.6	74.3	74.3	74.3	74.3	40.5	--	450.3
10 Barrier dams	--	--	--	--	--	--	--	--	--	--	--
11 Breakwater	--	--	--	--	--	--	--	--	--	--	--
12 Diversion scheme	--	--	--	--	--	--	--	--	--	--	--
13 Supporting construction	--	--	212.7	212.7	--	--	--	--	--	--	425.4
Subtotal	--	--	212.7	1,100.2	832.1	788.2	788.2	801.3	449.2	3.3	4,975.2
(B) Plant forming: permanent works:											
4 Gate leaves and related facilities	--	--	--	--	--	222.2	164.4	164.4	164.4	173.3	888.7
9 Navigation support system	--	--	--	--	--	--	--	207.1	103.6	103.6	414.3
Subtotal	--	--	--	--	--	222.2	164.4	371.5	268.0	276.9	1,303.0
Total construction costs	--	--	212.7	1,100.2	832.1	1,010.4	952.6	1,172.8	717.2	280.2	6,278.2
II. INDIRECT COSTS											
1 Administrative costs	3.8	3.8	7.3	8.9	8.9	8.9	8.9	8.9	8.9	8.9	77.2
2 Headquarter's costs	31.5	31.5	31.5	5.3	5.3	5.3	5.3	5.3	5.3	5.3	131.6
3 Construction supervision	4.6	4.6	12.2	19.0	19.0	19.0	19.0	19.0	19.0	19.0	154.4
4 Land acquisition and rights	--	--	--	--	--	--	--	--	--	--	--
5 Compensations costs	42.0	42.0	21.0	--	--	--	--	--	--	--	105.0
6 Contingency	--	--	--	62.8	62.8	62.8	62.8	125.5	125.5	125.5	627.7
Total indirect costs	81.9	81.9	72.0	96.0	96.0	96.0	96.0	158.7	158.7	158.7	1,095.9
Total project costs	81.9	81.9	284.7	1,196.2	928.1	1,106.4	1,048.6	1,331.5	875.9	438.9	7,374.1

Source: Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates," Table III. 3.4.2-1 (April 1993).

Table 4-2. High-Rise Lock Canal - 200,000 DWT: Project Costs by Year (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	11	Total
I. CONSTRUCTION COSTS												
(A) Civil works:												
1 Canal excavation	--	--	--	869.4	469.4	469.4	469.4	469.4	469.4	260.8	--	3,477.2
2 Placing area	--	--	--	22.0	13.2	5.7	5.7	6.2	22.0	13.2	--	88.0
3 Lock construction	--	--	--	281.8	186.0	186.0	186.0	186.0	101.4	--	--	1,127.2
5 New dams	--	--	--	59.3	23.7	38.4	38.4	38.4	38.9	--	--	237.1
6 Pump station	--	--	--	--	--	--	--	--	--	--	--	--
7 New permanent roads	--	--	--	--	--	--	--	--	2.2	3.9	2.6	8.7
8 New canal crossing	--	--	--	125.3	82.7	82.7	82.7	82.7	45.1	--	--	501.2
10 Barrier dams	--	--	--	--	--	--	--	--	--	--	--	--
11 Breakwater	--	--	--	--	--	--	--	--	--	--	--	--
12 Diversion scheme	--	--	--	--	--	--	--	--	--	--	--	--
13 Supporting construction	--	--	170.2	255.3	--	--	--	--	--	--	--	425.5
Subtotal	--	--	170.2	1,613.1	775.0	782.2	782.2	782.7	679.0	277.9	2.6	5,864.9
(B) Plant forming: permanent works:												
4 Gate leaves and related facilities	--	--	--	--	--	252.8	187.1	187.1	187.1	197.2	--	1,011.3
9 Navigation support system	--	--	--	--	--	--	--	103.6	124.3	124.3	62.1	414.3
Subtotal	--	--	--	--	--	252.8	187.1	290.7	311.4	321.5	62.1	1,425.6
Total construction costs	--	--	170.2	1,613.1	775.0	1,035.0	969.3	1,073.4	990.4	599.4	64.7	7,290.5
II. INDIRECT COSTS												
1 Administrative costs	4.0	4.0	8.0	9.9	9.9	9.9	9.9	9.9	9.9	9.9	4.4	89.7
2 Headquarter's costs	37.4	37.4	37.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	3.0	153.0
3 Construction supervision	4.9	4.9	14.3	20.6	20.6	20.6	20.6	20.6	20.6	20.6	10.7	179.0
4 Land acquisition and rights	--	--	--	--	--	--	--	--	--	--	--	--
5 Compensations costs	42.0	42.0	21.0	--	--	--	--	--	--	--	--	105.0
6 Contingency	--	--	--	54.6	54.6	54.6	54.6	145.8	145.8	145.8	72.9	728.7
Total indirect costs	88.3	88.3	80.7	90.5	90.5	90.5	90.5	181.7	181.7	181.7	91.0	1,255.4
Total project costs	88.3	88.3	250.9	1,703.6	865.5	1,125.5	1,059.8	1,255.1	1,172.1	781.1	155.7	8,545.9

Source: Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engeering and Cost Estimates," Table III. 3.4.1-1 (April 1993).

Table 4-3. Sea-Level Canal - Case A: Project Costs by Year (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
I. CONSTRUCTION COSTS																
(A) Civil works:																
1 Canal excavation	--	--	--	--	1,561.1	437.1	437.1	468.3	468.3	468.3	468.3	468.3	468.3	468.3	530.8	6,244.2
2 Placing area	--	--	--	--	47.2	18.9	6.6	6.6	6.6	6.6	6.6	6.6	6.6	37.7	38.7	188.7
3 Lock construction	--	--	--	--	509.3	173.2	173.2	173.2	173.2	173.2	173.2	173.2	173.2	142.6	--	2,037.5
5 New dams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6 Pump station	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7 New permanent roads	--	--	--	--	--	--	--	--	--	--	--	--	4.9	8.7	5.8	19.4
8 New canal crossing	--	--	--	--	55.5	25.5	25.5	25.5	25.5	25.5	25.5	13.3	--	--	--	221.8
10 Barrier dams	--	--	--	--	123.4	81.4	81.4	81.4	81.4	44.4	--	--	--	--	--	493.4
11 Breakwater	--	--	--	--	100.5	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	19.3	402.4
12 Diversion scheme	--	--	--	--	32.7	28.2	14.3	--	--	--	--	--	--	--	--	75.2
13 Supporting construction	--	--	--	229.8	344.6	--	--	--	--	--	--	--	--	--	--	574.4
Subtotal	--	--	--	229.8	2,774.3	795.7	769.5	786.4	786.4	749.4	705.0	692.8	684.4	688.7	594.6	10,257.0
(B) Plant forming: permanent works:																
4 Gate leaves and related facilities	--	--	--	--	--	--	--	--	--	237.4	137.7	137.7	137.7	137.7	161.4	949.6
9 Navigation support system	--	--	--	--	--	--	--	--	--	--	--	--	136.5	202.1	207.6	546.2
Subtotal	--	--	--	--	--	--	--	--	--	237.4	137.7	137.7	274.2	339.8	369.0	1,495.8
Total construction costs	--	--	--	229.8	2,774.3	795.7	769.5	786.4	786.4	986.8	842.7	830.5	958.6	1,028.5	963.6	11,752.8
II. INDIRECT COSTS																
1 Administrative costs	1.8	1.8	6.6	10.8	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	120.0
2 Headquarter's costs	50.8	50.8	50.8	26.4	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	203.0
3 Construction supervision	5.7	5.7	5.7	10.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	227.5
4 Land acquisition and rights	10.9	10.9	5.5	--	--	--	--	--	--	--	--	--	--	--	--	27.3
5 Compensations costs	5.4	5.4	2.7	--	--	--	--	--	--	--	--	--	--	--	--	13.5
6 Contingency	--	--	--	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	188.0	188.0	188.0	188.0	1,175.2
Total indirect costs	74.6	74.6	71.3	100.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	217.4	217.4	217.4	217.4	1,766.5
Total project costs	74.6	74.6	71.3	330.1	2,856.6	878.0	851.8	868.7	868.7	1,069.1	925.0	1,047.9	1,176.0	1,245.9	1,181.0	13,519.3

Note: In Case A tidal locks will be located on the Pacific side, 5 km inland from the mouth of the Caimito River. There will be no tidal locks on the Atlantic side. Three-lane tidal locks will be constructed by 2020 and an additional lane will be constructed by 2060, resulting in a total of four lanes.

Source: Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates," Table IV.3.4.1-1 (April 1993).

Table 4-4. High-Rise Lock Canal - 150,000 DWT: Project Costs on an Equipment Acquisition Basis by Year (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	Total
Major Construction Equipment											
Crawler drill (32T)	--	--	--	--	0.7	--	2.2	--	--	--	2.9
Bulldozer (98T)	--	--	--	83.2	--	--	--	--	--	--	83.2
Shovel (30m³)	--	--	--	52.7	--	--	--	--	--	--	52.7
Dump truck (240T)	--	--	--	129.7	--	--	--	--	--	--	129.7
Grab dredge (50m³)	--	--	--	--	26.6	--	--	--	--	--	26.6
Split barge (5000m³)	--	--	--	--	61.6	19.3	15.4	--	--	--	96.3
Split barge (1500m³)	--	--	--	--	--	--	--	8.0	--	--	8.0
Pusher tug (3200HP)	--	--	--	--	36.5	14.6	7.3		--	--	58.3
Pusher tug (1300HP)	--	--	--	--	--	--	--	4.2	--	--	4.2
Trailer (10,000m³)	--	--	--	--	82.6	--	--	--	--	--	82.6
Cutter (18,000HP)	--	--	--	--	27.5	--	27.5	--	--	--	55.0
Cutter (27,500HP)	--	--	--	--	81.5	122.3	81.5	--	--	--	285.4
Blasting barge w/tow assist	--	--	--	--	--	--	--	26.2	--	--	26.2
Batching plants (70m³/hr)	--	--	--	--	7.1	--	--	--	--	--	7.1
Generator (450 KVA)	--	--	--	--	1.1	--	--	--	--	--	1.1
Jib crane (13.5T)	--	--	--	--	41.8	--	--	--	--	--	41.8
Generator (800 KVA)	--	--	--	--	3.3	--	--	--	--	--	3.3
Agitating car (4.5m³)	--	--	--	--	3.4	--	--	--	--	--	3.4
Shovel (3.3 m³)	--	--	--	--	3.8	--	--	--	--	--	3.8
Dump trucks (32T)	--	--	--	--	16.8	--	--	--	--	--	16.8
Crushing plant (500T/hr)	--	--	--	--	29.8	--	--	--	--	--	29.8
Buses	--	--	--	0.7	0.7	0.7	--	--	--	--	2.1
Ambulance	--	--	--	0.3	0.3	0.2	--	--	--	--	0.7
Patrol vehicles	--	--	--	0.2	0.2	0.1	--	--	--	--	0.4
Fire engine	--	--	--	0.3	0.2	0.2	--	--	--	--	0.7
Contingency a/	--	--	--	26.7	42.5	15.7	13.4	3.8	--	--	102.2
Total construction equipment	--	--	--	293.7	468.0	173.1	147.3	42.2	--	--	1,124.2
Other Equipment											
Lock construction	--	--	--	--	--	--	--	--	--	--	--
Dewatering	--	--	--	27.7	--	--	--	--	--	--	27.7
Gate leaf (2/Gate)	--	--	--	--	112.9	67.7	67.7	67.7	67.7	67.7	451.4
Locomotive + rail	--	--	--	--	--	--	--	65.6	65.6	67.6	198.9
Electrical equipment	--	--	--	--	--	--	--	74.9	74.9	77.1	226.9
Navigation system	--	--	--	--	--	--	10.8	10.8	10.8	10.8	43.0
Tug boat & launches	--	--	--	--	--	--	41.1	41.1	41.1	41.1	164.5
Contingency a/	--	--	--	2.8	11.3	6.8	12.0	26.0	26.0	26.4	111.2
Total other equipment	--	--	--	30.5	124.1	74.5	131.6	286.1	286.1	290.8	1,223.7

Table 4-4 (continued)

	1	2	3	4	5	6	7	8	9	10	Total
Other Construction Costs b/	--	--	125.3	509.6	626.6	827.1	827.1	618.3	376.0	233.9	4,143.9
Contingency a/	--	--	12.5	51.0	62.7	82.7	82.7	61.8	37.6	23.4	414.4
Total other construction costs	--	--	137.8	560.6	689.3	909.8	909.8	680.1	413.6	257.3	4,558.3
Indirect Costs											
Administrative costs	3.7	3.7	7.3	8.9	8.9	8.9	8.9	8.9	8.9	8.9	77.0
Headquarters costs	31.6	31.6	31.6	5.3	5.3	5.3	5.3	5.3	5.3	5.3	131.9
Construction supervision	4.6	4.6	12.2	19.0	19.0	19.0	19.0	19.0	19.0	19.0	154.4
Land acquisition and rights Compensation costs	42.0	42.0	21.0	--	--	--	--	--	--	--	105.0
Total indirect costs	81.9	81.9	72.1	33.2	33.2	33.2	33.2	33.2	33.2	33.2	468.3
Total project costs	81.9	81.9	209.9	917.9	1,314.6	1,190.6	1,221.9	1,041.6	732.9	581.3	7,374.5

a/ Contingencies of 10 percent as per Yachiyo Engineering Ltd. estimates applied to all direct costs. In the Yachiyo presentation, contingencies were presented as a single item under indirect costs.

b/ Includes all construction works other than equipment acquisitions shown separately above.

Source: Data prepared for Nathan Associates, Inc. by Stone & Webster using information from Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates."

Table 4-5. High-Rise Lock Canal - 200,000 DWT: Project Costs on an Equipment Acquisition Basis by Year (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	11	Total
Major Construction Equipment												
Crawler drill (32T)	--	--	--	5.9	--	--	--	--	--	--	--	5.9
Bulldozer (98T)	--	--	--	83.2	--	--	--	--	--	--	--	83.2
Shovel (30m³)	--	--	--	52.7	--	--	--	--	--	--	--	52.7
Dump truck (240T)	--	--	--	129.7	--	--	--	--	--	--	--	129.7
Grab dredge (50m³)	--	--	--	--	26.6	--	--	--	--	--	--	26.6
Split barge (5000m³)	--	--	--	--	50.1	23.1	27.0	27.0	--	--	--	127.1
Split barge (1500m³)	--	--	--	--	--	--	--	8.0	--	--	--	8.0
Pusher tug (3200HP)	--	--	--	--	29.2	14.6	14.6	14.6	--	--	--	72.9
Pusher tug (1300HP)	--	--	--	--	--	--	--	4.2	--	--	--	4.2
Trailer (10,000m³)	--	--	--	--	82.6	82.6	--	--	--	--	--	165.1
Cutter (18,000HP)	--	--	--	--	--	--	--	--	--	--	--	--
Cutter (27,500HP)	--	--	--	--	40.8	81.5	163.1	--	--	--	--	285.4
Blasting barge w/tow assist	--	--	--	--	--	--	--	26.2	--	--	--	26.2
Batching plants (70m³/hr)	--	--	--	--	7.1	--	--	--	--	--	--	7.1
Generator (450 KVA)	--	--	--	--	1.1	--	--	--	--	--	--	1.1
Jib crane (13.5T)	--	--	--	--	41.8	--	--	--	--	--	--	41.8
Generator (800 KVA)	--	--	--	--	3.3	--	--	--	--	--	--	3.3
Agitating car (4.5m³)	--	--	--	--	3.4	--	--	--	--	--	--	3.4
Shovel (3.3 m³)	--	--	--	--	3.8	--	--	--	--	--	--	3.8
Dump trucks (32T)	--	--	--	--	16.8	--	--	--	--	--	--	16.8
Crushing plant (500T/hr)	--	--	--	--	29.8	--	--	--	--	--	--	29.8
Buses	--	--	--	0.7	0.7	0.7	--	--	--	--	--	2.1
Ambulance	--	--	--	0.3	0.3	0.2	--	--	--	--	--	0.7
Patrol vehicles	--	--	--	0.2	0.2	0.1	--	--	--	--	--	0.4
Fire engine	--	--	--	0.3	0.2	0.2	--	--	--	--	--	0.7
Total construction equipment	--	--	--	272.9	337.6	203.0	204.6	79.9	--	--	--	1097.9
Contingency a/	--	--	--	27.3	33.8	20.3	20.5	8.0	--	--	--	109.8
Total construction equipment	--	--	--	300.2	371.3	223.3	225.1	87.9	--	--	--	1,207.7
Other Equipment												
Lock construction	--	--	--	--	--	--	--	--	--	--	--	--
Dewatering	--	--	--	27.7	--	--	--	--	--	--	--	27.7
Gate leaf (2/Gate)	--	--	--	--	134.7	80.8	80.8	80.8	80.8	80.8	--	538.7
Locomotive + rail	--	--	--	--	--	--	--	67.0	67.0	69.1	--	203.1
Electrical equipment	--	--	--	--	--	--	--	84.4	84.4	86.9	--	255.7
Navigation system	--	--	--	--	--	--	10.8	10.8	10.8	10.8	--	43.0
Tug boat & launches	--	--	--	--	--	--	41.1	41.1	41.1	41.1	--	164.5
Total other equipment	--	--	--	27.7	134.7	80.8	132.7	284.1	284.1	288.7	--	1232.8
Contingency a/	--	--	--	2.8	13.5	8.1	13.3	28.4	28.4	28.9	--	123.3
Total other equipment	--	--	--	30.5	148.2	88.9	146.0	312.5	312.5	317.6	--	1,356.1

Table 4-5 (continued)

	1	2	3	4	5	6	7	8	9	10	11	Total
Other Construction Costs	--	--	125.9	453.2	696.5	889.5	847.6	805.6	604.2	402.8	134.3	4959.6
Contingency a/	--	--	12.6	45.3	69.7	89.0	84.8	80.6	60.4	40.3	13.4	496.0
Total other construction costs	--	--	138.5	498.5	766.2	978.5	932.4	886.2	664.6	443.1	147.7	5,455.6
Indirect Costs												
Administrative costs	4.0	4.0	8.1	9.8	9.8	9.8	9.8	9.8	9.8	9.8	4.5	89.2
Headquarters costs	37.4	37.4	37.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	3.1	153.1
Construction supervision	4.9	4.9	14.3	20.6	20.6	20.6	20.6	20.6	20.6	20.6	10.8	179.1
Land acquisition and rights												
Compensation costs	42.0	42.0	21.0	--	--	--	--	--	--	--	--	105.0
Total indirect costs	88.3	88.3	80.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	18.4	526.4
Total project costs	88.3	88.3	219.3	864.9	1,321.4	1,326.4	1,339.2	1,322.3	1,012.9	796.5	166.1	8,545.8

a/ Contingencies of 10 percent as per Yachiyo Engineering Ltd. estimates applied to all direct costs. In the Yachiyo presentation, contingencies were presented as a single item under indirect costs.

b/ Includes all construction works other than equipment acquisitions shown separately above.

Source: Data prepared for Nathan Associates, Inc. by Stone & Webster using information from Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates."

Table 4-6. Sea-Level Canal - Case A: Project Costs on an Equipment Acquisition Basis by Year (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Major Construction Equipment																
Crawler drill (32T)	--	--	--	--	--	2.9	1.5	0.7	--	--	--	--	--	--	--	5.1
Bulldozer (98T)	--	--	--	--	247.6	--	--	1.0	--	--	97.2	--	--	--	--	345.8
Shovel (30m³)	--	--	--	--	158.0	--	--	--	--	--	--	--	--	--	--	158.0
Dump truck (240T)	--	--	--	--	416.8	--	--	--	--	--	--	--	215.7	--	--	632.5
Grab dredge (50m³)	--	--	--	--	53.3	--	--	--	--	--	--	--	--	--	--	53.3
Split barge (5000m³)	--	--	--	--	46.2	--	--	--	--	--	--	--	--	--	--	46.2
Split barge (1500m³)	--	--	--	--	--	--	--	21.2	--	--	--	--	--	--	--	21.2
Pusher tug (3200HP)	--	--	--	--	21.9	--	--	--	--	--	--	--	--	--	--	21.9
Pusher tug (1300HP)	--	--	--	--	--	12.5	23.0	--	--	--	--	--	--	--	--	35.5
Trailer (10,000m³)	--	--	--	--	--	82.6	--	--	--	--	--	--	--	--	--	82.6
Cutter (18,000HP)	--	--	--	--	27.5	27.5	--	--	--	--	--	--	--	--	--	55.0
Cutter (27,500HP)	--	--	--	--	40.8	40.8	40.8	--	--	--	--	--	--	--	--	122.3
Blasting barge w/tow assist	--	--	--	--	--	--	--	52.4	--	--	--	--	--	--	--	52.4
Batching plants (70m³/hr)	--	--	--	--	--	--	--	3.6	--	--	--	--	--	--	--	3.6
Generator (450 KVA)	--	--	--	--	--	--	--	0.5	--	--	--	--	--	--	--	0.5
Jib crane (13.5T)	--	--	--	--	--	--	--	20.9	--	--	--	--	--	--	--	20.9
Generator (800 KVA)	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	1.6
Agitating car (4.5m³)	--	--	--	--	--	--	--	1.7	--	--	--	--	--	--	--	1.7
Shovel (3.3 m³)	--	--	--	--	--	--	--	2.8	--	--	--	--	--	--	--	2.8
Dump trucks (32T)	--	--	--	--	--	--	--	8.6	--	--	--	--	--	--	--	8.6
Crushing plant (500T/hr)	--	--	--	--	--	--	--	14.9	--	--	--	--	--	--	--	14.9
Stone barge (2000T)	--	--	--	--	30.5	50.9	--	--	--	--	--	--	--	--	--	81.4
Crawler crane (70T)	--	--	--	--	9.0	22.4	--	--	--	--	--	--	--	--	--	31.4
Backhoe barge (8m³)	--	--	--	--	--	1.3	0.7	--	--	--	--	--	--	--	--	2.0
Flat top barge (2000T)	--	--	--	--	12.9	30.0	--	--	--	--	--	--	--	--	--	42.9
Stone barge (1000T)	--	--	--	--	--	--	--	4.0	--	--	--	--	--	--	--	4.0
Crane barge (50Tx2)	--	--	--	--	--	--	5.6	1.4	--	--	--	--	--	--	--	7.0
Flat top barge (1000T)	--	--	--	--	--	--	11.4	2.9	--	--	--	--	--	--	--	14.3
Buses	--	--	--	--	0.7	0.7	0.7	--	--	--	--	--	--	--	--	2.1
Ambulance	--	--	--	--	0.3	0.3	0.2	--	--	--	--	--	--	--	--	0.7
Patrol vehicle	--	--	--	--	0.2	0.2	0.1	--	--	--	--	--	--	--	--	0.4
Fire engine	--	--	--	--	0.3	0.2	0.2	--	--	--	--	--	--	--	--	0.7
Contingency a/	--	--	--	--	106.6	27.2	8.4	13.8	--	--	9.7	--	21.6	--	--	187.3
Total construction equipment	--	--	--	--	1,172.3	299.4	92.6	152.2	--	--	106.9	--	237.3	--	--	2,060.7

Table 4-6 (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Other Equipment																
Lock construction	--	--	--	--	86.9	--	--	--	--	--	--	--	--	--	--	86.9
Dewatering	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0
Gate leaf	--	--	--	--	--	--	--	--	--	122.3	73.4	73.4	73.4	73.4	73.4	489.2
Locomotive + rail	--	--	--	--	--	--	--	--	--	--	--	72.0	72.0	72.0	72.0	288.0
Electric equipment	--	--	--	--	--	--	--	--	--	--	--	39.8	39.8	39.8	39.8	159.1
Navigation system	--	--	--	--	--	--	--	--	--	--	--	16.0	16.0	16.0	16.0	64.1
Tug boat & launches	--	--	--	--	--	--	--	--	--	--	--	37.6	37.6	37.6	37.6	150.6
Spillway gates	--	--	--	--	131.8	79.1	79.1	79.1	79.1	79.1	--	--	--	--	--	527.3
Contingency a/	--	--	--	--	21.9	7.9	7.9	7.9	7.9	20.1	7.3	23.9	23.9	23.9	23.9	176.5
Total other equipment	--	--	--	--	240.6	87.0	87.0	87.0	87.0	221.5	80.7	262.7	262.7	262.7	262.7	1,941.7
Other Construction Costs b/	--	--	--	149.9	665.3	721.5	758.9	899.5	693.4	777.7	702.8	721.5	693.4	730.9	599.7	8,114.5
Contingency a/	--	--	--	15.0	66.5	72.2	75.9	90.0	69.3	77.8	70.3	72.2	69.3	73.1	60.0	811.5
Total other construction costs	--	--	--	164.9	731.8	793.7	834.8	989.5	762.7	855.5	773.1	793.7	762.7	804.0	659.7	8,926.0
Indirect Costs																
Administrative costs	1.8	1.8	6.6	10.8	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	120.0
Headquarters costs	50.8	50.8	50.8	26.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	202.8
Construction supervision	5.7	5.7	5.7	10.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	227.5
Land acquisition and rights	10.9	10.9	5.5	--	--	--	--	--	--	--	--	--	--	--	--	27.3
Compensation costs	5.4	5.4	2.7	--	--	--	--	--	--	--	--	--	--	--	--	13.6
Total indirect costs	74.7	74.7	71.3	47.2	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	591.2
Total project costs	74.7	74.7	71.3	212.1	2,174.2	1,209.4	1,043.8	1,258.1	879.2	1,106.4	990.1	1,085.7	1,292.1	1,096.1	951.8	13,519.5

Note: In Case A tidal locks are located on the Pacific side, 5 km inland from the mouth of the Caimito River. There will be no tidal lock on the Atlantic side. Three-lane tidal locks will be constructed by 2020 and an additional lane will be constructed by 2060, resulting in a total of four lanes.

a/ Contingencies of 10 percent have been included in equipment and construction costs. This is an adjustment to the Stone & Webster data which reflected contingencies as an indirect cost.

b/ Includes all construction works other than equipment acquisitions shown separately above.

Source: Data prepared for Nathan Associates, Inc. by Stone & Webster using information from Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates."

Table 4-7. High-Rise Lock Canal - 150,000 DWT: Annual Project Costs on an Equipment Acquisition Basis, Adjusted for Annual Payments to Contractors (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	Total
Construction equipment	--	--	--	287.5	462.4	182.2	144.1	46.0	2.0	--	1,124.2
Other equipment	--	--	--	46.5	134.2	74.7	125.1	269.9	277.4	295.9	1,223.7
Other construction	--	--	195.4	591.7	662.3	871.8	882.5	670.8	414.1	269.7	4,558.3
Indirect costs	88.4	90.2	78.6	30.6	29.8	29.8	29.8	29.8	29.8	31.3	468.1
Total project costs	88.4	90.2	274.0	956.3	1,288.7	1,158.5	1,181.5	1,016.5	723.3	596.9	7,374.3

Note: Adjustments include advance payments due contractors of 3 percent of total construction costs and a one-year retainage of 5 percent of payments due to contractors. An advance of 10 percent of total indirect costs was allocated equally over the first 3 project years.

Source : Prepared for Nathan Associates by TAMS Consultants, Inc. on the basis of cost estimates from Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates," April 1993, as adjusted by Stone & Webster.

Table 4-8. High-Rise Lock Canal - 200,000 DWT: Annual Project Costs on an Equipment Acquisition Basis, Adjusted for Annual Payments to Contractors (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	11	Total
Construction equipment	--	--	--	294.7	374.9	223.8	218.2	91.9	4.2	--	--	1,207.7
Other equipment	--	--	--	48.4	158.4	89.1	138.8	295.1	303.1	307.8	15.4	1,356.1
Other construction	--	--	209.4	547.9	730.2	938.8	906.7	861.8	655.4	440.5	164.8	5,455.5
Indirect costs	95.7	97.8	88.3	33.3	32.2	32.2	32.2	32.2	32.2	32.2	18.1	526.4
Total project costs	95.7	97.8	297.7	924.3	1,295.7	1,283.9	1,295.9	1,281.0	994.9	780.5	198.3	8,545.7

Note: Adjustments include advance payments due contractors of 3 percent of total construction costs and a one-year retainage of 5 percent of payments due to contractors. An advance of 10 percent of total indirect costs was allocated equally over the first 3 project years.

Source : Prepared for Nathan Associates by TAMS Consultants, Inc. on the basis of cost estimates from Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates," April 1993, as adjusted by Stone & Webster.

Table 4-9. Sea-Level Canal - Case A: Annual Project Costs on an Equipment Acquisition Basis, Adjusted for Payments to Contractors (1990 US$ millions)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Construction equipment	--	--	--	--	1,111.1	363.6	99.8	144.7	7.4	--	98.6	5.2	218.6	11.5	--	2,060.5
Other equipment	--	--	--	--	250.8	121.0	84.4	84.4	84.4	208.3	85.2	246.0	254.8	254.8	267.6	1,941.7
Other construction	--	--	--	285.9	816.2	766.8	807.8	952.3	750.8	825.3	753.8	768.5	741.3	777.8	679.3	8,925.8
Indirect costs	84.5	87.1	83.0	43.2	27.3	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	27.8	591.4
Total project costs	84.5	87.1	83.0	329.1	2,205.4	1,277.9	1,018.5	1,207.9	869.1	1,060.1	964.1	1,046.2	1,241.2	1,070.6	974.7	13,519.4

Note: In Case A tidal locks will be located on the Pacific side, 5 km inland from the mouth of the Caimito River. There will be no tidal lock on the Atlantic side. Three-lane tidal locks will be constructed by 2020 and an additional lane will be constructed by 2060, resulting in a total of four lanes.
Adjustments include advance payments to contractors of 3 percent of total construction costs and a one-year retainage of 5 percent of payments due contractors. An advance of 10 percent of total indirect costs was allocated equally over the first 3 project years.
Source : Prepared for Nathan Associates by TAMS Consultants, Inc. on the basis of cost estimates from Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates," April 1993, as adjusted by Stone & Webster.

Table 4-10. Differences in Annual Project Costs as Estimated by Yachiyo Engineering Ltd. and TAMS Consultants, Inc. (1990 US$ millions)

Project year	High-Rise Lock Canal 150,000 DWT			High-Rise Lock Canal 200,000 DWT			Sea-Level Canal Case A		
	Yachiyo a/	TAMS b/	Difference	Yachiyo a/	TAMS b/	Difference	Yachiyo a/	TAMS b/	Difference
1	81.9	88.4	6.5	88.3	95.7	7.4	74.6	84.5	9.9
2	81.9	90.2	8.3	88.3	97.8	9.5	74.6	87.1	12.5
3	284.7	274.0	-10.7	250.9	297.7	46.8	71.3	83.0	11.7
4	1,196.2	956.3	-239.9	1,703.6	924.3	-779.3	330.1	329.1	-1.0
5	928.1	1,288.7	360.6	865.5	1,295.7	430.2	2,856.6	2,205.4	-651.2
6	1,106.4	1,158.5	52.1	1,125.5	1,283.9	158.4	878.0	1,277.9	399.9
7	1,048.6	1,181.5	132.9	1,059.8	1,295.9	236.1	851.8	1,018.5	166.7
8	1,331.5	1,016.5	-315.0	1,255.1	1,281.0	25.9	868.7	1,207.9	339.2
9	875.9	723.3	-152.6	1,172.1	994.9	-177.2	868.7	869.1	0.4
10	438.9	596.9	158.0	781.1	780.5	-0.6	1,069.1	1,060.1	-9.0
11	--	--	--	155.7	198.3	42.6	925.0	964.1	39.1
12	--	--	--	--	--	--	1,047.9	1,046.2	-1.7
13	--	--	--	--	--	--	1,176.0	1,241.2	65.2
14	--	--	--	--	--	--	1,245.9	1,070.6	-175.3
15	--	--	--	--	--	--	1,181.0	974.7	-206.3
Total project costs	7,374.1	7,374.3		8,545.9	8,545.7		13,519.3	13,519.4	

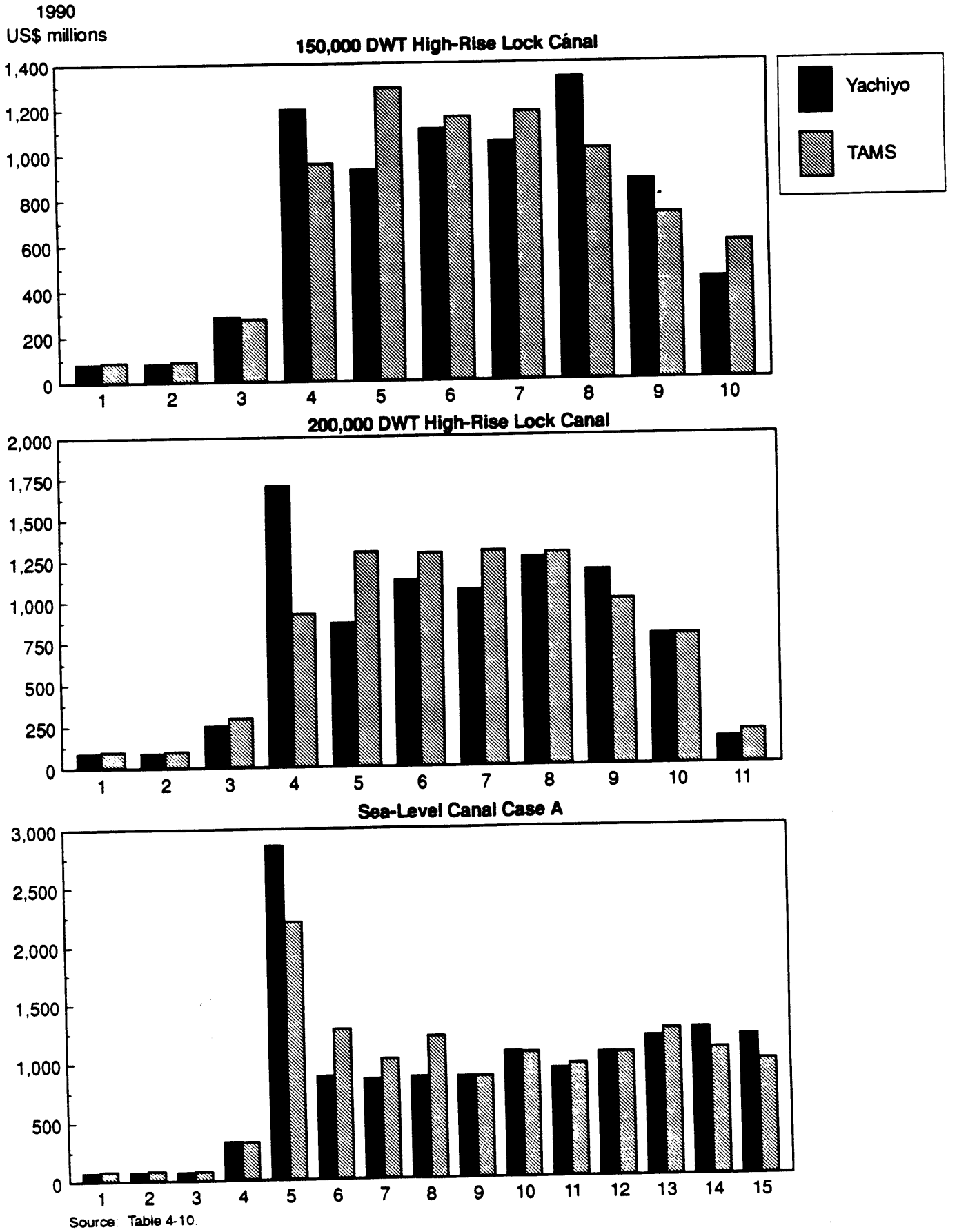
Note: Differences in total project costs are due to rounding.

a/ Estimated costs for Yachiyo are on a per unit cost basis.

b/ Estimated costs for TAMS are on an equipment acquisition basis, adjusted for annual payments due contractors.

Sources: Data for Yachiyo are from "Phase 2: Preliminary Engineering and Cost Estimates," April 1993, and data for TAMS were prepared for Nathan Associates on the basis of Yachiyo estimates, as adjusted by Stone & Webster.

Figure 4-1. Panama Canal Alternatives: Annual Project Costs as Estimated by Yachiyo Engineering Co., Ltd., and TAMS Consultants, Inc.



Source: Table 4-10.

Table 4-11. Panama Canal Commission: Statement of Operations, Fiscal Years 1980-1991 (US$ millions)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenues:												
Tolls	293.4	303.1	325.6	287.8	289.2	300.8	319.6	329.9	339.3	329.8	355.6	374.6
Advance for capital	-6.9	-9.9	-0.7	-4.1	--	--	--	--	--	--	--	-5.9
Net toll revenue	286.5	293.2	324.9	283.7	289.2	300.8	319.6	329.9	339.3	329.8	355.6	368.7
Other	82.9	94.8	112.9	111.4	120.1	111.7	104.7	106.3	110.1	106.0	119.1	137.7
Advances for capital	--	--	-5.9	-1.2	-4.9	-5.8	--	--	--	--	--	--
Net other revenue	82.9	94.8	107.1	110.2	115.3	105.9	104.7	106.3	110.1	106.0	119.1	137.7
Total operating revenue	369.4	388.0	432.0	394.0	404.4	406.7	424.3	436.1	449.4	435.8	474.7	506.4
Operating Expenses:												
Payment to the Republic of Panama:												
Public services	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Fixed annuity	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Tonnage	55.0	56.9	61.2	51.2	49.1	52.8	57.0	58.1	59.6	59.8	58.5	67.6
Subtotal	75.0	76.9	81.2	71.2	69.1	72.8	77.0	78.1	79.6	79.8	78.5	87.6
Maintenance of channels and harbors	29.3	29.6	45.2	36.0	39.6	42.4	40.3	49.3	42.3	36.5	29.5	35.6
Navigations service and control	55.2	65.8	79.1	72.5	71.4	66.8	70.8	73.3	77.4	79.8	78.9	86.2
Locks operation	31.5	41.0	46.0	45.6	46.5	42.9	49.3	46.5	47.7	49.0	48.3	53.8
General repair, storehouse, engineering and maintenance services	8.5	11.2	11.3	9.6	5.1	19.0	21.7	24.0	25.1	22.0	23.1	25.8
Supply and logistics	--	--	--	--	7.6	15.5	17.9	18.9	21.0	20.5	19.8	23.9
Transportation and utilities	36.2	36.2	36.4	42.1	34.5	34.7	31.8	30.2	31.9	30.0	29.9	31.8
Housing operations	8.2	6.7	8.1	8.9	6.1	6.9	4.9	6.4	5.6	5.4	--	--
General and administrative	70.2	70.0	72.2	69.1	70.5	65.9	66.5	69.2	73.1	76.6	77.7	78.6
Fire and facility protection	--	--	--	--	--	--	--	--	--	--	12.7	13.4
Depreciation	--	--	--	--	--	--	--	--	--	--	23.4	22.7
Interest	11.9	11.3	9.1	9.9	9.8	7.7	6.8	6.9	11.3	13.9	15.1	11.5
Other	40.8	40.3	42.0	33.2	37.3	31.0	35.4	34.0	36.3	29.6	30.9	32.1
Total operating expenses	366.7	388.9	430.7	398.1	397.6	405.6	422.3	436.7	451.2	443.1	467.7	502.8
Net Operating Revenue (loss)	2.7	-0.9	1.3	-4.1	6.8	1.1	2.0	-0.6	-1.8	-7.3	7.0	3.6

Source: Panama Canal Commission Annual Report, Fiscal Years 1980-1991.

Table 4-12. Panama Canal Commission: Other Revenues Fiscal Year 1992 (US$ thousands)

Revenue Item	Amount	Percent
Transit Operations		
Maintenance of channels, dams and spillways	59	a/
Navigation service and control:		
Towing and assisting ships	42,520	34.9
Handling ships' lines	29,204	24.0
Other navigation	2,645	2.2
General repair, engineering and maintenance services	1,054	0.9
Security and protection services	4,294	3.5
Total transit operations	79,776	65.6
Supporting Services		
Logistical services	267	0.2
Motor transportations operation	7	a/
Utilities:		
Power system	25,603	21.0
Water system	12,444	10.2
Communication services	704	0.6
Central chilled water system	1,667	1.4
Employee housing	689	0.6
Other supporting services	121	0.1
Total supporting services	41,502	34.1
Administrative and general	419	0.3
Total other operating revenue	121,697	100.0

a/ Less than 0.05 percent.

Source: Panama Canal Commission, Fiscal Year 1992 Board Presentation.

Table 4-13. Estimated Operation and Maintenance Costs for the Year 2020 for the Existing Canal and Alternatives (1990 US$ millions)

Item	Existing Canal 1990	Status Quo Canal	High-Rise Lock Canal 150,000 DWT	High-Rise Lock Canal 200,000 DWT	Sea-Level Canal Case A a/
Maintenance of channels, dams, and spillways	29.5	29.5	35.4	38.3	53.1
Navigation service and control	78.9	102.6	118.4	118.4	149.9
Locks operation	48.3	62.8	86.9	91.8	77.3
General repair, engineering and maintenance services	23.1	30.0	43.8	43.8	34.6
Supplies and transportation b/	19.8	19.8	27.7	27.7	29.7
Utilities	29.9	29.9	35.9	35.9	38.9
Administrative and general	77.7	77.7	93.2	93.2	101.0
Depreciation c/	23.4	25.3	31.5	32.0	34.6
Fire and facility protection	12.7	12.7	15.2	15.2	16.5
Interest on investments d/	15.1	0.0	0.0	0.0	0.0
Other	30.9	30.9	37.1	37.1	40.2
Total	389.3	421.2	525.1	533.4	575.8
Less adjustment for costs that will not be incurred after 2000 e/	50.0	50.0	50.0	50.0	50.0
Adjusted costs	339.3	371.2	475.1	483.4	525.8

a/ In Case A tidal locks will be located on the Pacific side, 5 km inland from the mouth of the Caimito River. There will be no tidal lock on the Atlantic side. Three-lane tidal locks will be constructed by 2020 and an additional lane will be constructed by 2060, resulting in a total of four lanes.

b/ Includes Canal crossings.

c/ Depreciation is estimated at 6 percent of operation and maintenance costs.

d/ Interest payments to U.S. suspended after 2000.

e/ Upon the return of the Canal to the Republic of Panama in 2000, certain costs will no longer be incurred. Such costs include

1. Cost of the special retirement program established in the treaty;
2. Reimbursement to the U.S. Department of Defense for health and education benefits paid on behalf of Canal employees and their families who are U.S. Citizens;
3. Employer's contribution to Federal Employees Compensation Act and Health Benefit Act ;
4. Housing subsidies for U.S. employees as authorized residents of PCC housing;
5. Commission employment costs for U.S. employees including home leave expense, repatriation expense, and transportation of employee vehicles;
6. Other statutory employment costs, including FEGLI, FICA, FERS, Medicare, and unemployment costs;
7. Operation of the Commission's Washington office.

Source: Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates," Table II.3.3-4 (April 1993).

Table 4-14. Estimated Operation and Maintenance Costs for the Year 2060 for the Existing Canal and Alternatives (1990 US$ millions)

Item	Existing Canal 1990	Status Quo Canal	High-Rise Lock Canal 150,000 DWT	High-Rise Lock Canal 200,000 DWT	Sea-Level Canal Case A a/
Maintenance of channels dams, and spillways	29.5	29.5	38.3	41.3	53.1
Navigation service and control	78.9	126.3	157.9	157.9	189.4
Locks operation	48.3	77.3	111.1	115.9	96.6
General repair, engineering and maintenance services	23.1	36.9	55.4	55.4	46.1
Supplies and transportation b/	19.8	19.8	35.7	35.7	37.6
Utilities	29.9	29.9	38.9	38.9	41.8
Administrative and general	77.7	77.7	101.0	101.0	108.8
Depreciation c/	23.4	28.2	38.0	38.5	40.6
Fire and facility protection	12.7	12.7	16.5	16.5	17.8
Interest on investments d/	15.1	0.0	0.0	0.0	0.0
Other	30.9	30.9	40.2	40.2	43.2
Total	389.3	469.2	633.0	641.3	675.0
Less adjustment for costs that will not be incurred after 2000 e/	50.0	50.0	50.0	50.0	50.0
Adjusted costs	339.3	419.2	583.0	591.3	625.0

a/ In Case A tidal locks will be located on the Pacific side, 5 km inland from the mouth of the Caimito River. There will be no tidal lock on the Atlantic side. Three-lane tidal locks will be constructed by 2020 and an additional lane will be constructed by 2060, resulting in a total of four lanes.

b/ Includes Canal crossings.

c/ Depreciation is estimated at 6 percent of operation and maintenance costs.

d/ Interest payments to U.S. suspended after 2000.

e/ Upon the return of the Canal to the Republic of Panama in 2000, certain costs will no longer be incurred. Such costs include

1. Cost of the special retirement program established in the treaty;
2. Reimbursement to the U.S. Department of Defense for health and education benefits paid on behalf of Canal employees and their families who are U.S. Citizens;
3. Employer's contribution to Federal Employees Compensation Act and Health Benefit Act ;
4. Housing subsidies for U.S. employees as authorized residents of PCC housing;
5. Commission employment costs for U.S. employees including home leave expense, repatriation expense, and transportation of employee vehicles;
6. Other statutory employment costs, including FEGLI, FICA, FERS, Medicare, and unemployment costs;
7. Operation of the Commission's Washington office.

Source: Yachiyo Engineering Co., Ltd. "Phase 2: Preliminary Engineering and Cost Estimates," Table II.3.3-5 (April 1993).

5. MANAGEMENT ARRANGEMENTS—COMPARATIVE ANALYSES AND EVALUATION OF PANAMA CANAL ALTERNATIVES

Introduction

- A range of management arrangement models for the Canal alternative was identified and evaluated to determine which model would be most suitable to handle the political, financial, management, and operating requirements of the Canal alternative.
- Management arrangements of the existing Panama Canal and other international waterways and transportation entities were reviewed and evaluated as possible management models for the Canal alternative.
- General management issues relevant to the design of the management arrangements for the Canal alternative were examined.
- Five models for managing the Canal alternative were defined and evaluated against a comprehensive set of criteria that addressed a range of political, financial, managerial, commercial, personnel, and international issues relevant to the alternative canal's efficient management and operation.
- A set of recommended management arrangement models emerged from the evaluations and analysis, and a preferred management arrangement model was selected.
- The management models, selection criteria, and recommendations discussed in this section pertain to a future Canal alternative, not to the existing Panama Canal. The management models analyzed have been chosen and examined for their relevance to the Canal alternatives, not to the existing Panama Canal. An in-depth review of the management and operation of the existing Panama Canal was not conducted for this study.
- Figure 5-1 (p. 5-34) presents an overview of the tasks and work flow for the management arrangements analyses.

Panama Canal

Facility Description

- The Panama Canal is approximately 51 miles long from deep water to deep water. The minimum width of its navigable channel is 500 feet, and it normally accommodates vessels with a maximum draft of 39 feet 6 inches (fresh tropical water).
- Much of the Canal consists of a channel marked through the man-made Gatun Lake.
- Vessels transiting the canal are raised 87.5 feet, three steps to the level of Gatun Lake, then lowered three steps back to sea level. The Canal has three sets of locks (Gatun, Pedro Miguel, and Miraflores) each with two lanes of traffic, allowing simultaneous lockage of two vessels in the same or opposite directions.
- The Canal handled 12,572 vessels and 162,695,886 long tons of commercial cargo in 1991.

Organizational History

- Construction began in 1904, and the Panama Canal opened officially on August 14, 1914. Until October 1, 1979, it was operated by the Panama Canal Company, a wholly owned corporation of the U.S. government. On that date, the Panama Canal Commission (PCC), an agency of the U.S. government, assumed operation of the Canal.
- For decades the issue of Panamanian control of the Canal has been debated. The debate was fueled by discussions of an additional canal to increase transoceanic capacity and Egypt's nationalization of the Suez Canal in 1956. Other relevant events include
  - A 1964 statement by President Johnson suggesting that a new canal and a new treaty on control of the existing Canal be negotiated with Panama.
  - A draft 1967 treaty for the United States and Panama to jointly create and operate a new sea-level canal.
- On October 1, 1979, the Panama Canal Commission, a U.S. government agency, was established under the terms of the Panama Canal Treaty of 1977, and assumed operation of the Canal from the Panama Canal Company. The Commission will operate the Canal until December 31, 1999, after which full responsibility will transfer to the Republic of Panama.

- As per the 1977 treaty and the Panama Canal Act of 1979 (P.L. 96-70), the PCC is an agency of the executive branch of the U.S. government.
  - The PCC reports to the President of the United States through the Secretary of Defense and the Secretary of the Army.
  - The PCC is supervised by a Board of Directors consisting of four Panamanian and five U.S. members.
  - The PCC is being managed by a Panamanian Administrator and a U.S. Deputy Administrator for the remaining years of the treaty. The Administrator is appointed by the President of the United States with the advice and consent of the U.S. Senate.

Issues

- To facilitate a smooth transition of the Canal operation to Panamanian control, both the Panamanian and U.S. governments are conducting numerous studies concerning the future management of the Canal.
- As dictated by the 1977 treaty, the U.S. government has been transferring assets to Panamanian control. Panama's past political and financial difficulties have produced mixed results in maintaining these assets.
- Discussions of alternatives to the Canal began decades ago and continue today. Other modes and methods of transoceanic transportation are also under consideration both within Panama and in neighboring countries.
- Traffic growth through the Canal has been weak during the past 10 years.

St. Lawrence Seaway

Facility Description

- The St. Lawrence Seaway is a system of lakes, rivers, and waterways 2,342 miles long, connecting the Great Lakes and the Atlantic Ocean. The core of the system is a 346-mile section between Montreal and Lake Erie. This portion of the binational waterway is operated jointly by the Canadian and U.S. governments.
- Vessels entering the seaway from the Atlantic Ocean sail 1,040 miles into the Gulf of St. Lawrence and up the St. Lawrence River to Montreal before encountering locks. Montreal is 20 feet above sea level.
- At Montreal, vessels transit the first of seven locks required to lift vessels 226 feet to the level of Lake Ontario.
  - Five of the seven locks on the St. Lawrence (St. Lambert, Côte St. Catherine, Upper Beauharnois, Lower Beauharnois, and Iroquois) are operated by the Canadian St. Lawrence Seaway Authority (SSA).
  - Two locks (Snell and Eisenhower) are operated by the U.S. St. Lawrence Seaway Development Corporation (SLDC).
  - The two authorities divided the river into U.S. and Canadian sectors for the control of vessels using the seaway.
- Vessels destined to the shores of Lake Ontario enter the Welland Canal at Port Weller. The 26-mile Welland Canal is operated by the SSA. The canal's seven locks lift vessels 326 feet to the height of Lake Erie, permitting vessels to bypass Niagara Falls. (An eighth lock on the Canal is a shallow-lift guard lock.)
  - St. Lawrence River locks are modeled on the locks in the Welland Canal. They are 80 feet wide, 766 feet long, and 30 feet over the sills.
- Vessels entering Lake Superior and the seaway's westernmost waters must transit a final series of locks that are not operated by the SSA or the SLDC.
- The St. Lawrence River section of the seaway handled 2,859 vessels and 35 million tons of cargo in 1991.

Organizational Background

- Canadians were the guiding force behind the creation of the St. Lawrence Seaway. In 1932, Canada completed the Welland Canal. In the United States, Midwestern legislators and several Presidents led U.S. efforts at jointly developing the Seaway but failed to attract enough support until the mid-1950s.
  - In 1951 Canada established the SSA to construct and develop (alone or with the United States) a deep-draft seaway between Montreal and Lake Erie.
  - Iron ore, desired by U.S. industry, was found in Labrador and could be inexpensively transported to U.S. mills via the seaway.
- U.S. President Eisenhower signed the Wiley-Dondero Act in 1954, creating the SLDC. The purpose of the corporation was to participate in the joint development of the seaway with Canada. Construction began in 1955 and was completed in 1959.
- Canada contributed $336.5 million and the United States $138 million to construction of the seaway.

Current Organization

- Canadian and U.S. agencies jointly set transit regulations, toll structures, and opening and closing dates of the Canal. Each agency operates its own locks and controls traffic on a portion of the Canal. Currently, tolls are set jointly for a 3-year period, but no rules govern how often tolls can be modified.
- The two agencies are operated independently of each other, and most management functions (financial control, marketing, planning, operations) are duplicated.
- The SLDC is a wholly owned U.S. government corporation. As such it can issue its own bonds and is not subject to many regulations that normally apply to U.S. government agencies.
- As a Crown corporation, the SSA is granted significantly more independence than Canadian government agencies.
  - Its employees are not civil servants and its corporate board reports directly to the Minister of Transportation.

- Although the SSA has considerable independence from standard governmental operating procedures, its policy decisions are, in fact, closely reviewed and coordinated by the Canadian executive branch.

Issues

- The seaway has not been able to recoup its investment.
- Tolls have been constrained by considerable political pressure and by competition from the Mississippi River, railroads, and even government policies on port preferences.
- In 1977 the Canadian government forgave the SSA its debt to the federal government by converting SSA's debt to equity. The SSA is now responsible only for covering its operating costs, but it has lost much of its autonomy.
- Since 1986 the U.S. portion of St. Lawrence Seaway tolls (currently one-quarter of the total) has been rebated to commercial shippers, and the SLDC's operating funds are now appropriated to it from the federal government's Harbor Maintenance Trust Fund. Although the SLDC still has legal authority to issue bonds, it has lost much of its direct revenue, which has effectively eliminated its capacity to float bonds independently.
- The SLDC continues to accumulate revenues from the joint operation of an international toll bridge with the SSA. It also rents office space at its Massena offices and commercial space to a duty-free enterprise at the border. The SLDC is, nevertheless, primarily funded by government appropriation.

Suez Canal Authority

Facility Description

- The Suez Canal, a 101-mile-long sea-level canal, links the Mediterranean Sea and the Indian Ocean. It is 980 to 1,150 feet wide. The channel is roughly 590 feet wide and at least 64 feet deep.
- Vessels transit the canal in one of three convoys per day. The northbound convoy departs at 07:00; southbound convoys depart at 01:00 and 07:00. Ships in each convoy are 20 minutes apart. Southbound convoys are detained at a bypass or lake to allow the northbound convoy to pass.
- Tidal range is less than 5 feet on the south side and 16 inches on the north side; thus, tidal gates or locks are not required. There are 14 signal stations along the western bank of the canal for traffic management and pilotage operations.
- In 1992 the Suez Canal handled 18,326 vessels and 273 million tons of cargo (85 million tons of oil).

Organizational History

- The Suez Canal was constructed by Ferdinand de Lesseps, a French diplomat who was granted a 99-year concession to build and operate the canal. The canal was completed in 1869, but years later, when the French–Egyptian consortium ran into hard times, Britain became the largest shareholder in the Compagnie Financière de Suez. Britain's influence throughout Egypt grew early into the twentieth century.
- In 1956, with 12 years to run on the original concession, Egypt's President Abdel Gamal Nasser nationalized the canal, removing it from Anglo–French control. Nasser created the Suez Canal Authority to manage the canal and gave it significant independence and autonomy. Critics world-wide predicted the demise of the canal because of mismanagement, but traffic continued to grow.

Current Organization

- The Suez Canal Authority (SCA) is a public authority, reporting directly to the President of the Arab Republic of Egypt. SCA is responsible for operating, maintaining, and developing the canal. It is also responsible for water, sewage, and other infrastructure needs of the surrounding areas, including the cities of Port Said, Ismailia, and Suez.

- SCA levies tolls and collects navigation, pilot, towing, and docking fees. It is granted considerable autonomy in this regard. According to Law 30-1975, the SCA need not adhere to or be restricted by government rules and conditions: "The authority's money is considered private money."
- The annual budget is reviewed by the Ministry of Finance and the Prime Minister (in lieu of the President), but in fact there is little questioning of the budget.
- Up to 15 percent of the Canal's net income is set aside for improvements to the Canal; all remaining net income is turned over to the national government.
  - If the SCA requires capital for a large project, it obtains "soft loans" from the government.
  - The SCA has never issued stocks or bonds.
- The Chairman of the Suez Canal is appointed by the President of Egypt. The Chairman nominates a board of directors, which is approved by the Prime Minister, and appoints an executive staff. The SCA has nine departments and eight affiliated companies (shipbuilding, engineering, and other maritime-related businesses), as well as a subsidiary that invests the SCA's income.
- The SCA employs 15,000 people, of which 300 are canal pilots. The eight affiliated companies employ another 8,000 people.
  - SCA sets its own wage scales, which are considerably higher than both civil service and prevailing wages.
  - SCA positions are considered prestigious and include housing until retirement, schooling, recreational clubs, and low-cost vacation rentals.

Issues

- Except for disruptions caused by war, the SCA has operated the canal successfully for more than three decades.
- The canal generates a substantial surplus for the Government of Egypt, which in turn provides the SCA with broad powers.
- Eng. Mohamed Ezzat Adel, the Chairman of the SCA, is an extremely strong force within the SCA. He has reportedly been at the helm of the SCA for much of its history and has an impressive reputation for guiding its expansion.

Rhine Main-Danube Canal

Facility Description

- The Main-Danube Canal, a 106-mile-long canal with 16 locks, is part of the 420-mile waterway linking the Main and Danube rivers. It fulfills a centuries'-old dream of linking Western Europe's longitudinal Rhine with Eastern Europe's latitudinal Danube, creating a 2,200-mile waterway touching 15 nations.
- The canal handles barges up to 3,300 DWT and vessels to 2,000 DWT and supplies water to the local area.
- The canal was built by Rhine Main-Danube, AG (RMD, AG), a private company wholly owned by the federal, state, and local governments. The canal was begun in 1962 and completed in 1992 at a cost of US$4 billion (DM 6 billion).
- The German government forecasts that 8 to 10 million tons of cargo—mostly bulk—will transit the canal in each of its first few years of operation.

Organizational History

- In 1921 the Rhine Main-Danube Convention between the German Reich and Bavaria was signed. RMD, AG was created to build and operate hydropower-generating facilities and, with the proceeds, to design and construct a canal. RMD, AG is a private company whose stock is held by the federal government (66 percent), the State of Bavaria (33.8 percent), and Baden-Wurttenberg and 12 other cities (0.2 percent).
- By 1991 RMD, AG was supplying 12 percent of the total electrical power in Bavaria through 57 power-generating facilities. It earned some $110 million in revenues from power sales.
- RMD, AG commenced development of the Main-Danube Canal in 1962, but by the mid-1970s the escalating cost of the project could not be financed by RMD, AG alone. Federal and state governments floated interest-free loans. Project delays, "government subsidies," and environmental concerns spurred a heated public debate over the value of the project.
- Regional interests pressed the federal government to complete the project to generate additional jobs, stimulate commerce, remove trucks from congested highways, and improve access to Eastern European markets.

- RMD, AG completed the canal in 1992 with
  - $1 billion in proceeds from energy sales,
  - $600 million in loans raised on the capital market, and
  - $2 billion in interest-free government loans.

  It will continue to operate power plants until 2050, when they revert to the government.
- The canal is now part of the 4,500-mile German national waterways system, which is managed by the Federal Waterways and Shipping Administration (BWV). Germany's Basic Law requires that waterways be administered by the federal government. The BWV employs 18,800 people.

Current Organization

- Management of the canal by the BWV is handled by a waterway board (1 of 34 nationwide) that reports to one of BWV's seven regional directorates. Other BWV divisions such as the Federal Institute for Hydrology and the Federal Institute for Waterway Engineering are responsible for some functions at the canal.
- Waterway usage charges are calculated by the Ministry of Transport in accordance with international agreements and conventions. There are no special tolls for the Main-Danube Canal.
- The BWV spent about $420 million in 1990 to operate and maintain the national waterways. This figure is expected to grow considerably as former East German waterways are improved.

Issues

- Government-owned private companies are not uncommon in the German maritime industry. The Ports of Bremen/Bremerhaven and Hamburg are examples.
- Without government interest-free loans and regional governments' insistence, the "private" RMD, AG would not have completed the canal.
- German Basic Law requires public management of German waterways. Protecting the free flow of commerce is considered to far outweigh the advantages of an autonomous body.

Channel Tunnel

Facility Description

- The Channel Tunnel consists of three 30-mile undersea rail tunnels under the English Channel between Calais, France, and Dover, England. The two outer tunnels have single tracks, which accommodate shuttles that ferry vehicles through the tunnel and intercity trains. The center tunnel is a maintenance and safety tunnel.
- The tunnel, a centuries'-old dream of monarchs and travelers, is expected to open by mid-1994.

Organizational History

- In January 1986, the British and French announced that a joint venture, The Channel Tunnel Group, Ltd. and France-Manche, S.A., had been selected to pursue construction of the Channel Tunnel.
  - A treaty between the two countries one month later provided the necessary international legal framework.
  - In March 1986, the British and French governments granted a 55-year concession to the group (July 1987 to 2042), after which the tunnel reverts to both governments.
- The joint venture consists of two major binational entities, one for construction and one for operation.
  - The operating company is called Eurotunnel.
  - The construction company is called Trans-Manche Link (TML).
- Eurotunnel consists of two publicly traded stock companies, Eurotunnel, S.A. and Eurotunnel, Plc.
  - The two companies have identical boards of directors, currently composed of 10 members (5 British, 4 French, 1 Belgian).
  - Eurotunnel consists of three divisions: project implementation, finance, and operations. Total staff numbers about 1,000 and is expected to increase to 2,700.
  - Eurotunnel's Operating Division will be restructured into TRANSCO to operate and maintain the shuttle vehicles for passenger cars and buses and trucks. It will also collect tolls.

- Eurotunnel set tolls in 1986 indexed to inflation, but it is free to alter tolls as long as they do not conflict with European Community regulations on fair trade.
- Trans-Manche Link is responsible for the design, construction, and testing of the tunnel under contract from Eurotunnel. TML began work in 1987. It has completed the tunnels and is nearing completion of the terminals. At its peak, TML employed 14,000 people.

Issues

- As of March 1993 Eurotunnel raised approximately $13 billion (£8.9 billion). Approximately £7.3 billion are long-term (18-year) loans; the remainder is equity share units (each unit represents one share of the French company and one share of the British company).
- A provision of Eurotunnel's concession was that it would receive no government support or guarantees, but Eurotunnel will seek considerable financial relief from both governments because of their difficulties in providing intercity rail services.
- Eurotunnel loans are underwritten by a syndicate of 220 banks worldwide.
- Delays and overruns have plagued the project, which was originally projected to cost a fraction of the current investment.
- Eurotunnel raised equity on three occasions and has sought additional debt on numerous occasions. It plans to raise an additional £200 million in 1994 and could need US$1.4 billion in cash to cover the first few years of operation.

Other Models of Interest

Port Authority of New York and New Jersey

- The Port Authority was created in 1921 to "promote and protect the commerce" of the New York metropolitan region, which consists of portions of both New York State and New Jersey.
- The Port Authority is the first interstate agency ever created under a U.S. Constitutional clause permitting compacts between states with Congressional consent.
- The agency is currently responsible for four airport facilities, six interstate tunnels and bridges, two bus terminals, an interstate subway system, the World Trade Center, port facilities, and several industrial parks.
- Each state appoints six members of the Port Authority's Board of Commissioners.
- The governor of each state retains the right to veto the actions of the Board, and both states must authorize major projects before the Port Authority undertakes them.

Los Angeles Coal Port

- In the early 1980s, the Port of Los Angeles determined that a coal export terminal would be strategically desirable as a part of its 2020 long-term plan.
  - The port would handle high-quality steam coal from reserves in the western United States for export to Japan and would help diversify the port's business portfolio.
  - The port estimates that the facility will handle 20 million metric tons per year.
- The projected cost of the terminal was $186 million. To ensure the success of the project, the port assembled a group of 38 interested parties to study and develop the concept.
  - Each entity had a potential stake in the project. They ranged from U.S. coal suppliers and railroads to Japanese trading companies and coal consumers.
  - Each participated in the project's study cost and each will receive an equity share.

- A multinational corporation will be formed. The Port of Los Angeles will be landlord to the project and an equity participant. The Port of Los Angeles will hold 10 percent of the corporation's equity; other shares may include Japanese trading companies, oil companies, shipping lines, banks (almost half of the equity), and U.S. coal producers (more than a quarter).

General Management Issues

Introduction

- Examination of the preceding seven entities highlights several general management issues relevant to the design of management arrangements for the Canal alternative.

Public Purpose versus Commercial Objectives

- Entities set up to manage major transportation infrastructure assets must often balance public policy goals with commercial objectives.
- Public purpose goals include reliance on transportation infrastructure to generate broad economic or political benefits to the economy and society at large. Commercial objectives require transportation infrastructure assets to earn direct financial profits and generate cash flows to finance future investment in plant and equipment.
- Such public policy and commercial considerations can conflict.
- Some management arrangements tend to be better at pursuing public policy purposes, whereas others are better suited to achieving commercial objectives; the ideal set of management arrangements is able to balance and integrate both goals.

Financial Self-Sufficiency

- When commercial objectives are important, financial performance is an indicator of management effectiveness in operating transportation assets. Sustained financial self-sufficiency is a key measure of sound financial performance.
- The ability to achieve financial self-sufficiency is linked to the degree of competitive advantage of a transportation entity over its rivals for a sustained period of time. Competition may come from a variety of modes delivering a similar transportation service.

- The ability to raise tolls is critical to financial self-sufficiency. Toll policy is inevitably political. The choice of management arrangements for a given transportation asset is important, because these arrangements often determine how, and how much, political influence can be applied in decisions regarding tolls and other revenues, as well as cost control.
- Ancillary activities can generate significant revenues and provide a financial cushion when financial performance of the primary business is weak. In certain cases, a portfolio of activities might include control over competing services (e.g., Port Authority of New York and New Jersey's control over bridges, tunnels, and interstate subway and ferry service).
- Although self-sufficiency implies self-financing, most major transportation infrastructure requires strong government participation in initial project funding. Even the Channel Tunnel could not have been undertaken without the full commitment of the respective governments to the supporting infrastructure, including rural rail improvements in both England and France.

Operating and Management Autonomy

- The management structures of the various transportation infrastructure entities discussed earlier have all enjoyed significant operating autonomy, as well as fiscal autonomy, at some stage in their development. However, as circumstances change over time, "independent" agencies have tended to exhibit less, rather than more, control over their own operations as political influences on them increase. (Financially successful entities may become coveted cash cows; less successful entities may become political wards.)
- Management's ability to make decisions without excessive bureaucracy, interference, and delay is critical to establishing the entity's credibility within its industry. This capability for rapid management response is, in particular, a prerequisite for efficient customer service and critical to operating successfully in a competitive framework.
- A strong but flexible legal framework is necessary for a quasi-governmental entity to evolve. The capability to evolve is important: a number of organizations set up for one purpose have absorbed other functions over time—usually adding to the financial strength of the organization. The compact establishing the Port Authority of New York and New Jersey, for example, gives this entity the power to pursue a broad range of projects under the aegis of commerce.

- Separation of a transportation entity's labor practices from those prevailing in government agencies encourages development of a high-quality, stable work force. In many cases, freedom from standard civil service regulations allows higher pay, richer career development, and other incentives for long-term service.
- All of this makes for superior labor productivity, a key determinant of operating efficiency and financial performance.

Private and Public Roles

- Developing major transportation infrastructure assets often encompasses both public purpose and commercial objectives. Managing these assets frequently involves a role for both the private and public sectors.
- Pricing (toll setting) and labor practices are often the domain in which private and public roles overlap.
- Few precedents exist for totally private control of a major infrastructure asset. And even when private ownership and operation predominate, some degree of public regulation and control can be expected (e.g., as in the case of utility companies).
- In the transportation sector, private entities often require direct or indirect government involvement in order to operate successfully (e.g., franchises, guarantees, support services). At a general level, government's overall industrial policy and its regulatory philosophy are important issues for management.
- When a transportation infrastructure asset is managed and operated by the public sector, privatization (contracting out to the private sector for services) is an increasingly attractive practice for cost control. Quasi-public agencies may contract out to private parties for construction, operation, or management of a facility.
- Models of truly mixed private–public entities for new businesses (i.e., private and public sector equity participation in the same entity) are limited. The Los Angeles Coal Port is perhaps the most recent example of a project in which both sides will take some risk in exchange for future returns. More common are such models as public air transportation corporations or German port operations, which are owned in majority share by government, but with some participation by private investors.

Multinational and Multijurisdictional Entities

- Numerous successful models of binational or bistate entities to manage transportation infrastructure exist: St. Lawrence Seaway, Channel Tunnel, Port Authority of New York and New Jersey, among others. Each was created by necessity because of the geographical dimensions of the service delivered or the facility required.
- In the case of the St. Lawrence Seaway, two parallel organizations exist. This is unlikely to provide maximum efficiencies. At present, the two organizations provide similar services in relation to their respective locks.
- In cases of a singular entity, integration needs to occur at the board level, with sharing of key management jobs as well. Accusations of bias in both policy and appointments are inevitable but less likely when executive management is well integrated.
- Multinational management patterns are difficult in any enterprise, leading to duplication and other inefficiencies, depending on structure and political context. The United Nations provides an extreme case; the European Commission runs a close second.

Panama Canal and Canal Alternatives: Need for a Single Management Entity

Introduction

- Both of the Canal alternatives currently under scrutiny—the High-Rise Lock Canal and the Single-Lane Sea-Level Canal—presuppose the continued use of the existing Panama Canal as modified by the Culebra Cut widening.
- The Republic of Panama would be a major stakeholder in the performance of both the existing Canal and either of the alternatives to the Canal. From the Panamanian perspective, the facilities must be managed and operated in a way that optimizes the efficient use of both the existing Canal and the Canal alternative and maximizes the overall financial and economic benefits to the Republic of Panama from these important assets.
- The management arrangements proposed for the Canal alternative must reflect these facts.

High-Rise Lock Canal Alternative

- In the case of the High-Rise Lock Canal, the existing Canal and the proposed Canal alternative would be a single inseparable operation, having in common canal alignment, channel accesses, navigable channels, and ancillary facilities such as tugs, pilots, and maintenance equipment and facilities.
- Of course, with a single inseparable operation, a single set of toll policies, structures, and rates would be required.
- For these reasons, it is wholly impractical to envisage a management arrangement that does not feature a single management entity with responsibility for both the existing Canal and its High-Rise Lock Canal alternative.

Single-Lane Sea-Level Canal Alternative

- Although the Single-Lane Sea-Level Canal would be physically separate from the existing Canal (to be constructed roughly 16 km to the west of the existing Canal), the two would need close and careful coordination in several major areas of activity.
  - On a physical operations level, at a minimum, such coordination would be essential in traffic management and water storage and usage.
  - On a financial level, in order to avoid uneconomic competition that would undermine the financial self-sufficiency of both facilities, coordination would be equally essential in toll policies, structures, and rates.
  - Moreover, in administration, strategic planning, and personnel management, substantial benefits and economies are likely to be obtained only through consolidated operation of the two facilities.
- Consequently, sound commercial practice and the principles of management efficiency dictate the establishment of a single management entity responsible for both the existing Canal and its Sea-Level Canal alternative.

Conclusion

- On the basis of the foregoing, all the models for management arrangements for the Canal alternative proposed below assume that a single entity will be established to manage and operate the existing Canal and the Canal alternative ultimately selected for implementation.
- The possible models examined on the following pages were chosen and evaluated for their relevance to a future Canal alternative—a major engineering project that would require considerable financial strength—*not* to the existing Panama Canal. Notwithstanding the inevitable operational integration of the two, the criteria by which we examine and evaluate the following options are not necessarily those one would use in examining the performance of the Canal today.

Models for Management of Canal Alternatives

Government Department (government agency, civil service operation)

- According to this model, the Canal alternative would be established as a government department and operated as a regular agency under civil service administration.
- As a government agency, the Canal alternative would function as an integral part of one of the ministries within the executive branch of government, with some direct exposure to the legislative branch.
- Standard government budgeting and accounting procedures, as well as civil service regulations for procurement, personnel, and general administration, apply in most cases. Regulations governing personal finances and post-career employment may limit the pool of managerial talent.
- Activities of government departments, including budgeting and policy oversight, are usually heavily influenced by political considerations. This limits their ability to undertake unpopular initiatives.
- Although government departments often have the capability to undertake long-term investments, they often fall prey to changing political winds or bureaucratic paralysis.

Public Authority (Panamanian public sector ownership, operating autonomy)

- Public authority status is frequently granted to "profitable" public enterprises to temper political influence and protect coffers.
- Under a public authority model, the Canal alternative would be set up as an independent authority by Panamanian legislation ("Authority Act"). The authority would be charged with managing and operating the asset for specific purposes spelled out in its charter.
  - The authority would have, among other powers, the capability to establish its own pricing and labor statutes.[1]

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[1]Discussion of toll policy issues and analyses is presented in Section 2, and the estimation of optimal toll structure and rates for the Canal alternative is presented in Section 3.

  - A board of directors would be appointed to oversee the authority. Although appointed by the President of Panama, the directors would serve independently of him and would be sheltered from political pressure.
- Public authorities or corporations are usually subject to a separate and customized body of regulations and guidelines governing action.
- Even well-insulated authorities can be used for political purposes, though less directly than an executive agency.
- The financial strength of any public authority depends on its ability to maintain prices (tolls) and avoid having to take on unprofitable activities.
- Public authorities often have the flexibility and capability to absorb other functions or related purposes, although they are usually established to carry out a specific purpose. The Port Authority of New York and New Jersey, for instance, started in rail, moved to tunnels and bridges, and then ultimately assumed port, aviation, real estate development, and telecommunications responsibilities.

International Public Entity (international public ownership, operating autonomy)

- According to this model, the Canal alternative would be set up by treaty or international agreement as an international public body, created expressly to manage and operate the Canal alternative asset.
  - Signatories to the treaty or agreement would be member states with a national interest in interoceanic shipping. Panama would, of course, have to accede to this treaty or agreement.
  - The international treaty or agreement and the related protocols establishing the entity would spell out in detail the purposes, powers, and obligations of this public body, including its toll-setting capabilities. The entity would have the ability to raise international debt finance.
  - Senior civil servants of the member states would likely constitute the entity's board of directors, and it would have its own international civil service statute.
  - Also specified would be the roles and responsibilities of the participating member states and the relationship of the international entity to Panama.
- Commitment to any new international entity over an extended period of time needs to be established at the outset.

- International entities are likely to provide stability and financial strength.
- However, international entities often have difficulty making decisions because of the diversity of interests represented. Depending on the framework, the ratification or support of national legislatures may be necessary for policy decisions.
- The need to limit the tendency toward bureaucratic expansion in these entities has become apparent in many situations. These include the United Nations and its member agencies, multilateral lending agencies (e.g., World Bank), and the European Commission.
- Long-term planning ability can be ensured if appropriate commitments are put in place and no dramatic geopolitical developments occur.

Special Purpose Corporation (mixed public–private sector and Panamanian–foreign ownership, operating autonomy)

- According to this model, the Panamanian government or one of its agencies would grant the Canal alternative—under a long-term concession agreement and operating contract—to a special purpose corporation (SPC), whose role would be to manage and operate the asset.
  - The SPC would be a special company, registered in Panama, whose owners could include the Panamanian public sector, interested foreign governments, and local and foreign private parties. The last among these might in particular include shipping lines using the Canal.
  - The concession agreement and operating contract would give the SPC independent operation, including toll-setting authority, special tax status, and control over its finances and labor force. Accordingly, the SPC would have the ability to try to raise capital in international financial markets.
  - The SPC's concession agreement and operating contract would specify its performance obligations in the development, operation, and maintenance of the Canal alternative asset.
  - An SPC board of directors would represent the owners of the corporation.
- Several different types of SPC operating contracts are possible: these could include an arrangement to operate the Canal on a cost-plus basis or, alternatively, on a profit-sharing basis.

- The SPC could be contracted to accomplish the construction of the Canal alternative. Involving the entity in both constructing and operating of the Canal could create incentives for efficiency and smooth commencement of operations.
- Arm's-length efficiency incentives need to be built into the SPC's relationship with government. These would be designed to avoid the danger that government and the SPC's management would get too comfortable with one another.
- The SPC could be set up with a unique legal-regulatory foundation, possibly enabling extension of its operation to other activities, as desirable. Such expansion would allow economies of scale to be achieved.

Private Company (private ownership, operating autonomy)

- According to this model, operation of the Canal alternative would be fully privatized, with all functions auctioned off to one or more private firms. The entities in question would likely include a consortium of foreign private and Panamanian private corporations.
- It is expected that a private operator of the Canal alternative would be subject to all the normal laws and regulations governing private sector firms.
- Maximum flexibility in decision-making might be achieved, but corporate structure could allow these decisions to be made abroad.
- The profit motive provides maximum incentives for efficiency in the short to medium term. In the long run, corporate goals may be geared toward recouping original investment rather than toward sustained operation.
- In general, there would be little government control over the evolution of a private company. Mergers and acquisitions are possible and could alter the firm's willingness and ability to sustainably deliver services.
- The viability of a private company as a Canal alternative operator might be suspect, unless accompanied by a special government grant of franchise or monopoly rights over all trans-isthmian transport activities.

Evaluation of Models

Evaluation Criteria

- **Compatibility with Panamanian sovereignty:** The Panama Canal and any of its prescreened alternatives lie within Panama's sovereign territory. The proposed management arrangements must recognize Panamanian sovereignty over all Canal-related assets.
- **Compatibility with existing international law:** The unique nature of the Panama Canal asset has made it the subject of numerous international treaties. The proposed management arrangements for the Canal alternative must recognize and be compatible with such obligations.
- **Insulation from local politics:** Panama has a record of political instability, but to date this has not affected Canal operations. Both Panama's leadership and the international shipping community understand that the proposed management arrangements must protect the future operation and development of the Canal from local political interference.
- **Financial integrity and stability:** Massive, long-term investment will be required in order to develop any of the Canal alternatives. An ability to attract outside finance, as well as the need to preserve operating efficiency and operating autonomy, requires that the proposed management arrangements guarantee the Canal alternative proper control of its own finances and revenues, including the ability to raise tolls.
- **Capacity for long-term planning:** Development of an asset of the scale and scope of the Canal alternative requires an extended planning horizon. The proposed management arrangements must guarantee institutional stability for the Canal alternative, allowing and encouraging comprehensive, long-term planning for the asset.
- **Customer responsiveness:** The Canal alternative will function in a highly competitive and dynamic transportation market, where shipping industry operators increasingly have and use other transportation options. The proposed management arrangements must guarantee and promote responsiveness to the needs of Canal alternative customers.
- **Management autonomy and flexibility:** Productivity and operating efficiency mean that managers of the Canal alternative must have the ability to respond quickly and decisively to the needs of the shipping industry and to the development of its own work force. The proposed management arrangements must guarantee management authority and flexibility to act.

- **Labor productivity:** A high-quality, career-oriented labor force, along with human resources policies that resolve conflict without the right to strike, have achieved high levels of labor productivity for the present Canal. This has been at the foundation for the Canal's success. The proposed management arrangements must do the same for the Canal alternative.
- **Ability to evolve and absorb or spin off functions:** To achieve maximum efficiencies in its core operations, in the future, railroads, ports, and even nontransportation functions may be integrated into the scope of Canal alternative activities. Additionally, it may be necessary to spin off some initial activities at a future time to meet changing circumstances. The proposed management arrangements must be adaptable enough to permit such evolution.
- **Compatibility with evolution of the existing Panama Canal entity:** The Canal alternative will not develop in an organizational vacuum. The proposed management arrangements must therefore be compatible with whatever entity evolves to succeed the existing Panama Canal Commission after 1999.
- **Ability to consolidate Panama's other interoceanic transportation initiatives:** Any existing or planned trans-isthmian transportation project in Panama (pipeline, railroad, or centerport project) may adversely affect the business and financial viability of the Canal alternative. The proposed management arrangements should permit—as necessary—consolidation of such activities with Canal alternative operations.

Application of Evaluation Criteria

- These evaluation criteria are applied to the five prototype management arrangements models in Figure 5-2 (pp. 5-35 and 5-36).
- The results of this application are measured on a scale from "Poor" to "Excellent" and permit preliminary judgments on the effectiveness and practicability of the various management arrangements.
- Figure 5-2 incorporates the results of the senior international financial engineering (SIFE) panel's review of the implications of various management arrangement models for the ability to attract financing for the Canal alternatives.
- These theoretical criteria and models were selected for their relevance to a future Canal alternative, not to the existing Panama Canal.

Analysis of Management Arrangements

Introduction

- Although a number of management arrangements could be considered for any alternative to the Canal, certain options are likely to prove more suitable than others to the political and commercial environment in Panama. At least two of the models are unlikely to prove successful over the medium or long term; three others hold greater potential. All five models are analyzed in the following subsections.

Government Department

- There are overwhelming problems with the structure of a government agency as a successor to the Panama Canal: foremost among these are the likelihood of political interference and the inability to provide adequate customer service. Neither of these problems is unique to Panama. As a result of the inability of government agencies to remain independent, many countries have attempted to keep government out of transportation-related businesses.
- Adequate resource allocation and speedy decision-making are critical to the future of the Canal. A government agency is least likely of all the alternatives to be able to address these issues.
- The ability to attract private bond financing for the Canal alternative would be extremely difficult if the Canal alternative were operated as a regular bureau or ministry under the Panamanian government, because the Canal's financial integrity would not be insulated from other governmental requirements.
- Labor productivity is an important issue. Civil service restrictions associated with a government agency could seriously restrict work force flexibility and quality.
- Long-term investment planning would be difficult given the likely impact of a change in governments.
- The fit between the existing Canal's processes and operations and those of a new government agency (in charge of a Canal alternative) would be uncomfortable at best.

Panama Canal (Public) Authority

- A Panama Canal Authority chartered under Panamanian law would be fully compatible with the requirement for Panamanian sovereignty over the Canal alternative.
- A Panama Canal Authority more closely related to the PCC than to the existing port authority in Panama could provide decision-making flexibility without raising concerns over private sector and foreign control.
- The structure of such an authority would need to be different from that of existing Panamanian government agencies, and the international shipping community would need to be convinced of the new entity's independence from local political influence.
- Long-term financial capability would need to be ensured through a variety of mechanisms. Protection from domestic competition would be necessary, and independent capability to generate—and control—financial resources through pricing and issuance of debt are critical. If these issues are addressed by a strong authority act, financing for the Canal alternative will be possible.
- Special labor policy directives, similar to those that currently characterize PCC operations, would be required. The directives would be unique to the authority.
- A Panama Canal Authority could evolve toward an SPC model. If the operating characteristics of a franchise or concession through an SPC arrangement is found to be beneficial, a Panama Canal Authority could easily establish and even invest in an SPC and contract out day-to-day operation and management of the Canal alternative to that entity.

International Public Entity

- Panama's likely partners in an international public entity would have to include wealthy nations such as the United States and Japan. However, these are not necessarily the countries with the heaviest commercial reliance on the Canal. Indeed, countries with the greatest economic interests in the Canal's future may not be able to provide sufficient financial support for its development—particularly Latin American countries.
- Long-term planning for the Canal's future would, in theory, be possible with a sufficient up-front commitment of resources. However, major decisions are likely to remain political, especially given the continuing economic and military value of the Canal to "equity-partner" nations.

- Labor arrangements would need to be different from those existing in any specific country or partner. This is not an overwhelming obstacle but would require a considerable investment in time and resources to develop appropriate policies.
- Questions of Panamanian sovereignty over the Canal could be addressed. However, an international public entity is unlikely to be able to integrate related activities, such as the railroad or pipeline, without encroaching on Panamanian sovereignty.
- A multinational environment is likely to constrain management flexibility and decision making. Although the bureaucracy that characterizes this type of institution is not terribly problematic when the main mission of the agency is resource distribution, it could pose a significant obstacle in the case of a Canal alternative. Few truly international entities work efficiently in an operating environment.

Special Purpose Corporation

- A special purpose corporation should allow significant flexibility in decision making. Close involvement of the Panamanian government in the creation of an SPC should give way to a more arm's-length oversight function.
- A number of arrangements between the SPC and the government could be established. Some might require considerable oversight and auditing, including cost-plus type arrangements. Incentives for efficiency would be critical in such a situation.
- The financial issues associated with private participation in an SPC are important. The franchise or concession would need to be long enough to attract adequate investment, but not so long that it risks losing accountability.
- There may be sensitivities associated with the appearance of significant private gain by a public asset. This could be a thorny local issue, particularly if overseas corporate entities operate the facility, and if significant foreign ownership shares are involved.
- A role for the world shipping community in the entity might be possible along the lines established by the Los Angeles Coal Port, but the poor financial condition of the industry makes significant participation unlikely.

Private Company

- The prospects of a private company's operating a future Canal alternative are slim. The private sector offers flexibility in decision making, but the absence of some measure of government control over an asset so critical to world shipping is a significant concern.
- The central conflict between profitability and the need to serve world shipping limits the potential for long-term private participation. Although the Canal could potentially generate significantly more revenue, a policy of maximizing toll revenues would have a disproportionate impact on certain countries and industries, creating considerable discomfort and controversy.
- The specter of labor stoppages is another issue of concern with a private entity. Workers employed by private entities in Panama currently have the right to strike.
- Given the difficulties in financing the Channel Tunnel, it is questionable whether a private company could attract sufficient capital to develop the alternative. In addition, the profit motive may reduce strict maintenance and repair routines over the long run if the private company seeks to maximize its original investment or is unable to secure additional working capital.

Recommended Management Arrangement

- Neither the private sector nor a government agency structure appears suitable to the situation in Panama. The international public entity is somewhat less risky in both perception and operating stability, but it poses practical difficulties in operating efficiency and its likely inability to integrate other trans-isthmian commercial activities.
- Both the public authority and SPC management arrangement models offer significantly more in the political, financial, and operating aspects of any Canal alternative. Advantages include the likelihood of faster decision making, greater customer responsiveness, a lower tendency toward bureaucratic growth, and more potential for future incorporation of other trans-isthmian initiatives. In addition, both are less likely than the international entity to raise concerns about Panamanian sovereignty.
- Although the public authority and the SPC offer many of the same benefits, the Panama Canal Authority solution appears to be the more pragmatic option.
  - From a Panamanian political point of view, the Canal authority is probably a more easily comprehensible and thus acceptable formula for organizing Panama's relationship to the Canal alternative.
  - At the same time, a strong "Authority Act" could be drafted to preserve all the necessary characteristics for effective operation and development of the Canal alternative in a competitive environment: financial integrity, insulation from politics, management flexibility, labor productivity, and others.
  - A Panama Canal Authority may well prove to be the organization most similar to the form of institution that succeeds the present Panama Canal Commission after December 31, 1999. This similarity would ensure a smooth transition into the new pattern of activity featuring the simultaneous, integrated operations of the existing Canal and the eventual Canal alternative.
- The Panama Canal Authority model has the additional advantage of being able to evolve toward being an SPC. If, over time, the ownership and operating characteristics of an SPC presented clear benefits for the development and management of the Canal alternative, the authority could easily establish and even invest in an SPC and contract out day-to-day operation and management of the Canal alternative to that entity.

Establishment of a Panama Canal Authority

Legal Conditions

- An amendment to the Panama Constitution is required in order to create a strong, independent, autonomous, and flexible entity that is isolated from the interference of political interests.
- There are two ways to amend the Constitution. Both require a legislative act that is ratified by a national referendum or by approval of the next national legislative assembly. Ratification of the amendment by the next national legislative assembly is the more efficient.
  - According to Article 308, Paragraph 1, Title XIII of the Constitution, an amendment can be incorporated into the Constitution by a legislative act approved after three discussions, with the approval of the absolute majority of its members, and ratified in one discussion without any changes by the next elected assembly.
  - Once a proposed amendment establishing the principles that will guide the law to develop the Authority has been incorporated into the Constitution, the entity can be created. The constitutional amendment should contain provisions
    - Establishing the purpose of the entity and its objectives;
    - Defining the entity's administration, operation, budgetary independence, and autonomy; and
    - Regarding the labor and moral standards of the entity.
  - The integrity and autonomy of the authority should be protected by a special provision included in the Constitution that would require at least a three-fifths majority of the national legislative body to amend the Authority Act.

Organizational Structure and Functions

- A proposed organizational structure and functions for the Panama Canal Authority that could serve as the management arrangement for the Canal alternative is shown in Figure 5-3 (p. 5-37). The structure and functions are based on a review of management arrangement models, consisting of the existing Panama Canal and other international waterways and transportation entities such as the St. Lawrence Seaway, the Suez Canal Authority, the Rhine Main-Danube Canal, the Los Angeles Coal Port, and the Port Authority of New York and New Jersey.

- As mentioned earlier, the Canal alternative cannot be developed in a vacuum. The organizational structure for the Canal alternative must therefore be compatible with whatever entity evolves to succeed the existing Panama Canal Commission after 1999.

Figure 5-1. Management Arrangements Work Flow

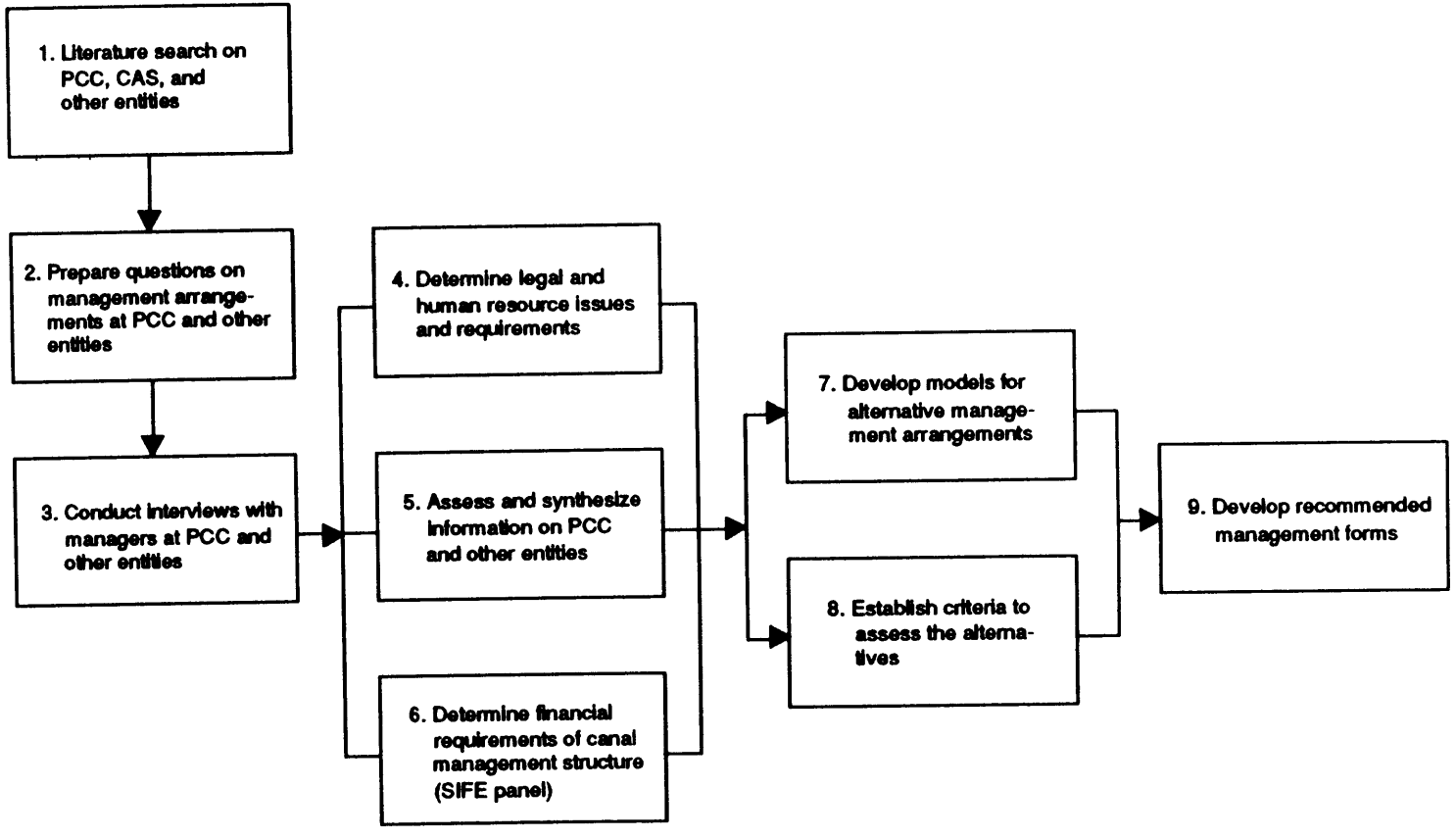


Figure 5-2. Management Arrangements: Analysis of Models

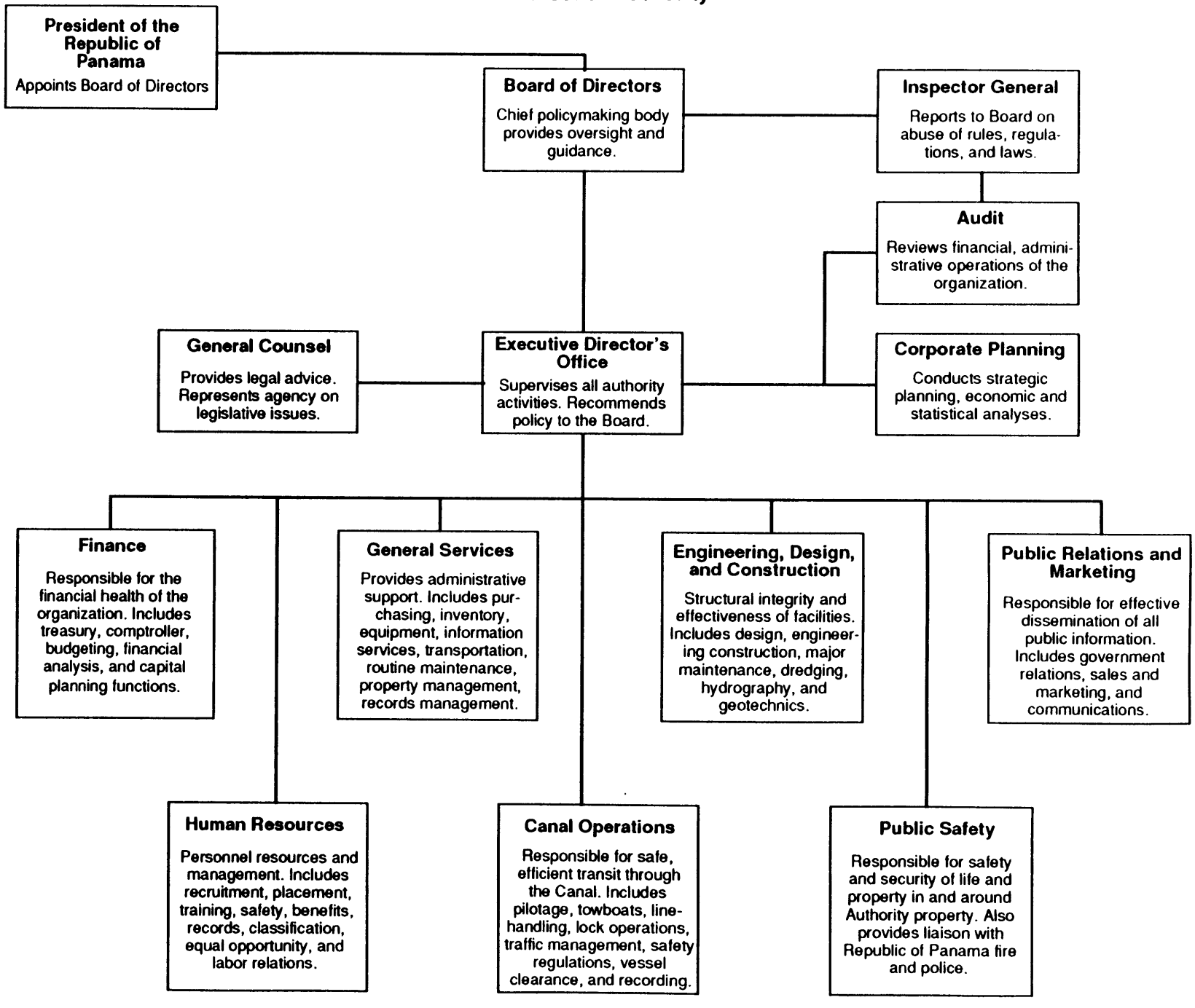
Evaluation Criteria	Panamanian Government Department	Panama Canal Authority	International Public Entity	Special Purpose Corporation (SPC)	Private Company
Compatibility with Panamanian sovereignty	★★★★★ Indistinguishable from any government agency	★★★★★ Chartered under Panama's law and exercised through presidential appointment of board	★★ Sovereignty limited by international agreement	★★★★ Full but indirectly exercised through concession agreement	★★★ Fully controlled by Panamanian law
Compatibility with existing international law	★★★★ As long as toll policies are controlled	★★★★ Authority Act would be drafted to conform	★★★ Depends on relationship of participating countries to neutrality treaties	★★★★ SPC concessions would be drafted to conform	★ Profit motive would conflict with neutrality treaties
Insulation from local politics	★ No insulation possible	★★★ Created by strong Authority Act	★★★★ International agreement would govern	★★★ Depends on legal framework of SPC and its concession	★ Panamanian private sector and government are interdependent
Financial integrity and stability	★ Must fight for resources; could become a "cash cow" for government	★★★★ Created by strong Authority Act including monopoly granted and ability to manage finances	★★★★ Depends on approvals of other governments for toll setting and financing	★★★★ Depends on legal framework of SPC and its concession	★★★ Ability to raise sufficient capital uncertain
Capacity for long-term planning	★ Horizons may be limited by political pressures	★★★★ Given minimal interference and secure revenues	★★★★ International agreement provides considerable planning autonomy	★★★ Depends on SPC concession terms and renewal options	★★ Depends on corporate profit-planning horizons
Customer responsiveness	★ Political connections and objectives intrude	★★★ Depends on degree of operating autonomy granted by Authority Act	★★ Depends on bureaucracy	★★★★ Especially favorable with participation of shipping lines in SPC but long-term concession and possible "cost-plus" arrangement could weaken	★★★★★ Profit motivation requires customer service or natural monopoly

Figure 5-2 (continued)

Evaluation Criteria	Panamanian Government Department	Panama Canal Authority	International Public Entity	Special Purpose Corporation (SPC)	Private Company
Management autonomy and flexibility	★ Civil service; government regulations and political decision making prevail	★★★★ Management independence would be created by Authority Act	★★★ Depends on Board of Directors but could be problematic if international politics intrude (NATO) (UN)	★★★ Concession contract provides autonomy but oversight processes could limit flexibility	★★★★ Theoretically favorable, but subject to outside political influence
Labor productivity	★ Undermined by lower pay scales and bureaucratic personnel procedures	★★★★ Special labor statutes encourage productivity	★★★ Special labor statutes can be established but international bureaucratic practice intrudes	★★★★ Special labor statutes encourage productivity	★★ Theoretically favorable but vulnerable to threat of strike
Ability to evolve and absorb other functions	★★ Subject to bureaucratic in-fighting and nonoperating considerations	★★★★ Important element of Authority Act	★ Limited amendment of initial charter difficult in multilateral setting	★★ Depends on terms of concession and contract	★★★ Theoretically favorable, but depends on insulation from local politics
Compatibility with the evolution of the existing Panama Canal entity	★ Very distant organizationally from existing entity	★★★★ Similar structure	★★ Distant organizationally from existing entity	★★★ Somewhat distant from existing entity	★ Very distant organizationally from existing entity
Ability to consolidate Panama's other interoceanic transportation activities	★★ Difficult given purely commercial character of other projects	★★★ Could be incorporated into Authority Act	★ Panamanian sovereignty would be an obstacle	★★ Commercial and political considerations would be obstacles	★★ Depends on corporate resources and nature of opportunity

Key: ★★★★★ = Excellent; ★★★★ = Good; ★★★ = Medium; ★★ = Fair; ★ = Poor

Figure 5-3. Hypothetical Organizational Structure for a Panama Canal Authority



6. FINANCING SCHEME AND FINANCIAL ANALYSES

General Approach

- The objectives of the financing scheme and financial analyses are to
  - Define the most appropriate financing configuration or scheme to accomplish each of the proposed Canal alternatives.
  - Measure the financial viability of each Canal alternative, including demonstrating the alternatives' respective detailed financial characteristics.
  - Recommend the preferred Canal alternative from a financial point of view.
- The financing scheme and financial analyses use the estimates for each Canal alternative of project costs prepared by Yachiyo Engineering Co. Ltd., and adjusted by Stone & Webster and TAMS Consultants, Inc. to restate annual costs on an equipment acquisition basis and to reflect contractor payment schedules. Details of the total and annual project cost for each Canal alternative are presented in Section 4.
- A panel of senior international financing experts (SIFE) was assembled for the development and selection of optimum financing schemes for the Canal alternatives. The panel was composed of financial practitioners with global project financing expertise in both public and private sector settings.
- To identify potential financing sources and likely terms and conditions, it was assumed that the Canal alternatives were financially viable. Thus the sources of financing selected and the assumed terms and conditions used are considered to be those that would be most favorable for the financing of the Canal alternatives. The financial analysis then evaluates the feasibility of each alternative under three different toll systems.
- Construction of the Sea-Level Canal would commence in 2005, and construction of the 150,000-DWT and 200,000-DWT High-Rise Lock Canal would begin in 2010 and 2009, respectively. The financing scheme and financial analyses assume that the existing Panama Canal will be maintained and operated efficiently and will be financially sound at the time financing of the Canal alternative is sought.
- Figure 6-1 (p. 6-19) presents the work flow for the financing scheme and financial analyses.

Identification of Sources of Financing and Their Terms and Conditions

The SIFE Panel

- The SIFE panel was responsible for developing a set of possible financing scenarios and for defining the optimum financing scheme for each of the Canal alternatives. SIFE panel members contributed extensive knowledge of U.S., Japanese, and European capital markets and project financing approaches and instruments. Additionally, certain panel members provided in-depth experience in legal issues of project finance and in solving institutional and management problems related to the Canal alternatives.
- The SIFE panel met in Washington, D.C., March 29–31, 1993. During the 3-day workshop, the panel identified potential sources of financing and the associated likely terms and conditions, reviewed the implications of alternative management arrangements on the ability to attract financing, and defined financial parameters and guidelines to conduct the financial analyses.
- Each SIFE panel member, before and after participating in the workshop in Washington, D.C., interviewed representatives of international financing institutions and agencies to obtain their views and potential interest in participating in the alternative canal project and the likely terms and conditions associated with financing.
- Terms and conditions included limits on the amount of financing to be obtained from a particular source, applicable interest rate, years for repayment of principal, grace period, requirements for Republic of Panama guarantees, and preferences for the entity or management arrangement that would operate the alternative canal.

Sources of Financing

- A wide range of possible sources of financing was explored, including traditional and nontraditional sources. Traditional sources of project financing include governmental export-import banks for financing of plant and equipment; international development lending institutions such as the World Bank and the Inter-American Development Bank; large investment houses in the United States, Japan, and Europe, for access to private bond and equity markets; and equity participation by individual countries. Nontraditional financing sources include possible equity participation by major users of the alternative canal, equity participation by multinational governmental institutions, such as the United Nations or the Organization of American States. A description of each source of financing follows.

- **Export-Import Bank of Japan:** The Export-Import Bank of Japan facilitates Japan's economic interchange with foreign countries by providing a wide range of financial facilities to encourage financing by commercial banks and other financial institutions in Japan for the export, development, and import of natural resources, and to promote Japan's overseas investment. In contrast to official export credit institutions in other countries, the Export-Import Bank of Japan is unique in its wide range of operations, which includes financing for imports and overseas investments, in addition to financing for exports. Lending facilities relevant to the Canal alternatives include export suppliers' credits and overseas investment credits.
  - Export suppliers' credits are provided to Japanese corporations for their export of plant and equipment. Alternatively, buyers' credits can be extended to foreign governments and financial institutions for the import of equipment and technical services from Japan.
  - Overseas investment credits are extended to Japanese corporations for their overseas investment activities or for their projects overseas. Alternatively, overseas investment credits can be provided to foreign governments to fund their capital contributions and loans to joint ventures with Japanese corporations. The Export-Import Bank of Japan is also authorized to extend credits directly to joint venture corporations.
- **Export-Import Bank of the United States (Eximbank):** The Eximbank facilitates export of U.S. goods and services by matching credit subsidies from other governments and by absorbing reasonable credit risks that are beyond the current reach of the private sector. The Eximbank helps exporters extend credit to their foreign customers by covering the political and commercial risk of nonpayment. It encourages commercial financing of U.S. exports by guaranteeing repayment of loans made to foreign buyers of U.S. exports. It encourages foreign buyers to purchase U.S. exports by offering competitive, fixed-rate loans, which may be extended directly or through an intermediary to provide foreign buyers with financing for their purchases from the United States.
  - The Eximbank can provide loans for the sale of U.S. goods or services to a creditworthy foreign buyer when competitive private financing is unavailable. To qualify for Eximbank support, the product must have at least 50 percent U.S. content and cannot be military-related. Transactions must have a reasonable assurance of repayment and must not adversely affect the U.S. economy.
- **Equipment suppliers:** Generally export-import banks will participate with other institutions and suppliers in providing credit up to 85 percent of the value of the equipment. However, when participation of export-import banks is less than 85 percent of the value of the equipment, loans may be obtained directly from the equipment supplier so that total loans for equipment equal 85 percent of

equipment value. The remaining 15 percent of the cost of the equipment comes from equity in the project.

- **Inter-American Development Bank (IDB):** In its 32 years of operation, the IDB has become a major catalyst in mobilizing resources for the Latin American and Caribbean region. According to its charter, the IDB is to (1) use its own capital—funds it raises in financial markets—and other resources for financing the development of borrowing member countries; (2) supplement private investment when private capital is not available on reasonable terms and conditions; and (3) provide technical assistance in the preparation, financing, and implementation of development plans and projects. In 1992 the IDB approved loans of more than $6 billion.
  - The IDB has made 79 loans totaling $987 million in Panama. Although problems occurred with Panama's default on the repayment of loans during the late 1980s, Panama came out of nonaccrual status in March 1992 when the IDB received payment on all amounts overdue on loans to borrowers in Panama. The IDB has now resumed loan operations in Panama, approving three loans from Ordinary Capital Resources in 1992 totaling $130 million.[1] Because of the importance of the Panama Canal to Latin American economies, the IDB has expressed an interest in participating in the Canal alternatives project, if economically feasible.
- **World Bank:** Consisting of the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA), the World Bank channels funds from financial resources in developed countries to help raise the standard of living in developing countries. The IBRD's charter spells out certain basic rules that govern its operations.[2] It must lend only for productive purposes and must stimulate economic growth in the developing countries in which it lends. It must pay due regard to the prospects of repayment. Each loan is made to the government or must be guaranteed by the government concerned. The use of the loans cannot be restricted to purchases in any particular member country. And the IBRD's decision to lend must be based on economic considerations alone.

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[1]The IDB issues loans under its Ordinary Capital Resources, Fund for Special Operations, and from the Intermediate Financing Facility. Because of Panama's relatively high per-capita income and the nature of the Canal alternative project, it is expected that IDB loans for the Canal alternative would come from Ordinary Capital Resources.

[2]World Bank, Annual Report, 1992, p. 4.

- In recent years, the World Bank has had no active loan program in Panama, reflecting Panama's nonaccrual status on other development loans. However, with Panama's return from nonaccrual status in 1992, the World Bank made an Economic Recovery loan of $120 million to Panama.

- **Japanese Overseas Economic Cooperation Fund (OECF):** The OECF is a governmental financial institution established to promote Japan's economic cooperation with foreign countries through the provision of loans on concessional terms—usually referred to as Official Development Aid (ODA). The OECF provides
  - Direct loans to foreign countries that have a grant element of 25 percent or greater.
  - Overseas investment credits for Japanese corporations investing in agriculture, forestry, fishing, and mineral exploration, and for preinvestment studies and experimental projects when it is difficult for the Export-Import Bank of Japan to participate.
  - Direct equity participation in Japanese corporations involved in projects in developing countries.
  - Japan's Overseas Economic Cooperation Fund (OECF) provides aid to developing countries for Official Development Assistance (ODA). OECF/ODA loans have very favorable terms and would require a guarantee from the Panamanian government. In 1991, OECF commenced a loan program in Panama. It is interesting to note that OECF made five loans to the Republic of Egypt for Suez Canal infrastructure projects between 1975 and 1982.

- **Commercial banks:** In recent years, commercial banks participating in large public infrastructure projects have had a series of negative experiences. In the mid-1980s, the Latin American debt crisis and the large portfolio of nonperforming loans of the commercial banks resulted in a substantial decline in loans for public infrastructure. In the late 1980s a loan syndicate of 220 banks worldwide involved with the Channel Tunnel project were confronted with a series of financial problems because of nearly 100 percent of cost overruns. This experience reinforced the commercial banks' cautious lending policies. However, with the resurgence of economic activity in Latin America, commercial banks have again commenced sizable loans for public infrastructure.
  - For a revenue-producing project such as the Canal alternative, commercial banks either individually or as part of a loan syndicate would be willing to provide construction credits as long as adequate assurances of financial viability can be provided. Participation by one or more of the multinational lending institutions such as the World Bank or the IDB would encourage commercial bank participation in the project.

- **Private bond markets in the United States and Japan:** The private bond markets in the United States, Japan, and other developed countries were also buffeted by the international debt crisis that affected the commercial banks. However, it is expected that if the project's financial viability were such that it could receive a medium investment grade rating (such as Moody's Investor Service rating of Baa or a Standard and Poor's rating of BBB), private bond issuers would be interested in participating in the project.
- **Panama Canal Toll Reserve Trust Fund:** A critical component of the financing scheme is the establishment and preservation of a trust fund that will be endowed with net income generated from Canal tolls after Panama acquires control of the Canal in 2000. It is assumed that Panama Canal tolls could be increased nominally from 2000 through 2019 to generate resources for the trust fund, especially since the toll increase will be associated with a capital improvement project. Panama's financial equity contribution to the Canal alternative will be taken from the trust fund, and a balance of $500 million will be maintained to assure creditors of the Canal alternative's financial solvency.[3] Panamanian Public Law No. 1 (January 5, 1984) recognizes the right of public entities to establish trusts and to act as trustees of assets.
- **Equity from Canal users or foreign governments:** If the management arrangement for the Canal alternative (such as an SPC or international public entity) permits foreign equity participation, beneficiaries of the Canal alternative might provide financing to ensure that the project is timely completed. Likely candidates for equity participation would be the larger Canal users in the United States and Japan, as well as users in some of the Latin American countries whose economies are more heavily dependent on the continued competitiveness of the Panama Canal route.
- **Grants from foreign governments:** Given the economic, military, and commercial importance of the Panama Canal, governments of some of the wealthier developed countries might have an interest in assisting the Republic of Panama in undertaking one of the Canal alternatives. It is possible that grants could be provided to the Republic of Panama for construction of the Canal alternative depending on the level of interest in the Canal alternative and on the political acceptability of the assistance (both in

[3]After construction of the Canal alternative, a balance of $500 million was considered by the SIFE panel as adequate protection against risks that could affect financial performance and the ability to meet annual debt service requirements. Before construction is complete, larger trust fund balances will be maintained to provide coverage against potential construction cost overruns. It should also be recognized that the Republic of Panama contributes the existing assets of Panama Canal, its national waters and other natural resources, and the value of its geographical position and characteristics to each of the Canal alternatives.

Panama and in the donor country). The SIFE panel discussed the potential for foreign grants and the lack of consensus for such financial assistance currently in the United States and Japan because of budgetary considerations, and concerns in Panama regarding the political acceptability of conditions (such as a significant foreign participation in the management and operation of the Canal alternative) that might be attached to foreign grants. For these reasons, there appears to be no support for the provision of foreign financial grants, and such grants were not included as part of the financing schemes.

Terms and Conditions

- The interest rates and other terms and conditions associated with each source of financing are presented in Table 6-1 (p. 6-20).
- In general, the interest rates used represent anticipated long-term interest rates under favorable economic conditions and for a project that is considered a medium investment-grade risk, corresponding to a Moody's Investor Service rating of Baa and a Standard and Poor's rating of BBB. This implies that the entity operating the existing Panama Canal will be financially sound at the time financing for the alternative canal is sought and that a track record of solid operational and management performance has been established.
- Interest rates presented for Japanese sources of financing denominated in yen include a cost for currency exchange or swap costs. Because the Panama Canal tolls are expected to continue to be paid in U.S. dollars, either loans from Japanese financing sources will have to be expressed in U.S. dollars or accommodations will have to be made to convert dollar toll revenues to yen. By either method, a cost will be incurred for swap arrangements or other currency hedging and insurance schemes. For the purpose of the financial analyses, a swap or currency insurance cost of 150 basis points has been added to yen-denominated interest rates on the basis of the current market swap rate for maturities up to 10 years quoted by Tokyo-based swap brokers.
- Equipment or suppliers' credit can be obtained from export-import banks in most developed or exporting countries. For the financing scheme analyses, the terms and conditions offered by the U.S. and Japanese export-import banks were considered representative of the range of terms and

conditions that would be available.[4] It is anticipated that export-import banks of other nations supplying equipment for the Canal alternatives would also participate in the financing.

Financing Plan Considerations by Management Arrangement

- In Section 5, a number of alternative management arrangements for operating the Canal alternative were identified and analyzed on the basis of a broad array of criteria, one of which is the ability to attract required capital financing.
- For several of the alternative management arrangements identified, ability to attract financing was a critical factor in determining whether the alternative was feasible. For instance, the ability to raise financing was considered limited if the Canal was operated as a regular bureau or ministry under the Panamanian government.
- On the basis of the reviews and analyses presented in Section 5, the Panama Canal Authority was selected for detailed study in the financing scheme and financial analyses.
- Between the Panama Canal Authority, the special purpose corporation, and the international public entity management arrangement options, only minor differences existed among the potential sources of financing available. For example, access to attractive Japanese OECF/ODA financing would be available only if the Canal alternative were operated by a Panamanian entity. If an international corporation were to operate the Canal alternative, such as under a SPC management arrangement, it would have access to Japanese Export-Import Overseas Investment loans instead of ODA funds.
- Sensitivity analyses were conducted for the case of a special purpose corporation as the management arrangement for the Canal alternative. However, as is discussed in the presentation of the sensitivity results, minor variations in the sources of financing associated with the SPC management arrangement do not materially affect the attractiveness of the financing scheme selected for each alternative (p. 6-18).

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[4]The "Arrangement on Guidelines for Officially Supported Export Credits," commonly referred to as the Consensus, was established in 1976 among OECD-member nations in order to avoid excessive competition in financing for plant exports. The Consensus stipulates the minimum interest rates, maximum credit terms, and minimum down payments for officially supported medium- and long-term export credits.

Financing Scheme by Canal Alternative and Management Arrangement

- The proposed financing scheme for each Canal alternative under a Panama Canal Authority is presented in Tables 6-2 through 6-4 (pp. 6-21 through 6-23).
- The proposed financing scheme for the 150,000-DWT High-Rise Lock Canal operated by a Panama Canal Authority uses a mix of nine financing sources (Table 6-2).
  - Capital costs for construction and other equipment are financed equally by export-import banks in the United States and Japan—up to 80 percent of the equipment cost.
  - The remaining 20 percent of equipment cost is financed by equipment suppliers (5 percent) and capital from the toll reserve trust fund (15 percent).
  - Other construction costs and indirect costs are financed by development banks (27 percent); foreign bonds (34 percent, split between U.S. and Japanese private markets); commercial bank loans (5 percent); ODA loans (4 percent); and capital from the toll revenue trust fund (30 percent).
- The proposed financing schemes for the 200,000-DWT High-Rise Lock Canal and the Sea-Level Canal, Case A, are the same as that for the 150,000-DWT High-Rise Lock Canal (Tables 6-3 and 6-4). This indicates that once an optimum mix of financing had been identified, use of a different financing scheme would only penalize other Canal alternatives. The amount of financing required for the 200,000-DWT High-Rise Lock Canal is indeed of the same order of magnitude as the 150,000-DWT High-Rise Lock Canal. Although the Sea-Level Canal requires substantially more capital, the same financing scheme was used to test the feasibility of this Canal alternative on the same footing as the High-Rise Lock Canal alternatives.
- For each Canal alternative and financing scheme, the annual amounts of financing required from each source of financing were determined by a mix of project financing by source and the distribution of annual project costs by type. The resulting estimates of annual financing required from each source are presented in Appendix H.
- Debt service requirements were calculated on the basis of the terms and conditions of each source of financing as presented in Table 6-1 and the amount of loan proceeds to be drawn each year. The debt service calculations were based on biannual interest and principal payments. The debt service requirements for private bonds were calculated similarly to other loans, with biannual interest and principal payments. The estimated annual debt service requirements are presented in Appendix I.

Financial Analysis of the Canal Alternatives

- For each of the Canal alternatives, detailed financial analyses were conducted and estimates prepared of total revenues, operation and maintenance costs, net income from operations, payments to the Republic of Panama, and debt service requirements. Estimated cash flows to and from the proposed toll reserve trust fund were analyzed, and incremental cash flows of the project before and after financing were calculated along with the corresponding financial internal rate of return (FIRR) and other financial indicators such as the net present value and debt service coverage ratio.

Assumptions

- For the financing scheme and financial analysis it has been assumed that the entity operating the existing Panama Canal will be financially sound at the time financing for the alternative canal is sought and that a track record of solid operational and management performance has been established.
- The financial analysis of each of the Canal alternatives was prepared for three scenarios of alternative toll revenue estimates. These toll revenue estimates, as discussed in Section 3, are
  - Existing Panama Canal toll structure and rates,
  - Existing Panama Canal toll structure and rates increased by 50 percent, and
  - The optimal toll system developed by Nathan Associates that differentiates toll rates on the basis of the type and size of vessel.
- Estimates of toll revenues under each of these systems were prepared for 2020 and 2060 and interpolated using average annual growth rates for the intervening years (Table 6-5, pp. 6-23 and 6-24).
- For the 2000–2019 period, toll revenues for the status quo canal and all Canal alternatives under the existing toll rate were estimated on the basis of the average annual growth rate of toll revenues between actual 1991 tolls of $374 million and projected 2020 toll revenues of $482 million. For the 50 percent increase and optimal toll scenarios, toll revenues in 2000–2019 were estimated on the basis of the average annual growth of toll revenues calculated between 1999 status quo canal existing tolls and the projection for 2020 status quo canal toll revenue for each corresponding toll scenario (Table 3-37, p. 3-58).

- Other canal operating revenues were calculated on the basis of the FY 1991 revenues from transit operations (see Table 4-12, p. 4-24) and the Canal advance reservation service, and increased according to the annual average growth in Canal transits projected for the 1991–2020 and 2020–2060 periods.
- For each of the Canal alternatives, estimates of operation and maintenance costs were prepared by Yachiyo Engineering and adjusted by Nathan Associates (Tables 4-13 and 4-14, pp. 4-26 and 4-27) for 2020 and 2060, respectively.
- The existing Panama Canal Commission makes annual payments to the Republic of Panama for public services provided to the PCC by Panama of $10 million, a fixed annuity of $10 million, and a payment linked to tonnage moved through the Canal. During FY 1991 these payments totaled $87.6 million, or approximately 17 percent of total Canal operating revenues of $506.4 million.
- It is anticipated that the alternative canal operating as a Panama Canal Authority would have substantial fiscal autonomy from the Republic of Panama government. However, it is unlikely that the government treasury would be willing to part entirely with the flow of funds generated by Canal operations. Conversely, in order for the Canal alternative to be able to attract the proposed financing, limits need to be established on the amount of funds that will be paid to the government treasury. For these reasons, we have assumed that annual payment to the Republic of Panama would be 10 percent of total Canal revenues.
- Funds maintained in the toll reserve trust fund are assumed to earn 4 percent interest on the prior year's balance. Distributions from the trust fund will be made as part of Panama's financial equity contribution to the Canal alternative, and dividends will be paid from the trust fund after construction of the Canal alternative subject to certain financial criteria.[5]
- All of the financial analyses were conducted on the basis of constant 1990 U.S. dollars, consistent with the guidelines established by CAS for the overall study.

[5]Dividends consisting of the trust fund balance of more than $500 million are assumed to be distributed in years in which the net income after debt service and payment to Panama is positive and the prior year's trust fund balance exceeds $500 million. The dividend distributions may be regarded as the return on part of Panama's capital in the project; the toll reserve trust fund has been financed from Panama Canal net income, funds that otherwise would have accrued directly to the Republic of Panama.

Status Quo Canal

- The status quo canal is defined as the existing Panama Canal as modified for the Culebra Cut widening project. When completed, the widening will allow two current Panama vessels to pass each other at any point during a Canal transit. The annual capacity of the status quo Canal was estimated at 17,000 transits, which is adequate for 2020 forecasted traffic.[6] After 2020, the status quo traffic forecasts as prepared by The WEFA Group assume that potential traffic demand higher than the status quo Canal capacity is diverted to other routes.
- The estimated net income for the status quo Canal, assuming no change in existing Panama Canal toll rates, is presented in Table 6-6 (pp. 6-27 and 6-28). The status quo Canal would generate net income from operations of $152.0 million in 2000, $243.4 million in 2020, and $351.3 million in 2060.
- A sensitivity analysis for the status quo Canal, using existing Panama Canal toll rates increased by 50 percent by 2020 is presented, in Appendix J, Tables J-76 through J-78.

Evaluation Criteria

- The criteria by which the financing scheme and financial analysis of each Canal alternative were evaluated are as follows:
  - Is the toll reserve trust fund balance always positive?
  - Is the minimum debt service coverage ratio on a current basis greater than 1.3, and on an overall basis (including the trust fund balance) greater than 1.5 to 2.0?
  - Is the FIRR of the incremental cash flow *before* financing greater than 8 percent in order to encourage international development institutions and agencies to participate in the project?
  - Is the FIRR of the incremental cash flow *after* financing greater than 12 percent in order to encourage private investors and commercial banks to participate in the project?
  - Are the net present values of the incremental cash flow *before* and *after* financing positive values?[7]

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[6]TAMS Consultants, Inc., Draft Final Report, *Phase 2: Operating Characteristics and Capacity Evaluation Study*, p. 5-2.

[7]A discount rate of 8 percent was used for the net present value calculations. This reflects the SIFE panel's consensus of the interest rate that could be obtained on a low-risk corporate bond.

- Is the debt-to-equity ratio below 4.0?
- Does the alternative remain financially viable under the various sensitivity analyses that include interest rates increased by 25 percent, capital costs increased by 25 percent, operation and maintenance costs increased by 25 percent, and status quo Canal toll rates increased by 50 percent?

- The target results for the evaluation criteria were determined by the panel of Senior International Financing Experts (SIFE) that was assembled for the development and selection of optimum financing schemes for the Canal alternatives.

Base Case Results

- Tables 6-7 through 6-24 (pp. 6-29 through 6-64) present the estimated net income after debt service and the financial analysis for each of the Canal alternatives, assuming a Panama Canal Authority for the three toll scenarios. A summary of the financial results by Canal alternative and toll scenario is presented in Table 6-25 (p. 6-65).
- On the basis of the evaluation criteria, the *150,000-DWT High-Rise Lock Canal* appears to be financially viable under the optimal toll system scenario.

	Existing Tolls	*Tolls Increased 50 Percent*	*Optimal Tolls*
Trust fund balance always positive?	No	Yes	Yes
FIRR before financing (percent)	–3.2	4.6	10.1
FIRR after financing (percent)	–5.6	3.4	18.0
Net present value before financing (US$ million)	–4,314	–1,591	951
Net present value after financing (US$ million)	–3,806	–1,285	1,069

- Under this scenario, the FIRR before financing of 10.1 percent is adequate to permit participation by international development lending institutions and governmental export-import banks (Table 6-12).[8] The FIRR after financing of 18.0 percent is also adequate to attract commercial bank and private bond financing.
- The net present value before and after financing are positive, and the overall debt service coverage ratio never falls below 1.8. The toll reserve trust fund increases to $3.6 billion by 2014 before being drawn down for contributions to the capital costs and dividend distributions (Table 6-11). The sizable trust fund balance is necessary to assure financing sources of the viability of the project to withstand cost overruns and other events that may negatively affect the Canal alternative's ability to attract financing.[9]
- With only a 50 percent increase in Panama Canal toll rates, the trust fund balance still remains positive in all years (Table 6-9). However, the FIRR before and after financing fall to 4.6 and 3.4 percent, respectively (Table 6-10). These low rates of return, coupled with the negative net present values of the incremental cash flows, indicate that it would not be possible for the Canal alternative to attract the required financing.
- If Panama Canal tolls are maintained at current levels, the 150,000-DWT High-Rise Lock Canal would not maintain a positive balance in the toll reserve trust fund and would not be financially viable (Table 6-7).

- The *200,000-DWT High-Rise Lock Canal* is not financially viable under any of the toll system scenarios analyzed.

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[8]All FIRR calculations are based on incremental cash flows from the first year of the project through 2060. Extending the FIRR calculation period to 2120 (100 years after project completion) increases the FIRR estimate slightly. For example, under an optimal toll system the FIRR before and after financing for the 150,000-DWT High-Rise Lock Canal are 10.3 percent and 18.1 percent, respectively; for the 200,000-DWT High-Rise Lock Canal the FIRR become 8.7 percent and 10.3 percent, respectively; and for the Sea-Level Canal, Case A, the FIRR become 5.3 percent and 4.6 percent, respectively.

[9]The toll reserve trust fund balance also provides coverage for the negative annual net income flows occurring in the later years of project construction (2017-2019). During these years, net income after debt service and payment to Panama totals –$138.3 million, which is easily absorbed by the substantial trust fund balance of more than $3 billion.

	Existing Tolls	*Tolls Increased 50 Percent*	*Optimal Tolls*
Trust fund balance always positive?	No	No	Yes
FIRR before financing (percent)	–3.1	3.7	8.4
FIRR after financing (percent)	–5.4	2.3	9.8
Net present value before financing (US$ million)	–4,882	–2,337	193
Net present value after financing (US$ million)	–4,308	–1,952	391

  - Under the existing Panama Canal toll rates, the balance of the toll reserve trust fund becomes negative in 2016 and never recovers (Table 6-13). This fact, plus the negative FIRR both before and after financing, means that the financing scheme would not be attainable (Table 6-14).
  - With Panama Canal tolls increased by 50 percent, the trust fund maintains a positive balance throughout 2000–2060 (Table 6-15). However, the low FIRR before and after financing fall and the negative net present values of the incremental cash flows indicate that the financing scheme would not be feasible (Table 6-16).
  - Under the optimal toll system, the FIRR before financing of 8.4 percent and the FIRR after financing of 9.8 percent are not adequate to attract the required project financing (Table 6-18).
- The *Sea-Level Canal, Case A*, under all toll scenarios analyzed is not financially viable. The toll reserve trust fund balance in all scenarios remains negative for extended periods. Only under the optimal toll system does the cumulative net income stream recover from negative balances, but this occurs only by 2045 (Table 6-23). Under all toll scenarios, the Sea Level Canal, Case A, has a negative net present value of the incremental cash flow before and after financing. The minimum current debt service coverage ratio, which ranges from 0.2 to 0.5, is another indication of the financial weakness of this Canal alternative. For these reasons, the Sea-Level Canal, Case A, is not financially viable.

	Existing Tolls	*Tolls Increased 50 Percent*	*Optimal Tolls*
Trust fund balance always positive?	No	No	No
FIRR before financing (percent)	–5.1	1.3	4.5
FIRR after financing (percent)	–7.6	–0.5	3.3
Net present value before financing (US$ million)	–6,803	–4,648	–2,608
Net present value after financing (US$ million)	–6,014	–4,019	–2,130

Sensitivity Analyses

- To test the robustness of the base case financial results, a series of sensitivity analyses was conducted. The sensitivity analyses were designed to include factors considered likely to affect the evaluation of the Canal alternatives and to address concerns of potential investors and financing institutions. Sensitivity analyses were conducted for
  - Interest rates increased by 25 percent
  - Capital costs of all Canal alternatives increased by 25 percent
  - Capital costs of all Canal alternatives decreased by 25 percent
  - Operation and maintenance costs of the status quo Canal and all Canal alternatives increased by 25 percent
  - The combination of interest rates increased by 25 percent and capital costs decreased by 25 percent
  - Tolls for the status quo Canal increased by 50 percent
  - A special purpose corporation as the management arrangement
  - Capital costs as presented by Yachiyo Engineering on a unit-cost basis for the 150,000-DWT High-Rise Lock Canal
- The results of the sensitivity analyses using the same criteria for the base case financial analyses are summarized in Table 6-26 (pp. 6-66 through 6-68). Because the base case analyses indicated that

none of the Canal alternatives was financially feasible under existing Panama tolls, only the 50 percent increased and optimal toll scenarios were used in the sensitivity analyses.

- The *150,000-DWT High-Rise Lock Canal* under an optimal toll system remained financially feasible under six of the eight sensitivity analyses.
  - A 25 percent decrease in capital costs had the expected result of improving the financial attractiveness of the project and increasing the FIRR before and after financing to 15.1 and 28.2 percent, respectively.
  - It is interesting that this Canal alternative remained financially viable even under three sensitivity analyses that had a negative impact on financial performance—an increase in interest rates of 25 percent, increase in operation and maintenance costs by 25 percent, and the combination increase in interest rates and decrease in capital costs. For each of these scenarios, the toll reserve trust fund balance is always positive, the FIRR before and after financing are adequate to attract financing, and the net present value before and after financing are positive. Of particular importance is the ability of the 150,000-DWT High-Rise Lock Canal to remain financially viable under a less favorable interest rate climate and with a significant increase in estimated operation and maintenance costs.
  - With a special purpose corporation management arrangement and with Yachiyo Engineering's unadjusted cost flows the financial results are little changed from the base case, and the Canal alternative remains financially feasible. With a special purpose corporation management arrangement, the FIRR before and after financing are 10.1 percent and 17.2 percent, respectively. In the sensitivity analysis using Yachiyo Engineering's unadjusted cost flows, the FIRR before and after financing are 10.2 and 17.8 percent, respectively.
  - An increase in capital costs of 25 percent resulted in FIRR before and after financing of around 7.7 percent and 8.2 percent, respectively. Under such conditions, the project would not be able to attract the required financing, and the alternative is not financially feasible. This indicates the sensitivity of the project to cost overruns and highlights the need for either a reduction in project costs (to allow for possible cost overruns) or strict cost control measures, such as shifting portions of the risk of cost overruns to contractors.
  - With status quo Canal tolls increased by 50 percent, the net income of the status quo Canal improves and the incremental cash flows of the Canal alternative worsens. The FIRR before and after financing are 5.4 and 4.5 percent, respectively, and the corresponding net present values are

negative. This scenario indicates that if Panama Canal tolls could be increased by 50 percent in the status quo case, the incremental financial benefits of undertaking the Canal alternative are minimal. However, it is unlikely that tolls could be increased without the rationale provided by a major improvement to the Canal and the corresponding cost savings provided to Canal users.

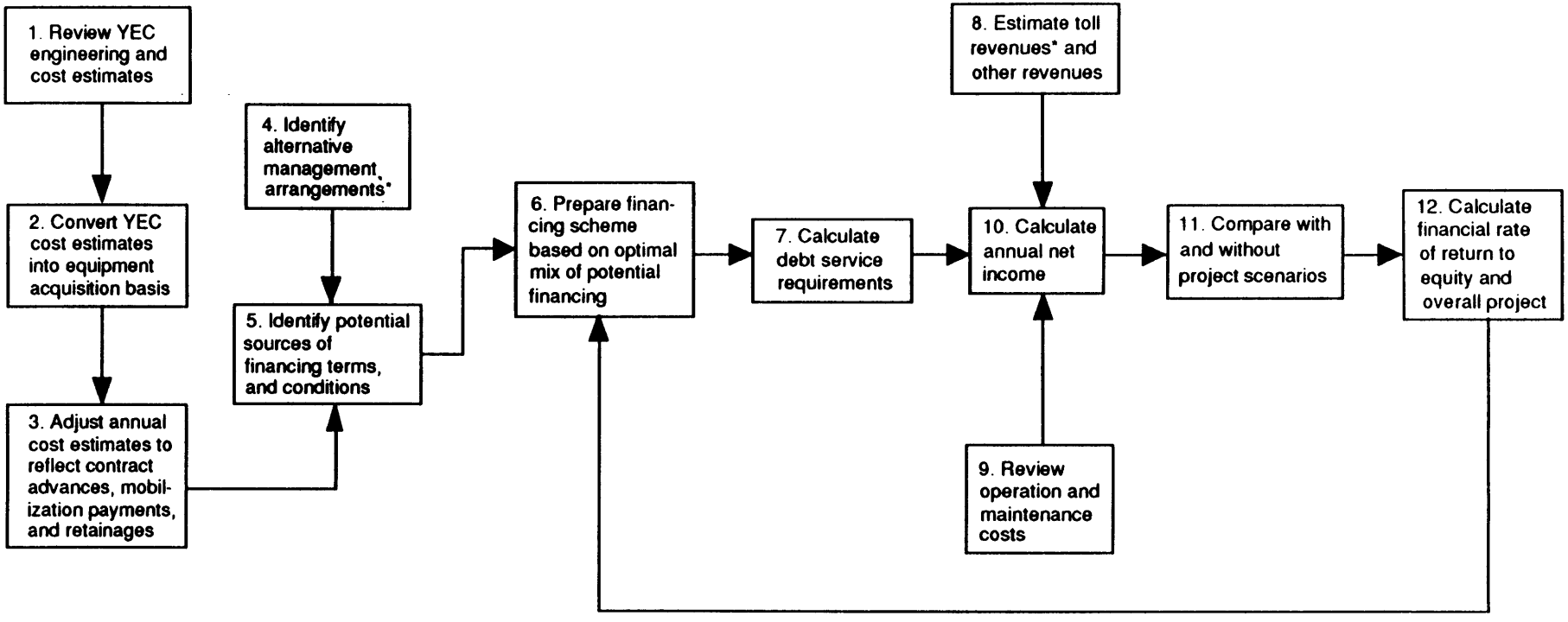
  - It is noteworthy that under all eight of the sensitivity analyses for the 150,000-DWT High-Rise Lock Canal using optimal tolls, the toll reserve trust fund balance is always positive. This indicates the robustness of the financing scheme and highlights the assurance to financing sources provided by the establishment of the trust fund.

- As noted earlier in the base case analyses, the 150,000-DWT High-Rise Lock Canal was found to be not financially feasible with tolls increased by 50 percent. In the sensitivity analyses, even under the most optimistic assumption of capital costs decreased by 25 percent, this Canal alternative is not feasible when tolls are increased by 50 percent.
- The *200,000-DWT High-Rise Lock Canal* was determined to be not financially viable in the base case results. In the sensitivity analyses, the financial viability of this Canal alternative under optimal tolls improves under two scenarios—decrease in capital costs by 25 percent and the combination of decreased capital costs and increased interest rates. For both of these scenarios, the FIRR and the net present values before and after financing are adequate to attract financing. However, it should be noted that these results are still less favorable than those for the 150,000-DWT High-Rise Lock Canal.
- The *Sea-Level Canal, Case A*, remains not financially feasible under all of the sensitivity analyses. The net present value before and after financing are negative and the balance of the trust fund turns negative for extended periods.

Conclusion

- The 150,000-DWT High-Rise Lock Canal under an optimal toll system is the only Canal alternative that is feasible from a financing scheme and financial analysis perspective.

Figure 6-1. Financing Scheme and Financial Analysis Work Flow



* See Figures 3-1 and 5-1 for work flow diagrams of these component analyses.

Table 6-1. Panama Canal Alternatives: Sources of Financing, Assumed Terms and Conditions

Source of financing	Interest rate	Grace period	Total term	Conditions
U.S. Export-Import Bank (suppliers credit)	7.00	3 years	12 years	Up to 85 percent of value of equipment exported
Japan Export-Import Bank (suppliers credit)	6.70 a/	0 years	10 years	Up to 85 percent of value of equipment exported; MITI insurance required
Commercial Banks	6.75	5 years	10 years	Terms for a medium grade investment; participation of multilateral development bank in project preferred
Equipment Suppliers	6.75	3 years	5 years	5 percent of value of equipment; terms for a medium grade investment
Development Banks	7.50	5 years	20 years	Requires Panamanian Government guarantee; economically feasible project
U.S. Private Bonds	8.25	5 years	15 years	Participation of multilateral development bank in project preferred; terms for a medium-grade investment
Japanese Private Bonds	7.35 a/	0 years	20 years	Yen-denominated; participation of multilateral development bank in project;
OECF/ODA Loans	4.50 a/	7 years	20 years	Loan to Panamanian Government ; FIRR should be between 10 and 20 percent; yen-denominated; Panamanian Government guarantee required;
Japan-EXIM Overseas Investment	6.70 a/	0 years	10 years	Possible for SPC entity; MITI insurance required; Panamanian Government guarantee; limited to 60 percent of Japanese non-financial corporations participation in project.
Toll Reserve Trust Fund	n.a.	n.a.	n.a.	Trust fund should maintain balance of $500 million;
Other Equity	n.a.	n.a.	n.a.	Would require a Special Purpose Corporation or an International Public Entity management arrangement
Government Grants	n.a.	n.a.	n.a.	Not anticipated under current conditions

n.a.= not applicable

a\ Includes cost of currency swap, hedging or currency risk insurance of 150 basis points for yen-denominated loans. Swap rates used are those for 10-year maturities as a liquid swap market does not exist for maturities beyond 10-years.

Source: Nathan Associates Inc.

Table 6-2. Single Lane High-Rise Lock Canal 150,000 DWT: Project Costs and Sources of Financing Assuming a Panama Canal Authority

Cost component	Total Project Cost	Percent of Project Cost	Source of Financing: Export-Import Banks U.S	Export-Import Banks Japan	Commercial Banks	Equip Suppliers	Develop Banks	Foreign Bonds U.S	Foreign Bonds Japan	ODA Loans	Japan-EXIM Overseas Inv	Trust Fund	Outside Equity	Gov't Grants	Total
			---------- Share of Financing by Source (Percent) ----------												
Construction equipment	1,124.2	15.2	40.0	40.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	100.0
Other equipment	1,223.7	16.6	40.0	40.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	100.0
Other construction costs	4,558.3	61.8	0.0	0.0	5.0	0.0	27.0	17.0	17.0	4.0	0.0	30.0	0.0	0.0	100.0
Indirect costs	468.1	6.3	0.0	0.0	5.0	0.0	27.0	17.0	17.0	4.0	0.0	30.0	0.0	0.0	100.0
Total	7,374.3	100.0													
			---------- Share of Financing by Source (1990 US$ millions) ----------												
Construction equipment	1,124.2	15.2	449.7	449.7	0.0	56.2	0.0	0.0	0.0	0.0	0.0	168.6	0.0	0.0	1,124.2
Other equipment	1,223.7	16.6	489.5	489.5	0.0	61.2	0.0	0.0	0.0	0.0	0.0	183.6	0.0	0.0	1,223.7
Other construction costs	4,558.3	61.8	0.0	0.0	227.9	0.0	1,230.7	774.9	774.9	182.3	0.0	1,367.5	0.0	0.0	4,558.3
Indirect costs	468.1	6.3	0.0	0.0	23.4	0.0	126.4	79.6	79.6	18.7	0.0	140.4	0.0	0.0	468.1
Total	7,374.3	100.0	939.2	939.2	251.3	117.4	1,357.1	854.5	854.5	201.1	0.0	1,860.1	0.0	0.0	7,374.3
Financing source as a percent of total cost			12.7	12.7	3.4	1.6	18.4	11.6	11.6	2.7	0.0	25.2	0.0	0.0	100.0

Source: Project costs from Table 4-7 and financing sources from Table 6-1.

Table 6-3. Single Lane High-Rise Lock Canal 200,000 DWT: Project Costs and Sources of Financing Assuming a Panama Canal Authority

Cost component	Total Project Cost	Percent of Project Cost	Source of Financing: Export-Import Banks U.S.	Export-Import Banks Japan	Commercial Banks	Equip. Suppliers	Develop. Banks	Foreign Bonds U.S.	Foreign Bonds Japan	ODA Loans	Japan-EXIM Overseas Inv.	Trust Fund	Outside Equity	Govt Grants	Total
			---------- Share of Financing by Source (Percent) ----------												
Construction equipment	1,207.7	14.1	40.0	40.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	100.0
Other equipment	1,356.1	15.9	40.0	40.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	100.0
Other construction costs	5,455.5	63.8	0.0	0.0	5.0	0.0	27.0	17.0	17.0	4.0	0.0	30.0	0.0	0.0	100.0
Indirect costs	526.4	6.2	0.0	0.0	5.0	0.0	27.0	17.0	17.0	4.0	0.0	30.0	0.0	0.0	100.0
Total	8,545.7	100.0													
			---------- Share of Financing by Source (1990 US$ millions) ----------												
Construction equipment	1,207.7	14.1	483.1	483.1	0.0	60.4	0.0	0.0	0.0	0.0	0.0	181.2	0.0	0.0	1,207.7
Other equipment	1,356.1	15.9	542.4	542.4	0.0	67.8	0.0	0.0	0.0	0.0	0.0	203.4	0.0	0.0	1,356.1
Other construction costs	5,455.5	63.8	0.0	0.0	272.8	0.0	1,473.0	927.4	927.4	218.2	0.0	1,636.7	0.0	0.0	5,455.5
Indirect costs	526.4	6.2	0.0	0.0	26.3	0.0	142.1	89.5	89.5	21.1	0.0	157.9	0.0	0.0	526.4
Total	8,545.7	100.0	1,025.5	1,025.5	299.1	128.2	1,615.1	1,016.9	1,016.9	239.3	0.0	2,179.1	0.0	0.0	8,545.7
Financing source as a percent of total cost			12.0	12.0	3.5	1.5	18.9	11.9	11.9	2.8	0.0	25.5	0.0	0.0	100.0

Source: Project costs from Table 4-8 and financing sources from Table 6-1.

Table 6-4. Sea-Level Canal Case A: Project Costs and Sources of Financing Assuming a Panama Canal Authority

Cost component	Total Project Cost	Percent of Project Cost	Source of Financing: Export-Import Banks U.S.	Export-Import Banks Japan	Commercial Banks	Equip. Suppliers	Develop. Banks	Foreign Bonds U.S.	Foreign Bonds Japan	ODA Loans	Japan-EXIM Overseas Inv	Trust Fund	Outside Equity	Gov't Grants	Total
			---------- Share of Financing by Source (Percent) ----------												
Construction equipment	2,060.5	15.2	40.0	40.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	100.0
Other equipment	1,941.7	14.4	40.0	40.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	100.0
Other construction costs	8,925.8	66.0	0.0	0.0	5.0	0.0	27.0	17.0	17.0	4.0	0.0	30.0	0.0	0.0	100.0
Indirect costs	591.4	4.4	0.0	0.0	5.0	0.0	27.0	17.0	17.0	4.0	0.0	30.0	0.0	0.0	100.0
Total	13,519.4	100.0													
			---------- Share of Financing by Source (1990 US$ millions) ----------												
Construction equipment	2,060.5	15.2	824.2	824.2	0.0	103.0	0.0	0.0	0.0	0.0	0.0	309.1	0.0	0.0	2,060.5
Other equipment	1,941.7	14.4	776.7	776.7	0.0	97.1	0.0	0.0	0.0	0.0	0.0	291.3	0.0	0.0	1,941.7
Other construction costs	8,925.8	66.0	0.0	0.0	446.3	0.0	2,410.0	1,517.4	1,517.4	357.0	0.0	2,677.7	0.0	0.0	8,925.8
Indirect costs	591.4	4.4	0.0	0.0	29.6	0.0	159.7	100.5	100.5	23.7	0.0	177.4	0.0	0.0	591.4
Total	13,519.4	100.0	1,600.9	1,600.9	475.9	200.1	2,569.6	1,617.9	1,617.9	380.7	0.0	3,455.5	0.0	0.0	13,519.4
Financing source as a percent of total cost			11.8	11.8	3.5	1.5	19.0	12.0	12.0	2.8	0.0	25.6	0.0	0.0	100.0

Source: Project costs from Table 4-9 and financing sources from Table 6-1.

Table 6-5. Estimated Annual Toll Revenues by Canal Alternative and Toll Scenario, 2000-2060 (1990 US$ millions)

	Status Quo Canal		High-Rise 150,000 DWT Lock Canal			High-Rise 200,000 DWT Lock Canal			Sea-Level Canal Case A		
Year	Existing Tolls	Tolls Increased 50 %	Existing Tolls	Tolls Increased 50 %	Optimal Tolls	Existing Tolls	Tolls Increased 50 %	Optimal Tolls	Existing Tolls	Tolls Increased 50 %	Optimal Tolls
2000	404.6	411.9	404.6	411.9	417.6	404.6	411.9	417.6	404.6	411.9	417.6
2001	408.2	423.1	408.2	423.1	434.7	408.2	423.1	434.7	408.2	423.1	434.7
2002	411.8	434.5	411.8	434.5	452.6	411.8	434.5	452.6	411.8	434.5	452.6
2003	415.4	446.2	415.4	446.2	471.2	415.4	446.2	471.2	415.4	446.2	471.2
2004	419.0	458.3	419.0	458.3	490.5	419.0	458.3	490.5	419.0	458.3	490.5
2005	422.7	470.7	422.7	470.7	510.7	422.7	470.7	510.7	422.7	470.7	510.7
2006	426.4	483.4	426.4	483.4	531.7	426.4	483.4	531.7	426.4	483.4	531.7
2007	430.2	496.4	430.2	496.4	553.5	430.2	496.4	553.5	430.2	496.4	553.5
2008	434.0	509.8	434.0	509.8	576.3	434.0	509.8	576.3	434.0	509.8	576.3
2009	437.8	523.6	437.8	523.6	599.9	437.8	523.6	599.9	437.8	523.6	599.9
2010	441.6	537.7	441.6	537.7	624.6	441.6	537.7	624.6	441.6	537.7	624.6
2011	445.5	552.3	445.5	552.3	650.3	445.5	552.3	650.3	445.5	552.3	650.3
2012	449.4	567.2	449.4	567.2	677.0	449.4	567.2	677.0	449.4	567.2	677.0
2013	453.4	582.5	453.4	582.5	704.8	453.4	582.5	704.8	453.4	582.5	704.8
2014	457.4	598.2	457.4	598.2	733.7	457.4	598.2	733.7	457.4	598.2	733.7
2015	461.4	614.4	461.4	614.4	763.9	461.4	614.4	763.9	461.4	614.4	763.9
2016	465.4	631.0	465.4	631.0	795.3	465.4	631.0	795.3	465.4	631.0	795.3
2017	469.5	648.0	469.5	648.0	827.9	469.5	648.0	827.9	469.5	648.0	827.9
2018	473.6	665.5	473.6	665.5	862.0	473.6	665.5	862.0	473.6	665.5	862.0
2019	477.8	683.5	477.8	683.5	897.4	477.8	683.5	897.4	477.8	683.5	897.4
2020	482.0	702.0	612.0	904.0	1,175.0	630.0	904.0	1,186.0	637.0	938.0	1,221.0
2021	484.5	705.6	617.4	911.9	1,184.8	635.6	912.6	1,197.3	642.7	946.3	1,232.1
2022	486.9	709.2	622.8	919.8	1,194.7	641.2	921.2	1,208.7	648.4	954.7	1,243.3
2023	489.4	712.8	628.3	927.8	1,204.6	646.8	930.0	1,220.2	654.2	963.2	1,254.6
2024	491.9	716.5	633.8	935.9	1,214.7	652.5	938.8	1,231.8	660.0	971.7	1,266.0
2025	494.4	720.1	639.4	944.1	1,224.8	658.3	947.7	1,243.5	665.9	980.3	1,277.6
2026	497.0	723.8	645.0	952.3	1,235.0	664.1	956.7	1,255.3	671.8	989.0	1,289.2
2027	499.5	727.5	650.7	960.6	1,245.3	669.9	965.8	1,267.3	677.8	997.8	1,300.9
2028	502.1	731.3	656.5	969.0	1,255.7	675.8	975.0	1,279.3	683.8	1,006.6	1,312.7
2029	504.6	735.0	662.2	977.4	1,266.2	681.8	984.2	1,291.5	689.9	1,015.5	1,324.7
2030	507.2	738.8	668.1	985.9	1,276.8	687.8	993.5	1,303.8	696.0	1,024.5	1,336.7
2031	509.8	742.5	673.9	994.5	1,287.4	693.9	1,003.0	1,316.2	702.2	1,033.6	1,348.9
2032	512.4	746.3	679.9	1,003.2	1,298.1	700.0	1,012.5	1,328.7	708.5	1,042.8	1,361.2
2033	515.0	750.2	685.9	1,011.9	1,309.0	706.1	1,022.1	1,341.3	714.8	1,052.0	1,373.5
2034	517.6	754.0	691.9	1,020.7	1,319.9	712.4	1,031.8	1,354.1	721.1	1,061.3	1,386.0
2035	520.3	757.9	698.0	1,029.6	1,330.9	718.7	1,041.6	1,367.0	727.6	1,070.7	1,398.7
2036	523.0	761.7	704.1	1,038.6	1,342.0	725.0	1,051.5	1,380.0	734.0	1,080.2	1,411.4
2037	525.6	765.6	710.3	1,047.7	1,353.2	731.4	1,061.5	1,393.1	740.6	1,089.8	1,424.2
2038	528.3	769.5	716.6	1,056.8	1,364.5	737.8	1,071.5	1,406.3	747.2	1,099.4	1,437.2
2039	531.0	773.5	722.9	1,066.0	1,375.8	744.3	1,081.7	1,419.7	753.8	1,109.2	1,450.2
2040	533.7	777.4	729.3	1,075.3	1,387.3	750.9	1,092.0	1,433.2	760.5	1,119.0	1,463.4
2041	536.5	781.4	735.7	1,084.6	1,398.9	757.5	1,102.3	1,446.9	767.3	1,128.9	1,476.7
2042	539.2	785.4	742.2	1,094.1	1,410.6	764.2	1,112.8	1,460.6	774.1	1,138.9	1,490.2

Table 6-5 (continued)

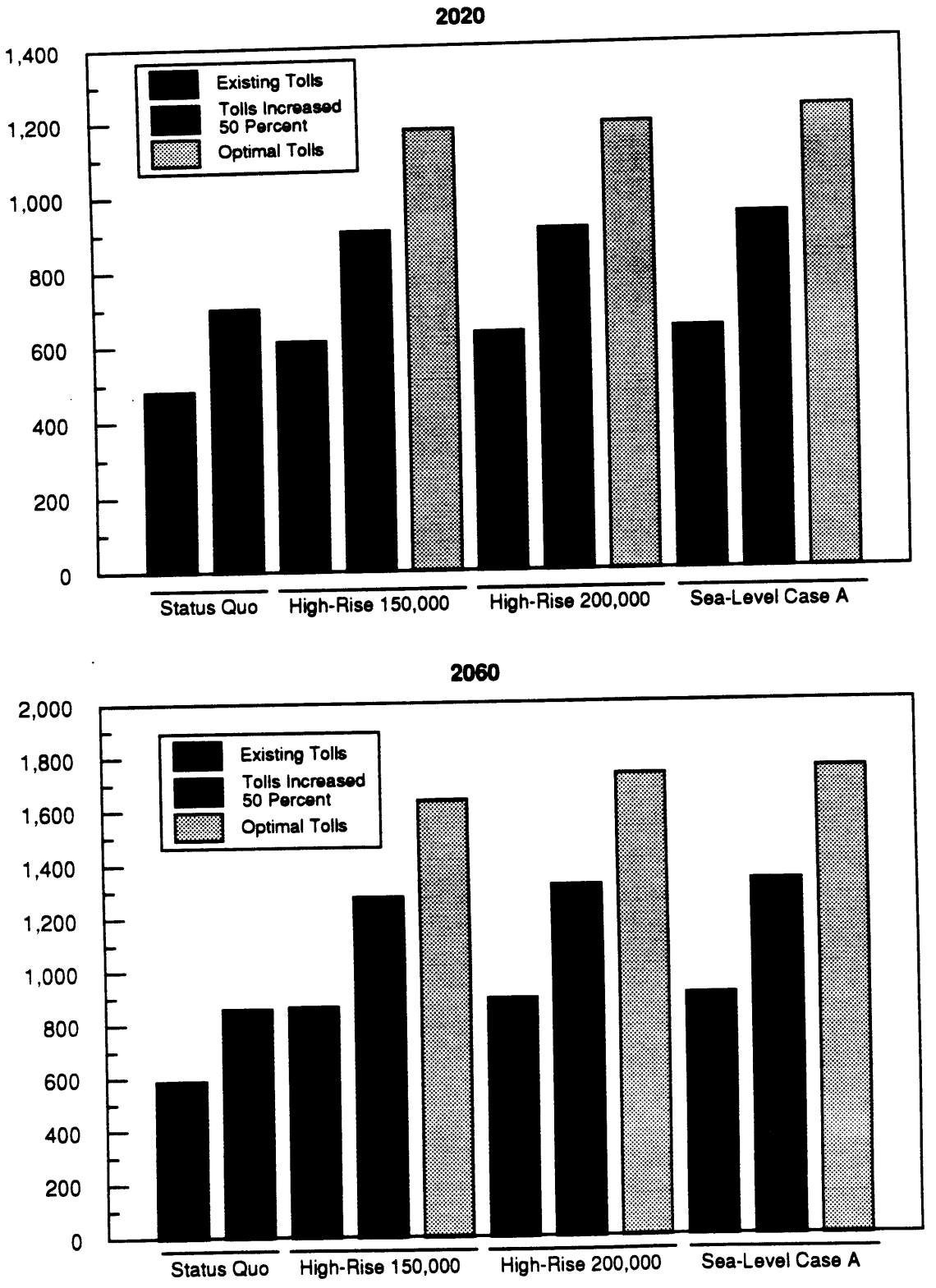
Year	Status Quo Canal		High-Rise 150,000 DWT Lock Canal			High-Rise 200,000 DWT Lock Canal			Sea-Level Canal Case A		
	Existing Tolls	Tolls Increased 50 %	Existing Tolls	Tolls Increased 50 %	Optimal Tolls	Existing Tolls	Tolls Increased 50 %	Optimal Tolls	Existing Tolls	Tolls Increased 50 %	Optimal Tolls
2043	541.9	789.4	748.7	1,103.6	1,422.3	770.9	1,123.3	1,474.5	781.0	1,149.0	1,503.7
2044	544.7	793.5	755.3	1,113.2	1,434.2	777.7	1,134.0	1,488.5	788.0	1,159.2	1,517.4
2045	547.5	797.5	761.9	1,122.9	1,446.1	784.6	1,144.8	1,502.7	795.0	1,169.5	1,531.2
2046	550.3	801.6	768.6	1,132.7	1,458.2	791.5	1,155.6	1,517.0	802.1	1,179.9	1,545.2
2047	553.1	805.7	775.4	1,142.6	1,470.4	798.5	1,166.6	1,531.4	809.2	1,190.3	1,559.2
2048	555.9	809.8	782.2	1,152.6	1,482.6	805.5	1,177.7	1,546.0	816.4	1,200.9	1,573.4
2049	558.8	814.0	789.1	1,162.6	1,495.0	812.6	1,188.8	1,560.7	823.7	1,211.5	1,587.7
2050	561.6	818.2	796.1	1,172.7	1,507.5	819.8	1,200.1	1,575.5	831.0	1,222.2	1,602.1
2051	564.5	822.3	803.1	1,182.9	1,520.0	827.0	1,211.5	1,590.5	838.4	1,233.1	1,616.7
2052	567.4	826.5	810.2	1,193.3	1,532.7	834.3	1,223.0	1,605.7	845.8	1,244.0	1,631.4
2053	570.3	830.8	817.3	1,203.6	1,545.5	841.7	1,234.6	1,620.9	853.4	1,255.0	1,646.3
2054	573.2	835.0	824.5	1,214.1	1,558.4	849.1	1,246.3	1,636.3	861.0	1,266.1	1,661.2
2055	576.1	839.3	831.7	1,224.7	1,571.4	856.6	1,258.2	1,651.9	868.6	1,277.4	1,676.4
2056	579.1	843.6	839.1	1,235.4	1,584.5	864.1	1,270.1	1,667.6	876.4	1,288.7	1,691.6
2057	582.0	847.9	846.5	1,246.1	1,597.7	871.7	1,282.2	1,683.5	884.2	1,300.1	1,707.0
2058	585.0	852.3	853.9	1,257.0	1,611.0	879.4	1,294.3	1,699.5	892.0	1,311.6	1,722.5
2059	588.0	856.6	861.4	1,268.0	1,624.5	887.2	1,306.6	1,715.7	900.0	1,323.2	1,738.2
2060	591.0	861.0	869.0	1,279.0	1,638.0	895.0	1,319.0	1,732.0	908.0	1,335.0	1,754.0
Total	30,727.7	42,671.6	38,866.2	55,057.3	69,730.8	39,758.2	55,788.9	71,707.1	40,158.1	56,868.5	72,921.4

Note: Toll revenues are based upon traffic forecasts and transportation costs for least costly alternatives from the WEFA Group and on existing Panama Canal toll rates. Vessels are assumed to divert from the Canal if transport costs exceed the least-cost alternative.

For the 2000-2019 period, toll revenues for the Status Quo and all Canal alternatives under existing toll rates were estimated based upon the average growth rate of toll revenues between actual 1991 tolls of $374 million and projected 2020 toll revenues of $482 million. For the 50 percent increase and optimal toll scenarios, toll revenues in 2000-2019 were estimated based upon the average annual growth of toll revenues calculated between 1999 Status Quo existing tolls and the projection for 2020 Status Quo toll revenue for each corresponding toll scenario. (See Table 3-37). Estimates of toll revenues between 2020 and 2060 were interpolated using average annual growth rates.

Source: Toll revenues for 2020 and 2060 from Table 3-37. Toll revenues for other years as noted above.

Figure 6-2. Estimated Toll Revenues by Canal Alternative and Toll Scenario, 2020 and 2060 (1990 US$ millions)



Source: Table 6-5.

Table 6-6. Status Quo Canal: Estimated Net Income, 2000-2060 Assuming Existing Panama Canal Toll Rates (1990 US$ millions)

Year	Revenues			Oper. & Maint. c/	Net Income from Operations
	Tolls a/	Other b/	Total		
2000	404.6	97.1	501.7	349.7	152.0
2001	408.2	98.6	506.8	350.8	156.0
2002	411.8	100.2	512.0	351.9	160.1
2003	415.4	101.7	517.1	353.0	164.2
2004	419.0	103.3	522.4	354.0	168.4
2005	422.7	105.0	527.7	355.1	172.6
2006	426.4	106.6	533.1	356.2	176.9
2007	430.2	108.3	538.5	357.2	181.2
2008	434.0	110.0	544.0	358.3	185.6
2009	437.8	111.7	549.5	359.4	190.1
2010	441.6	113.5	555.1	360.5	194.6
2011	445.5	115.3	560.8	361.5	199.2
2012	449.4	117.1	566.5	362.6	203.9
2013	453.4	118.9	572.3	363.7	208.6
2014	457.4	120.8	578.1	364.8	213.4
2015	461.4	122.7	584.0	365.8	218.2
2016	465.4	124.6	590.0	366.9	223.1
2017	469.5	126.5	596.1	368.0	228.1
2018	473.6	128.5	602.2	369.1	233.1
2019	477.8	130.5	608.3	370.1	238.2
2020	482.0	132.6	614.6	371.2	243.4
2021	484.5	133.6	618.1	372.4	245.7
2022	486.9	134.6	621.6	373.6	248.0
2023	489.4	135.6	625.1	374.8	250.3
2024	491.9	136.7	628.6	376.0	252.6
2025	494.4	137.7	632.2	377.2	255.0
2026	497.0	138.8	635.7	378.4	257.3
2027	499.5	139.8	639.3	379.6	259.7
2028	502.1	140.9	642.9	380.8	262.1
2029	504.6	141.9	646.6	382.0	264.6
2030	507.2	143.0	650.2	383.2	267.0
2031	509.8	144.1	653.9	384.4	269.5
2032	512.4	145.2	657.6	385.6	272.0
2033	515.0	146.3	661.3	386.8	274.5
2034	517.6	147.4	665.1	388.0	277.1

Table 6-6 (continued)

Year	Revenues			Oper. & Maint. c/	Net Income from Operations
	Tolls a/	Other b/	Total		
2035	520.3	148.5	668.8	389.2	279.6
2036	523.0	149.7	672.6	390.4	282.2
2037	525.6	150.8	676.4	391.6	284.8
2038	528.3	152.0	680.3	392.8	287.5
2039	531.0	153.1	684.1	394.0	290.1
2040	533.7	154.3	688.0	395.2	292.8
2041	536.5	155.5	691.9	396.4	295.5
2042	539.2	156.6	695.8	397.6	298.2
2043	541.9	157.8	699.8	398.8	301.0
2044	544.7	159.0	703.7	400.0	303.7
2045	547.5	160.2	707.7	401.2	306.5
2046	550.3	161.4	711.7	402.4	309.3
2047	553.1	162.7	715.8	403.6	312.2
2048	555.9	163.9	719.8	404.8	315.0
2049	558.8	165.2	723.9	406.0	317.9
2050	561.6	166.4	728.0	407.2	320.8
2051	564.5	167.7	732.2	408.4	323.8
2052	567.4	169.0	736.3	409.6	326.7
2053	570.3	170.2	740.5	410.8	329.7
2054	573.2	171.5	744.7	412.0	332.7
2055	576.1	172.8	749.0	413.2	335.8
2056	579.1	174.1	753.2	414.4	338.8
2057	582.0	175.5	757.5	415.6	341.9
2058	585.0	176.8	761.8	416.8	345.0
2059	588.0	178.1	766.1	418.0	348.1
2060	591.0	179.5	770.5	419.2	351.3
Total	30,727.7	8,611.7	39,339.4	23,401.8	15,937.6

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

Table 6-7. Single Lane High-Rise Lock Canal 150,000 DWT: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and Existing Panama Canal Tolls (1990 US$ millions)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2000		404.6	97.1	501.7	349.7	152.0	50.2	0.0	0.0	0.0	101.8	0.0	0.0	101.8	--	--
2001		408.2	98.6	506.8	350.8	156.0	50.7	0.0	0.0	0.0	105.3	0.0	0.0	211.2	--	--
2002		411.8	100.2	512.0	351.9	160.1	51.2	0.0	0.0	0.0	108.9	0.0	0.0	328.6	--	--
2003		415.4	101.7	517.1	353.0	164.2	51.7	0.0	0.0	0.0	112.5	0.0	0.0	454.2	--	--
2004		419.0	103.3	522.4	354.0	168.4	52.2	0.0	0.0	0.0	116.1	0.0	0.0	588.5	--	--
2005		422.7	105.0	527.7	355.1	172.6	52.8	0.0	0.0	0.0	119.8	0.0	0.0	731.8	--	--
2006		426.4	106.6	533.1	356.2	176.9	53.3	0.0	0.0	0.0	123.6	0.0	0.0	884.7	--	--
2007		430.2	108.3	538.5	357.2	181.2	53.8	0.0	0.0	0.0	127.4	0.0	0.0	1,047.4	--	--
2008		434.0	110.0	544.0	358.3	185.6	54.4	0.0	0.0	0.0	131.2	0.0	0.0	1,220.6	--	--
2009		437.8	111.7	549.5	359.4	190.1	54.9	0.0	0.0	0.0	135.2	0.0	0.0	1,404.6	--	--
2010	1	441.6	113.5	555.1	360.5	194.6	55.5	4.6	0.8	5.3	133.8	26.5	0.0	1,568.0	26.1	320.3
2011	2	445.5	115.3	560.8	361.5	199.2	56.1	9.2	1.5	10.7	132.4	27.1	0.0	1,736.1	13.4	175.4
2012	3	449.4	117.1	566.5	362.6	203.9	56.6	23.3	3.8	27.1	120.1	82.2	0.0	1,843.5	5.4	73.4
2013	4	453.4	118.9	572.3	363.7	208.6	57.2	74.4	22.5	96.9	54.4	236.8	0.0	1,734.8	1.6	19.5
2014	5	457.4	120.8	578.1	364.8	213.4	57.8	143.0	52.2	195.3	-39.7	297.1	0.0	1,467.4	0.8	8.3
2015	6	461.4	122.7	584.0	365.8	218.2	58.4	200.8	74.2	275.0	-115.2	309.0	0.0	1,101.9	0.6	4.6
2016	7	465.4	124.6	590.0	366.9	223.1	59.0	257.9	119.9	377.8	-213.7	314.1	0.0	618.2	0.4	2.1
2017	8	469.5	126.5	596.1	368.0	228.1	59.6	303.0	192.6	495.6	-327.1	257.6	0.0	58.2	0.3	0.5
2018	9	473.6	128.5	602.2	369.1	233.1	60.2	327.9	245.3	573.2	-400.3	175.1	0.0	-514.8	0.3	-0.6
2019	10	477.8	130.5	608.3	370.1	238.2	60.8	342.6	295.4	638.0	-460.6	134.7	0.0	-1,130.7	0.3	-1.5
2020	11	612.0	132.6	744.6	475.1	269.5	74.5	320.5	352.6	673.1	-478.1	0.0	0.0	-1,654.0	0.3	-2.2
2021	12	617.4	133.6	751.0	477.8	273.2	75.1	294.4	407.5	701.9	-503.8	0.0	0.0	-2,224.0	0.3	-2.9
2022	13	622.8	134.6	757.4	480.5	277.0	75.7	264.3	451.7	716.1	-514.9	0.0	0.0	-2,827.8	0.3	-3.7
2023	14	628.3	135.6	764.0	483.2	280.8	76.4	231.9	447.9	679.9	-475.5	0.0	0.0	-3,416.4	0.3	-4.7
2024	15	633.8	136.7	770.5	485.9	284.6	77.1	200.0	425.5	625.4	-417.9	0.0	0.0	-3,971.0	0.3	-6.0
2025	16	639.4	137.7	777.1	488.6	288.5	77.7	169.7	391.2	560.9	-350.1	0.0	0.0	-4,479.9	0.4	-7.6
2026	17	645.0	138.8	783.8	491.3	292.5	78.4	142.1	344.2	486.2	-272.1	0.0	0.0	-4,931.1	0.4	-9.7
2027	18	650.7	139.8	790.5	494.0	296.6	79.1	117.5	308.5	425.9	-208.4	0.0	0.0	-5,336.8	0.5	-12.0
2028	19	656.5	140.9	797.3	496.7	300.7	79.7	95.5	270.3	365.8	-144.9	0.0	0.0	-5,695.1	0.6	-15.0
2029	20	662.2	141.9	804.2	499.4	304.8	80.4	76.3	229.6	305.9	-81.5	0.0	0.0	-6,004.5	0.7	-18.9
2030	21	668.1	143.0	811.1	502.1	309.0	81.1	59.9	199.3	259.2	-31.3	0.0	0.0	-6,275.9	0.9	-23.3
2031	22	673.9	144.1	818.1	504.8	313.3	81.8	45.8	168.0	213.8	17.7	0.0	0.0	-6,509.3	1.1	-29.4
2032	23	679.9	145.2	825.1	507.5	317.6	82.5	33.9	147.9	181.9	53.2	0.0	0.0	-6,716.4	1.3	-35.6
2033	24	685.9	146.3	832.2	510.2	322.0	83.2	23.7	122.0	145.7	93.1	0.0	0.0	-6,892.0	1.6	-45.7
2034	25	691.9	147.4	839.3	512.9	326.5	83.9	15.4	96.4	111.8	130.7	0.0	0.0	-7,036.9	2.2	-60.8
2035	26	698.0	148.5	846.5	515.6	331.0	84.7	9.0	69.7	78.7	167.6	0.0	0.0	-7,150.8	3.1	-87.7
2036	27	704.1	149.7	853.8	518.3	335.6	85.4	4.5	42.8	47.3	202.9	0.0	0.0	-7,233.9	5.3	-147.8
2037	28	710.3	150.8	861.2	521.0	340.2	86.1	1.8	22.0	23.8	230.2	0.0	0.0	-7,293.1	10.7	-295.2

Table 6-7 (continued)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2038	29	716.6	152.0	868.6	523.7	344.9	86.9	0.5	8.9	9.4	248.7	0.0	0.0	-7,336.1	27.5	-754.6
2039	30	722.9	153.1	876.0	526.4	349.7	87.6	0.0	0.0	0.0	262.1	0.0	0.0	-7,367.5	--	--
2040	31	729.3	154.3	883.5	529.1	354.5	88.4	0.0	0.0	0.0	266.1	0.0	0.0	-7,396.0	--	--
2041	32	735.7	155.5	891.1	531.7	359.4	89.1	0.0	0.0	0.0	270.3	0.0	0.0	-7,421.6	--	--
2042	33	742.2	156.6	898.8	534.4	364.4	89.9	0.0	0.0	0.0	274.5	0.0	0.0	-7,444.0	--	--
2043	34	748.7	157.8	906.5	537.1	369.4	90.7	0.0	0.0	0.0	278.7	0.0	0.0	-7,463.0	--	--
2044	35	755.3	159.0	914.3	539.8	374.5	91.4	0.0	0.0	0.0	283.0	0.0	0.0	-7,478.5	--	--
2045	36	761.9	160.2	922.2	542.5	379.6	92.2	0.0	0.0	0.0	287.4	0.0	0.0	-7,490.2	--	--
2046	37	768.6	161.4	930.1	545.2	384.9	93.0	0.0	0.0	0.0	291.9	0.0	0.0	-7,498.0	--	--
2047	38	775.4	162.7	938.1	547.9	390.2	93.8	0.0	0.0	0.0	296.3	0.0	0.0	-7,501.6	--	--
2048	39	782.2	163.9	946.2	550.6	395.5	94.6	0.0	0.0	0.0	300.9	0.0	0.0	-7,500.7	--	--
2049	40	789.1	165.2	954.3	553.3	401.0	95.4	0.0	0.0	0.0	305.5	0.0	0.0	-7,495.2	--	--
2050	41	796.1	166.4	962.5	556.0	406.5	96.2	0.0	0.0	0.0	310.2	0.0	0.0	-7,484.8	--	--
2051	42	803.1	167.7	970.8	558.7	412.0	97.1	0.0	0.0	0.0	315.0	0.0	0.0	-7,469.2	--	--
2052	43	810.2	169.0	979.1	561.4	417.7	97.9	0.0	0.0	0.0	319.8	0.0	0.0	-7,448.2	--	--
2053	44	817.3	170.2	987.5	564.1	423.4	98.8	0.0	0.0	0.0	324.7	0.0	0.0	-7,421.5	--	--
2054	45	824.5	171.5	996.0	566.8	429.2	99.6	0.0	0.0	0.0	329.6	0.0	0.0	-7,388.8	--	--
2055	46	831.7	172.8	1,004.6	569.5	435.1	100.5	0.0	0.0	0.0	334.6	0.0	0.0	-7,349.7	--	--
2056	47	839.1	174.1	1,013.2	572.2	441.0	101.3	0.0	0.0	0.0	339.7	0.0	0.0	-7,304.0	--	--
2057	48	846.5	175.5	1,021.9	574.9	447.0	102.2	0.0	0.0	0.0	344.8	0.0	0.0	-7,251.4	--	--
2058	49	853.9	176.8	1,030.7	577.6	453.1	103.1	0.0	0.0	0.0	350.0	0.0	0.0	-7,191.4	--	--
2059	50	861.4	178.1	1,039.6	580.3	459.3	104.0	0.0	0.0	0.0	355.3	0.0	0.0	-7,123.7	--	--
2060	51	869.0	179.5	1,048.5	583.0	465.5	104.9	0.0	0.0	0.0	360.7	0.0	0.0	-7,048.0	--	--
	Total	38,866.2	8,611.7	47,477.9	28,889.7	18,588.3	4,747.8	3,793.5	5,514.2	9,307.7	4,532.8	1,860.1	0.0			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-8. Single Lane High-Rise Lock Canal 150,000 DWT: Financial Analysis, 2009-2060 Assuming a Panama Canal Authority and Existing Panama Canal Tolls (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2009							61.9	61.9
2010	1	194.6	194.6	0.0	88.4	-88.4	57.8	-30.6
2011	2	199.2	199.2	0.0	90.2	-90.2	181.1	90.9
2012	3	203.9	203.9	0.0	274.0	-274.0	692.4	418.4
2013	4	208.6	208.6	0.0	956.3	-956.3	894.7	-61.6
2014	5	213.4	213.4	0.0	1,288.7	-1,288.7	654.2	-634.5
2015	6	218.2	218.2	0.0	1,158.5	-1,158.5	592.5	-566.0
2016	7	223.1	223.1	0.0	1,181.5	-1,181.5	381.1	-800.4
2017	8	228.1	228.1	0.0	1,016.5	-1,016.5	52.6	-963.9
2018	9	233.1	233.1	0.0	723.3	-723.3	-111.0	-834.3
2019	10	238.2	238.2	0.0	596.9	-596.9	-638.0	-1,234.9
2020	11	269.5	243.4	26.1	0.0	26.1	-673.1	-647.0
2021	12	273.2	245.7	27.5	0.0	27.5	-701.9	-674.4
2022	13	277.0	248.0	29.0	0.0	29.0	-716.1	-687.1
2023	14	280.8	250.3	30.5	0.0	30.5	-679.9	-649.4
2024	15	284.6	252.6	32.0	0.0	32.0	-625.4	-593.4
2025	16	288.5	255.0	33.6	0.0	33.6	-560.9	-527.3
2026	17	292.5	257.3	35.2	0.0	35.2	-486.2	-451.0
2027	18	296.6	259.7	36.8	0.0	36.8	-425.9	-389.1
2028	19	300.7	262.1	38.5	0.0	38.5	-365.8	-327.3
2029	20	304.8	264.6	40.2	0.0	40.2	-305.9	-265.7
2030	21	309.0	267.0	42.0	0.0	42.0	-259.2	-217.2
2031	22	313.3	269.5	43.8	0.0	43.8	-213.8	-170.0
2032	23	317.6	272.0	45.6	0.0	45.6	-181.9	-136.3
2033	24	322.0	274.5	47.5	0.0	47.5	-145.7	-98.2
2034	25	326.5	277.1	49.4	0.0	49.4	-111.8	-62.4
2035	26	331.0	279.6	51.3	0.0	51.3	-78.7	-27.4
2036	27	335.6	282.2	53.3	0.0	53.3	-47.3	6.1
2037	28	340.2	284.8	55.4	0.0	55.4	-23.8	31.5
2038	29	344.9	287.5	57.4	0.0	57.4	-9.4	48.0
2039	30	349.7	290.1	59.5	0.0	59.5	0.0	59.5
2040	31	354.5	292.8	61.7	0.0	61.7	0.0	61.7
2041	32	359.4	295.5	63.9	0.0	63.9	0.0	63.9
2042	33	364.4	298.2	66.1	0.0	66.1	0.0	66.1
2043	34	369.4	301.0	68.4	0.0	68.4	0.0	68.4
2044	35	374.5	303.7	70.7	0.0	70.7	0.0	70.7
2045	36	379.6	306.5	73.1	0.0	73.1	0.0	73.1
2046	37	384.9	309.3	75.5	0.0	75.5	0.0	75.5

Table 6-8 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2047	38	390.2	312.2	78.0	0.0	78.0	0.0	78.0
2048	39	395.5	315.0	80.5	0.0	80.5	0.0	80.5
2049	40	401.0	317.9	83.0	0.0	83.0	0.0	83.0
2050	41	406.5	320.8	85.6	0.0	85.6	0.0	85.6
2051	42	412.0	323.8	88.3	0.0	88.3	0.0	88.3
2052	43	417.7	326.7	90.9	0.0	90.9	0.0	90.9
2053	44	423.4	329.7	93.7	0.0	93.7	0.0	93.7
2054	45	429.2	332.7	96.5	0.0	96.5	0.0	96.5
2055	46	435.1	335.8	99.3	0.0	99.3	0.0	99.3
2056	47	441.0	338.8	102.2	0.0	102.2	0.0	102.2
2057	48	447.0	341.9	105.1	0.0	105.1	0.0	105.1
2058	49	453.1	345.0	108.1	0.0	108.1	0.0	108.1
2059	50	459.3	348.1	111.1	0.0	111.1	0.0	111.1
2060	51	465.5	351.3	114.2	0.0	114.2	0.0	114.2
	Total	16,881.2	14,230.5	2,650.7	7,374.3	-4,723.6		-8,579.0
					Financial Internal Rate of Return:	-3.2%		-5.6%
					Net Present Value at 8 percent discount rate:	-4,314.2		-3,806.3

a/ From Table 6-7.

b/ From Table 6-6.

c/ From Appendix H.

d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-9. Single Lane High-Rise Lock Canal 150,000 DWT: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and a 50 Percent Increase in Tolls (1990 US$ millions)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2000		411.9	97.1	509.0	349.7	159.3	50.9	0.0	0.0	0.0	108.4	0.0	0.0	108.4	--	--
2001		423.1	98.6	521.7	350.8	170.9	52.2	0.0	0.0	0.0	118.7	0.0	0.0	231.4	--	--
2002		434.5	100.2	534.7	351.9	182.8	53.5	0.0	0.0	0.0	129.3	0.0	0.0	370.0	--	--
2003		446.2	101.7	548.0	353.0	195.0	54.8	0.0	0.0	0.0	140.2	0.0	0.0	525.0	--	--
2004		458.3	103.3	561.6	354.0	207.6	56.2	0.0	0.0	0.0	151.4	0.0	0.0	697.5	--	--
2005		470.7	105.0	575.6	355.1	220.5	57.6	0.0	0.0	0.0	163.0	0.0	0.0	888.3	--	--
2006		483.4	106.6	590.0	356.2	233.8	59.0	0.0	0.0	0.0	174.8	0.0	0.0	1,098.7	--	--
2007		496.4	108.3	604.7	357.2	247.5	60.5	0.0	0.0	0.0	187.0	0.0	0.0	1,329.6	--	--
2008		509.8	110.0	619.8	358.3	261.5	62.0	0.0	0.0	0.0	199.5	0.0	0.0	1,582.3	--	--
2009		523.6	111.7	635.3	359.4	275.9	63.5	0.0	0.0	0.0	212.4	0.0	0.0	1,858.0	--	--
2010	1	537.7	113.5	651.2	360.5	290.7	65.1	4.6	0.8	5.3	220.3	26.5	0.0	2,126.1	42.3	441.3
2011	2	552.3	115.3	667.5	361.5	306.0	66.8	9.2	1.5	10.7	228.5	27.1	0.0	2,412.6	22.3	247.5
2012	3	567.2	117.1	684.2	362.6	321.6	68.4	23.3	3.8	27.1	226.1	82.2	0.0	2,653.0	9.3	107.2
2013	4	582.5	118.9	701.4	363.7	337.7	70.1	74.4	22.5	96.9	170.7	236.8	0.0	2,693.0	2.8	30.5
2014	5	598.2	120.8	719.0	364.8	354.2	71.9	143.0	52.2	195.3	87.1	297.1	0.0	2,590.7	1.4	14.7
2015	6	614.4	122.7	737.1	365.8	371.2	73.7	200.8	74.2	275.0	22.6	309.0	0.0	2,407.8	1.1	9.8
2016	7	631.0	124.6	755.6	366.9	388.7	75.6	257.9	119.9	377.8	-64.7	314.1	0.0	2,125.4	0.8	6.5
2017	8	648.0	126.5	774.6	368.0	406.6	77.5	303.0	192.6	495.6	-166.5	257.6	0.0	1,786.3	0.7	4.3
2018	9	665.5	128.5	794.1	369.1	425.0	79.4	327.9	245.3	573.2	-227.6	175.1	0.0	1,455.1	0.6	3.1
2019	10	683.5	130.5	814.1	370.1	443.9	81.4	342.6	295.4	638.0	-275.5	134.7	0.0	1,103.1	0.6	2.3
2020	11	904.0	132.6	1,036.6	475.1	561.5	103.7	320.5	352.6	673.1	-215.3	0.0	0.0	932.0	0.7	2.1
2021	12	911.9	133.6	1,045.5	477.8	567.7	104.5	294.4	407.5	701.9	-238.7	0.0	0.0	730.5	0.7	1.7
2022	13	919.8	134.6	1,054.4	480.5	573.9	105.4	264.3	451.7	716.1	-247.6	0.0	0.0	512.2	0.7	1.4
2023	14	927.8	135.6	1,063.5	483.2	580.3	106.3	231.9	447.9	679.9	-205.9	0.0	0.0	326.8	0.7	1.2
2024	15	935.9	136.7	1,072.6	485.9	586.7	107.3	200.0	425.5	625.4	-146.0	0.0	0.0	193.8	0.8	1.1
2025	16	944.1	137.7	1,081.8	488.6	593.2	108.2	169.7	391.2	560.9	-75.9	0.0	0.0	125.7	0.9	1.1
2026	17	952.3	138.8	1,091.1	491.3	599.8	109.1	142.1	344.2	486.2	4.4	0.0	0.0	135.2	1.0	1.3
2027	18	960.6	139.8	1,100.4	494.0	606.4	110.0	117.5	308.5	425.9	70.4	0.0	0.0	211.1	1.2	1.7
2028	19	969.0	140.9	1,109.8	496.7	613.2	111.0	95.5	270.3	365.8	136.4	0.0	0.0	355.9	1.4	2.3
2029	20	977.4	141.9	1,119.4	499.4	620.0	111.9	76.3	229.6	305.9	202.1	0.0	0.0	572.2	1.7	3.5
2030	21	985.9	143.0	1,129.0	502.1	626.9	112.9	59.9	199.3	259.2	254.8	0.0	327.1	522.9	2.0	4.0
2031	22	994.5	144.1	1,138.6	504.8	633.9	113.9	45.8	168.0	213.8	306.2	0.0	329.1	520.9	2.4	4.9
2032	23	1,003.2	145.2	1,148.4	507.5	640.9	114.8	33.9	147.9	181.9	344.2	0.0	365.1	520.8	2.9	5.8
2033	24	1,011.9	146.3	1,158.2	510.2	648.1	115.8	23.7	122.0	145.7	386.5	0.0	407.4	520.8	3.7	7.2
2034	25	1,020.7	147.4	1,168.2	512.9	655.3	116.8	15.4	96.4	111.8	426.7	0.0	447.5	520.8	4.8	9.5
2035	26	1,029.6	148.5	1,178.2	515.6	662.6	117.8	9.0	69.7	78.7	466.1	0.0	486.9	520.8	6.9	13.5
2036	27	1,038.6	149.7	1,188.3	518.3	670.0	118.8	4.5	42.8	47.3	503.9	0.0	524.8	520.8	11.7	22.7
2037	28	1,047.7	150.8	1,198.5	521.0	677.5	119.8	1.8	22.0	23.8	533.8	0.0	554.6	520.8	23.4	45.2

Table 6-9 (continued)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2038	29	1,056.8	152.0	1,208.7	523.7	685.1	120.9	0.5	8.9	9.4	554.8	0.0	575.7	520.8	60.2	115.7
2039	30	1,066.0	153.1	1,219.1	526.4	692.8	121.9	0.0	0.0	0.0	570.8	0.0	591.7	520.8	--	--
2040	31	1,075.3	154.3	1,229.6	529.1	700.5	123.0	0.0	0.0	0.0	577.6	0.0	598.4	520.8	--	--
2041	32	1,084.6	155.5	1,240.1	531.7	708.3	124.0	0.0	0.0	0.0	584.3	0.0	605.2	520.8	--	--
2042	33	1,094.1	156.6	1,250.7	534.4	716.3	125.1	0.0	0.0	0.0	591.2	0.0	612.0	520.8	--	--
2043	34	1,103.6	157.8	1,261.5	537.1	724.3	126.1	0.0	0.0	0.0	598.2	0.0	619.0	520.8	--	--
2044	35	1,113.2	159.0	1,272.3	539.8	732.4	127.2	0.0	0.0	0.0	605.2	0.0	626.0	520.8	--	--
2045	36	1,122.9	160.2	1,283.2	542.5	740.6	128.3	0.0	0.0	0.0	612.3	0.0	633.2	520.8	--	--
2046	37	1,132.7	161.4	1,294.2	545.2	748.9	129.4	0.0	0.0	0.0	619.5	0.0	640.4	520.8	--	--
2047	38	1,142.6	162.7	1,305.3	547.9	757.3	130.5	0.0	0.0	0.0	626.8	0.0	647.6	520.8	--	--
2048	39	1,152.6	163.9	1,316.5	550.6	765.8	131.6	0.0	0.0	0.0	634.2	0.0	655.0	520.8	--	--
2049	40	1,162.6	165.2	1,327.8	553.3	774.4	132.8	0.0	0.0	0.0	641.7	0.0	662.5	520.8	--	--
2050	41	1,172.7	166.4	1,339.1	556.0	783.1	133.9	0.0	0.0	0.0	649.2	0.0	670.0	520.8	--	--
2051	42	1,182.9	167.7	1,350.6	558.7	791.9	135.1	0.0	0.0	0.0	656.8	0.0	677.7	520.8	--	--
2052	43	1,193.3	169.0	1,362.2	561.4	800.8	136.2	0.0	0.0	0.0	664.6	0.0	685.4	520.8	--	--
2053	44	1,203.6	170.2	1,373.9	564.1	809.8	137.4	0.0	0.0	0.0	672.4	0.0	693.2	520.8	--	--
2054	45	1,214.1	171.5	1,385.7	566.8	818.9	138.6	0.0	0.0	0.0	680.3	0.0	701.1	520.8	--	--
2055	46	1,224.7	172.8	1,397.5	569.5	828.0	139.8	0.0	0.0	0.0	688.3	0.0	709.1	520.8	--	--
2056	47	1,235.4	174.1	1,409.5	572.2	837.3	141.0	0.0	0.0	0.0	696.4	0.0	717.2	520.8	--	--
2057	48	1,246.1	175.5	1,421.6	574.9	846.7	142.2	0.0	0.0	0.0	704.6	0.0	725.4	520.8	--	--
2058	49	1,257.0	176.8	1,433.8	577.6	856.2	143.4	0.0	0.0	0.0	712.8	0.0	733.7	520.8	--	--
2059	50	1,268.0	178.1	1,446.1	580.3	865.8	144.6	0.0	0.0	0.0	721.2	0.0	742.0	520.8	--	--
2060	51	1,279.0	179.5	1,458.5	583.0	875.5	145.9	0.0	0.0	0.0	729.7	0.0	750.5	520.8	--	--
	Total	55,057.3	8,611.7	63,669.0	28,889.7	34,779.3	6,366.9	3,793.5	5,514.2	9,307.7	19,104.8	1,860.1	18,714.4			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-10. Single Lane High-Rise Lock Canal 150,000 DWT: Financial Analysis, 2009-2060 Assuming a Panama Canal Authority and a 50 Percent Increase in Tolls (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2009							61.9	61.9
2010	1	290.7	194.6	96.1	88.4	7.7	57.8	65.5
2011	2	306.0	199.2	106.8	90.2	16.6	181.1	197.6
2012	3	321.6	203.9	117.8	274.0	-156.2	692.4	536.2
2013	4	337.7	208.6	129.1	956.3	-827.2	894.7	67.5
2014	5	354.2	213.4	140.9	1,288.7	-1,147.8	654.2	-493.6
2015	6	371.2	218.2	153.0	1,158.5	-1,005.5	592.5	-413.0
2016	7	388.7	223.1	165.6	1,181.5	-1,015.9	381.1	-634.8
2017	8	406.6	228.1	178.5	1,016.5	-838.0	52.6	-785.4
2018	9	425.0	233.1	191.9	723.3	-531.4	-111.0	-642.4
2019	10	443.9	238.2	205.7	596.9	-391.2	-638.0	-1,029.2
2020	11	561.5	243.4	318.1	0.0	318.1	-673.1	-355.0
2021	12	567.7	245.7	322.0	0.0	322.0	-701.9	-379.9
2022	13	573.9	248.0	326.0	0.0	326.0	-716.1	-390.1
2023	14	580.3	250.3	330.0	0.0	330.0	-679.9	-349.9
2024	15	586.7	252.6	334.1	0.0	334.1	-625.4	-291.3
2025	16	593.2	255.0	338.2	0.0	338.2	-560.9	-222.6
2026	17	599.8	257.3	342.4	0.0	342.4	-486.2	-143.8
2027	18	606.4	259.7	346.7	0.0	346.7	-425.9	-79.2
2028	19	613.2	262.1	351.0	0.0	351.0	-365.8	-14.8
2029	20	620.0	264.6	355.4	0.0	355.4	-305.9	49.5
2030	21	626.9	267.0	359.8	0.0	359.8	-259.2	100.7
2031	22	633.9	269.5	364.3	0.0	364.3	-213.8	150.6
2032	23	640.9	272.0	368.9	0.0	368.9	-181.9	187.0
2033	24	648.1	274.5	373.5	0.0	373.5	-145.7	227.8
2034	25	655.3	277.1	378.2	0.0	378.2	-111.8	266.4
2035	26	662.6	279.6	383.0	0.0	383.0	-78.7	304.2
2036	27	670.0	282.2	387.8	0.0	387.8	-47.3	340.5
2037	28	677.5	284.8	392.7	0.0	392.7	-23.8	368.8
2038	29	685.1	287.5	397.6	0.0	397.6	-9.4	388.2
2039	30	692.8	290.1	402.6	0.0	402.6	0.0	402.6
2040	31	700.5	292.8	407.7	0.0	407.7	0.0	407.7
2041	32	708.3	295.5	412.8	0.0	412.8	0.0	412.8
2042	33	716.3	298.2	418.1	0.0	418.1	0.0	418.1
2043	34	724.3	301.0	423.3	0.0	423.3	0.0	423.3
2044	35	732.4	303.7	428.7	0.0	428.7	0.0	428.7
2045	36	740.6	306.5	434.1	0.0	434.1	0.0	434.1
2046	37	748.9	309.3	439.6	0.0	439.6	0.0	439.6

Table 6-10 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2047	38	757.3	312.2	445.2	0.0	445.2	0.0	445.2
2048	39	765.8	315.0	450.8	0.0	450.8	0.0	450.8
2049	40	774.4	317.9	456.5	0.0	456.5	0.0	456.5
2050	41	783.1	320.8	462.3	0.0	462.3	0.0	462.3
2051	42	791.9	323.8	468.1	0.0	468.1	0.0	468.1
2052	43	800.8	326.7	474.0	0.0	474.0	0.0	474.0
2053	44	809.8	329.7	480.0	0.0	480.0	0.0	480.0
2054	45	818.9	332.7	486.1	0.0	486.1	0.0	486.1
2055	46	828.0	335.8	492.3	0.0	492.3	0.0	492.3
2056	47	837.3	338.8	498.5	0.0	498.5	0.0	498.5
2057	48	846.7	341.9	504.8	0.0	504.8	0.0	504.8
2058	49	856.2	345.0	511.2	0.0	511.2	0.0	511.2
2059	50	865.8	348.1	517.7	0.0	517.7	0.0	517.7
2060	51	875.5	351.3	524.2	0.0	524.2	0.0	524.2
	Total	32,624.5	14,230.5	18,394.0	7,374.3	11,019.7		7,164.4
				Financial Internal Rate of Return:		4.6%		3.4%
				Net Present Value at 8 percent discount rate:		-1,590.6		-1,284.5

a/ From Table 6-9.

b/ From Table 6-6.

c/ From Appendix H.

d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-11. Single Lane High-Rise Lock Canal 150,000 DWT: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and an Optimal Toll System (1990 US$ millions)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2000		417.6	97.1	514.7	349.7	164.9	51.5	0.0	0.0	0.0	113.5	0.0	0.0	113.5	--	--
2001		434.7	98.6	533.4	350.8	182.6	53.3	0.0	0.0	0.0	129.2	0.0	0.0	247.2	--	--
2002		452.6	100.2	552.8	351.9	200.9	55.3	0.0	0.0	0.0	145.6	0.0	0.0	402.7	--	--
2003		471.2	101.7	572.9	353.0	220.0	57.3	0.0	0.0	0.0	162.7	0.0	0.0	581.5	--	--
2004		490.5	103.3	593.9	354.0	239.9	59.4	0.0	0.0	0.0	180.5	0.0	0.0	785.3	--	--
2005		510.7	105.0	615.7	355.1	260.6	61.6	0.0	0.0	0.0	199.0	0.0	0.0	1,015.7	--	--
2006		531.7	106.6	638.3	356.2	282.1	63.8	0.0	0.0	0.0	218.3	0.0	0.0	1,274.6	--	--
2007		553.5	108.3	661.8	357.2	304.6	66.2	0.0	0.0	0.0	238.4	0.0	0.0	1,564.0	--	--
2008		576.3	110.0	686.3	358.3	327.9	68.6	0.0	0.0	0.0	259.3	0.0	0.0	1,885.9	--	--
2009		599.9	111.7	711.7	359.4	352.3	71.2	0.0	0.0	0.0	281.1	0.0	0.0	2,242.4	--	--
2010	1	624.6	113.5	738.1	360.5	377.6	73.8	4.6	0.8	5.3	298.5	26.5	0.0	2,604.0	57.0	545.6
2011	2	650.3	115.3	765.5	361.5	404.0	76.6	9.2	1.5	10.7	316.7	27.1	0.0	2,997.8	30.6	310.4
2012	3	677.0	117.1	794.0	362.6	431.4	79.4	23.3	3.8	27.1	324.9	82.2	0.0	3,360.5	13.0	136.9
2013	4	704.8	118.9	823.7	363.7	460.0	82.4	74.4	22.5	96.9	280.7	236.8	0.0	3,538.8	3.9	40.4
2014	5	733.7	120.8	854.5	364.8	489.7	85.5	143.0	52.2	195.3	209.0	297.1	0.0	3,592.3	2.1	20.5
2015	6	763.9	122.7	886.5	365.8	520.7	88.7	200.8	74.2	275.0	157.1	309.0	0.0	3,584.0	1.6	14.6
2016	7	795.3	124.6	919.9	366.9	552.9	92.0	257.9	119.9	377.8	83.1	314.1	0.0	3,496.4	1.2	10.5
2017	8	827.9	126.5	954.5	368.0	586.5	95.4	303.0	192.6	495.6	-4.5	257.6	0.0	3,374.2	1.0	7.8
2018	9	862.0	128.5	990.5	369.1	621.4	99.0	327.9	245.3	573.2	-50.8	175.1	0.0	3,283.2	0.9	6.6
2019	10	897.4	130.5	1,027.9	370.1	657.8	102.8	342.6	295.4	638.0	-83.0	134.7	0.0	3,196.9	0.9	5.9
2020	11	1,175.0	132.6	1,307.6	475.1	832.5	130.8	320.5	352.6	673.1	28.6	0.0	2,725.5	627.9	1.0	2.0
2021	12	1,184.8	133.6	1,318.4	477.8	840.6	131.8	294.4	407.5	701.9	6.9	0.0	134.8	525.1	1.0	1.8
2022	13	1,194.7	134.6	1,329.3	480.5	848.8	132.9	264.3	451.7	716.1	-0.2	0.0	0.0	545.9	1.0	1.8
2023	14	1,204.6	135.6	1,340.3	483.2	857.1	134.0	231.9	447.9	679.9	43.2	0.0	89.1	521.8	1.1	1.8
2024	15	1,214.7	136.7	1,351.4	485.9	865.5	135.1	200.0	425.5	625.4	104.9	0.0	126.7	520.9	1.2	2.0
2025	16	1,224.8	137.7	1,362.5	488.6	873.9	136.3	169.7	391.2	560.9	176.8	0.0	197.7	520.8	1.3	2.2
2026	17	1,235.0	138.8	1,373.8	491.3	882.5	137.4	142.1	344.2	486.2	258.9	0.0	279.7	520.8	1.5	2.6
2027	18	1,245.3	139.8	1,385.2	494.0	891.2	138.5	117.5	308.5	425.9	326.7	0.0	347.5	520.8	1.8	3.0
2028	19	1,255.7	140.9	1,396.6	496.7	899.9	139.7	95.5	270.3	365.8	394.5	0.0	415.3	520.8	2.1	3.5
2029	20	1,266.2	141.9	1,408.1	499.4	908.8	140.8	76.3	229.6	305.9	462.0	0.0	482.9	520.8	2.5	4.2
2030	21	1,276.8	143.0	1,419.8	502.1	917.7	142.0	59.9	199.3	259.2	516.6	0.0	537.4	520.8	3.0	5.0
2031	22	1,287.4	144.1	1,431.5	504.8	926.7	143.2	45.8	168.0	213.8	569.8	0.0	590.7	520.8	3.7	6.1
2032	23	1,298.1	145.2	1,443.4	507.5	935.9	144.3	33.9	147.9	181.9	609.7	0.0	630.5	520.8	4.4	7.2
2033	24	1,309.0	146.3	1,455.3	510.2	945.1	145.5	23.7	122.0	145.7	653.9	0.0	674.7	520.8	5.5	9.1
2034	25	1,319.9	147.4	1,467.3	512.9	954.4	146.7	15.4	96.4	111.8	695.9	0.0	716.7	520.8	7.2	11.9
2035	26	1,330.9	148.5	1,479.4	515.6	963.9	147.9	9.0	69.7	78.7	737.2	0.0	758.0	520.8	10.4	17.0
2036	27	1,342.0	149.7	1,491.7	518.3	973.4	149.2	4.5	42.8	47.3	777.0	0.0	797.8	520.8	17.4	28.5
2037	28	1,353.2	150.8	1,504.0	521.0	983.0	150.4	1.8	22.0	23.8	808.8	0.0	829.6	520.8	34.9	56.8

Table 6-11 (continued)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2038	29	1,364.5	152.0	1,516.4	523.7	992.8	151.6	0.5	8.9	9.4	831.8	0.0	852.6	520.8	89.7	145.2
2039	30	1,375.8	153.1	1,529.0	526.4	1,002.6	152.9	0.0	0.0	0.0	849.7	0.0	870.5	520.8	--	--
2040	31	1,387.3	154.3	1,541.6	529.1	1,012.6	154.2	0.0	0.0	0.0	858.4	0.0	879.2	520.8	--	--
2041	32	1,398.9	155.5	1,554.3	531.7	1,022.6	155.4	0.0	0.0	0.0	867.2	0.0	888.0	520.8	--	--
2042	33	1,410.6	156.6	1,567.2	534.4	1,032.7	156.7	0.0	0.0	0.0	876.0	0.0	896.9	520.8	--	--
2043	34	1,422.3	157.8	1,580.1	537.1	1,043.0	158.0	0.0	0.0	0.0	885.0	0.0	905.8	520.8	--	--
2044	35	1,434.2	159.0	1,593.2	539.8	1,053.4	159.3	0.0	0.0	0.0	894.0	0.0	914.9	520.8	--	--
2045	36	1,446.1	160.2	1,606.4	542.5	1,063.8	160.6	0.0	0.0	0.0	903.2	0.0	924.0	520.8	--	--
2046	37	1,458.2	161.4	1,619.7	545.2	1,074.4	162.0	0.0	0.0	0.0	912.5	0.0	933.3	520.8	--	--
2047	38	1,470.4	162.7	1,633.0	547.9	1,085.1	163.3	0.0	0.0	0.0	921.8	0.0	942.6	520.8	--	--
2048	39	1,482.6	163.9	1,646.5	550.6	1,095.9	164.7	0.0	0.0	0.0	931.3	0.0	952.1	520.8	--	--
2049	40	1,495.0	165.2	1,660.2	553.3	1,106.8	166.0	0.0	0.0	0.0	940.8	0.0	961.6	520.8	--	--
2050	41	1,507.5	166.4	1,673.9	556.0	1,117.9	167.4	0.0	0.0	0.0	950.5	0.0	971.3	520.8	--	--
2051	42	1,520.0	167.7	1,687.7	558.7	1,129.0	168.8	0.0	0.0	0.0	960.2	0.0	981.1	520.8	--	--
2052	43	1,532.7	169.0	1,701.7	561.4	1,140.2	170.2	0.0	0.0	0.0	970.1	0.0	990.9	520.8	--	--
2053	44	1,545.5	170.2	1,715.7	564.1	1,151.6	171.6	0.0	0.0	0.0	980.0	0.0	1,000.9	520.8	--	--
2054	45	1,558.4	171.5	1,729.9	566.8	1,163.1	173.0	0.0	0.0	0.0	990.1	0.0	1,010.9	520.8	--	--
2055	46	1,571.4	172.8	1,744.2	569.5	1,174.7	174.4	0.0	0.0	0.0	1,000.3	0.0	1,021.1	520.8	--	--
2056	47	1,584.5	174.1	1,758.6	572.2	1,186.4	175.9	0.0	0.0	0.0	1,010.6	0.0	1,031.4	520.8	--	--
2057	48	1,597.7	175.5	1,773.2	574.9	1,198.3	177.3	0.0	0.0	0.0	1,021.0	0.0	1,041.8	520.8	--	--
2058	49	1,611.0	176.8	1,787.8	577.6	1,210.2	178.8	0.0	0.0	0.0	1,031.4	0.0	1,052.3	520.8	--	--
2059	50	1,624.5	178.1	1,802.6	580.3	1,222.3	180.3	0.0	0.0	0.0	1,042.0	0.0	1,062.9	520.8	--	--
2060	51	1,638.0	179.5	1,817.5	583.0	1,234.5	181.8	0.0	0.0	0.0	1,052.8	0.0	1,073.6	520.8	--	--
	Total	69,730.8	8,611.7	78,342.5	28,889.7	49,452.9	7,834.3	3,793.5	5,514.2	9,307.7	32,310.9	1,860.1	32,494.5			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-12. Single Lane High-Rise Lock Canal 150,000 DWT: Financial Analysis, 2009-2060 Assuming a Panama Canal Authority and an Optimal Toll System (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Without Project b/	Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2009							61.9	61.9
2010	1	377.6	194.6	183.0	88.4	94.6	57.8	152.4
2011	2	404.0	199.2	204.7	90.2	114.5	181.1	295.6
2012	3	431.4	203.9	227.5	274.0	-46.5	692.4	645.9
2013	4	460.0	208.6	251.4	956.3	-704.9	894.7	189.8
2014	5	489.7	213.4	276.4	1,288.7	-1,012.3	654.2	-358.1
2015	6	520.7	218.2	302.5	1,158.5	-856.0	592.5	-263.5
2016	7	552.9	223.1	329.8	1,181.5	-851.7	381.1	-470.6
2017	8	586.5	228.1	358.4	1,016.5	-658.1	52.6	-605.5
2018	9	621.4	233.1	388.3	723.3	-335.0	-111.0	-446.0
2019	10	657.8	238.2	419.6	596.9	-177.3	-638.0	-815.3
2020	11	832.5	243.4	589.1	0.0	589.1	-673.1	-84.0
2021	12	840.6	245.7	594.9	0.0	594.9	-701.9	-106.9
2022	13	848.8	248.0	600.8	0.0	600.8	-716.1	-115.2
2023	14	857.1	250.3	606.8	0.0	606.8	-679.9	-73.0
2024	15	865.5	252.6	612.9	0.0	612.9	-625.4	-12.6
2025	16	873.9	255.0	619.0	0.0	619.0	-560.9	58.1
2026	17	882.5	257.3	625.2	0.0	625.2	-486.2	139.0
2027	18	891.2	259.7	631.4	0.0	631.4	-425.9	205.5
2028	19	899.9	262.1	637.8	0.0	637.8	-365.8	272.0
2029	20	908.8	264.6	644.2	0.0	644.2	-305.9	338.3
2030	21	917.7	267.0	650.7	0.0	650.7	-259.2	391.5
2031	22	926.7	269.5	657.2	0.0	657.2	-213.8	443.5
2032	23	935.9	272.0	663.9	0.0	663.9	-181.9	482.0
2033	24	945.1	274.5	670.6	0.0	670.6	-145.7	524.9
2034	25	954.4	277.1	677.4	0.0	677.4	-111.8	565.6
2035	26	963.9	279.6	684.2	0.0	684.2	-78.7	605.5
2036	27	973.4	282.2	691.2	0.0	691.2	-47.3	643.9
2037	28	983.0	284.8	698.2	0.0	698.2	-23.8	674.4
2038	29	992.8	287.5	705.3	0.0	705.3	-9.4	695.9
2039	30	1,002.6	290.1	712.5	0.0	712.5	0.0	712.5
2040	31	1,012.6	292.8	719.7	0.0	719.7	0.0	719.7
2041	32	1,022.6	295.5	727.1	0.0	727.1	0.0	727.1
2042	33	1,032.7	298.2	734.5	0.0	734.5	0.0	734.5
2043	34	1,043.0	301.0	742.0	0.0	742.0	0.0	742.0
2044	35	1,053.4	303.7	749.6	0.0	749.6	0.0	749.6
2045	36	1,063.8	306.5	757.3	0.0	757.3	0.0	757.3
2046	37	1,074.4	309.3	765.1	0.0	765.1	0.0	765.1

Table 6-12 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2047	38	1,085.1	312.2	772.9	0.0	772.9	0.0	772.9
2048	39	1,095.9	315.0	780.9	0.0	780.9	0.0	780.9
2049	40	1,106.8	317.9	788.9	0.0	788.9	0.0	788.9
2050	41	1,117.9	320.8	797.0	0.0	797.0	0.0	797.0
2051	42	1,129.0	323.8	805.2	0.0	805.2	0.0	805.2
2052	43	1,140.2	326.7	813.5	0.0	813.5	0.0	813.5
2053	44	1,151.6	329.7	821.9	0.0	821.9	0.0	821.9
2054	45	1,163.1	332.7	830.4	0.0	830.4	0.0	830.4
2055	46	1,174.7	335.8	838.9	0.0	838.9	0.0	838.9
2056	47	1,186.4	338.8	847.6	0.0	847.6	0.0	847.6
2057	48	1,198.3	341.9	856.4	0.0	856.4	0.0	856.4
2058	49	1,210.2	345.0	865.2	0.0	865.2	0.0	865.2
2059	50	1,222.3	348.1	874.2	0.0	874.2	0.0	874.2
2060	51	1,234.5	351.3	883.2	0.0	883.2	0.0	883.2
	Total	46,917.1	14,230.5	32,686.6	7,374.3	25,312.3		21,457.0
				Financial Internal Rate of Return:		10.1%		18.0%
				Net Present Value at 8 percent discount rate:		951.0		1,068.9

a/ From Table 6-11.

b/ From Table 6-6.

c/ From Appendix H.

d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-13. Single Lane High-Rise Lock Canal 200,000 DWT: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and Existing Panama Canal Tolls (1990 US$ millions)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2000		404.6	97.1	501.7	349.7	152.0	50.2	0.0	0.0	0.0	101.8	0.0	0.0	101.8	--	--
2001		408.2	98.6	506.8	350.8	156.0	50.7	0.0	0.0	0.0	105.3	0.0	0.0	211.2	--	--
2002		411.8	100.2	512.0	351.9	160.1	51.2	0.0	0.0	0.0	108.9	0.0	0.0	328.6	--	--
2003		415.4	101.7	517.1	353.0	164.2	51.7	0.0	0.0	0.0	112.5	0.0	0.0	454.2	--	--
2004		419.0	103.3	522.4	354.0	168.4	52.2	0.0	0.0	0.0	116.1	0.0	0.0	588.5	--	--
2005		422.7	105.0	527.7	355.1	172.6	52.8	0.0	0.0	0.0	119.8	0.0	0.0	731.8	--	--
2006		426.4	106.6	533.1	356.2	176.9	53.3	0.0	0.0	0.0	123.6	0.0	0.0	884.7	--	--
2007		430.2	108.3	538.5	357.2	181.2	53.8	0.0	0.0	0.0	127.4	0.0	0.0	1,047.4	--	--
2008		434.0	110.0	544.0	358.3	185.6	54.4	0.0	0.0	0.0	131.2	0.0	0.0	1,220.6	--	--
2009	1	437.8	111.7	549.5	359.4	190.1	54.9	5.0	0.8	5.8	129.4	28.7	0.0	1,370.1	23.4	260.9
2010	2	441.6	113.5	555.1	360.5	194.6	55.5	10.0	1.6	11.6	127.5	29.3	0.0	1,523.1	12.0	143.2
2011	3	445.5	115.3	560.8	361.5	199.2	56.1	25.3	4.2	29.4	113.7	89.3	0.0	1,608.4	4.9	59.5
2012	4	449.4	117.1	566.5	362.6	203.9	56.6	74.8	22.8	97.6	49.6	225.8	0.0	1,496.5	1.5	16.8
2013	5	453.4	118.9	572.3	363.7	208.6	57.2	143.3	50.7	194.0	-42.6	308.7	0.0	1,205.0	0.8	7.0
2014	6	457.4	120.8	578.1	364.8	213.4	57.8	208.0	75.7	283.8	-128.2	338.2	0.0	786.7	0.5	3.3
2015	7	461.4	122.7	584.0	365.8	218.2	58.4	271.4	126.2	397.7	-237.9	335.2	0.0	245.1	0.4	1.0
2016	8	465.4	124.6	590.0	366.9	223.1	59.0	330.5	200.2	530.7	-366.6	326.9	0.0	-438.6	0.3	-0.5
2017	9	469.5	126.5	596.1	368.0	228.1	59.6	368.9	257.8	626.6	-458.1	251.7	0.0	-1,166.0	0.3	-1.6
2018	10	473.6	128.5	602.2	369.1	233.1	60.2	392.9	321.4	714.3	-541.4	190.3	0.0	-1,944.3	0.2	-2.5
2019	11	477.8	130.5	608.3	370.1	238.2	60.8	378.4	386.8	765.2	-587.8	54.9	0.0	-2,664.8	0.2	-3.3
2020	12	630.0	132.6	762.6	483.4	279.2	76.3	349.8	442.6	792.3	-589.4	0.0	0.0	-3,360.8	0.3	-4.0
2021	13	635.6	133.6	769.2	486.1	283.1	76.9	317.1	495.5	812.6	-606.4	0.0	0.0	-4,101.6	0.3	-4.8
2022	14	641.2	134.6	775.8	488.8	287.0	77.6	281.3	502.2	783.5	-574.1	0.0	0.0	-4,839.8	0.3	-5.9
2023	15	646.8	135.6	782.5	491.5	291.0	78.2	245.3	489.2	734.4	-521.7	0.0	0.0	-5,555.1	0.3	-7.3
2024	16	652.5	136.7	789.2	494.2	295.0	78.9	210.2	460.4	670.6	-454.6	0.0	0.0	-6,231.8	0.3	-9.0
2025	17	658.3	137.7	796.0	496.9	299.1	79.6	177.5	412.8	590.4	-370.9	0.0	0.0	-6,852.0	0.4	-11.2
2026	18	664.1	138.8	802.8	499.6	303.2	80.3	148.1	369.8	517.9	-294.9	0.0	0.0	-7,421.0	0.4	-13.9
2027	19	669.9	139.8	809.7	502.3	307.5	81.0	121.6	325.1	446.7	-220.3	0.0	0.0	-7,938.1	0.5	-17.3
2028	20	675.8	140.9	816.7	505.0	311.7	81.7	98.5	277.1	375.6	-145.6	0.0	0.0	-8,401.2	0.6	-21.8
2029	21	681.8	141.9	823.7	507.7	316.1	82.4	78.6	242.5	321.1	-87.4	0.0	0.0	-8,824.6	0.7	-26.8
2030	22	687.8	143.0	830.8	510.4	320.5	83.1	61.4	209.2	270.6	-33.2	0.0	0.0	-9,210.9	0.9	-33.2
2031	23	693.9	144.1	838.0	513.1	324.9	83.8	46.5	185.2	231.7	9.4	0.0	0.0	-9,569.9	1.0	-40.3
2032	24	700.0	145.2	845.2	515.8	329.4	84.5	33.5	156.4	189.9	55.0	0.0	0.0	-9,897.7	1.3	-50.8
2033	25	706.1	146.3	852.5	518.5	334.0	85.2	22.8	125.8	148.6	100.2	0.0	0.0	-10,193.4	1.7	-66.9
2034	26	712.4	147.4	859.8	521.2	338.6	86.0	14.4	93.9	108.3	144.3	0.0	0.0	-10,456.8	2.3	-94.2
2035	27	718.7	148.5	867.2	523.9	343.3	86.7	8.2	66.2	74.3	182.3	0.0	0.0	-10,692.8	3.5	-140.4
2036	28	725.0	149.7	874.7	526.6	348.1	87.5	3.9	39.7	43.6	217.0	0.0	0.0	-10,903.5	6.0	-243.9
2037	29	731.4	150.8	882.2	529.3	352.9	88.2	1.4	19.4	20.8	243.9	0.0	0.0	-11,095.7	12.7	-520.3
2038	30	737.8	152.0	889.8	532.0	357.8	89.0	0.3	5.4	5.7	263.2	0.0	0.0	-11,276.4	--	--
2039	31	744.3	153.1	897.4	534.7	362.8	89.7	0.0	0.0	0.0	273.1	0.0	0.0	-11,454.4	--	--
2040	32	750.9	154.3	905.2	537.4	367.8	90.5	0.0	0.0	0.0	277.3	0.0	0.0	-11,635.3	--	--

Table 6-13 (continued)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2041	33	757.5	155.5	913.0	540.0	372.9	91.3	0.0	0.0	0.0	281.6	0.0	0.0	-11,819.1	--	--
2042	34	764.2	156.6	920.8	542.7	378.1	92.1	0.0	0.0	0.0	286.0	0.0	0.0	-12,005.8	--	--
2043	35	770.9	157.8	928.8	545.4	383.3	92.9	0.0	0.0	0.0	290.4	0.0	0.0	-12,195.6	--	--
2044	36	777.7	159.0	936.7	548.1	388.6	93.7	0.0	0.0	0.0	294.9	0.0	0.0	-12,388.5	--	--
2045	37	784.6	160.2	944.8	550.8	394.0	94.5	0.0	0.0	0.0	299.5	0.0	0.0	-12,584.6	--	--
2046	38	791.5	161.4	952.9	553.5	399.4	95.3	0.0	0.0	0.0	304.1	0.0	0.0	-12,783.8	--	--
2047	39	798.5	162.7	961.2	556.2	404.9	96.1	0.0	0.0	0.0	308.8	0.0	0.0	-12,986.4	--	--
2048	40	805.5	163.9	969.4	558.9	410.5	96.9	0.0	0.0	0.0	313.6	0.0	0.0	-13,192.3	--	--
2049	41	812.6	165.2	977.8	561.6	416.1	97.8	0.0	0.0	0.0	318.4	0.0	0.0	-13,401.6	--	--
2050	42	819.8	166.4	986.2	564.3	421.9	98.6	0.0	0.0	0.0	323.3	0.0	0.0	-13,614.4	--	--
2051	43	827.0	167.7	994.7	567.0	427.7	99.5	0.0	0.0	0.0	328.2	0.0	0.0	-13,830.8	--	--
2052	44	834.3	169.0	1,003.3	569.7	433.5	100.3	0.0	0.0	0.0	333.2	0.0	0.0	-14,050.8	--	--
2053	45	841.7	170.2	1,011.9	572.4	439.5	101.2	0.0	0.0	0.0	338.3	0.0	0.0	-14,274.6	--	--
2054	46	849.1	171.5	1,020.6	575.1	445.5	102.1	0.0	0.0	0.0	343.4	0.0	0.0	-14,502.1	--	--
2055	47	856.6	172.8	1,029.4	577.8	451.6	102.9	0.0	0.0	0.0	348.6	0.0	0.0	-14,733.6	--	--
2056	48	864.1	174.1	1,038.3	580.5	457.8	103.8	0.0	0.0	0.0	353.9	0.0	0.0	-14,969.0	--	--
2057	49	871.7	175.5	1,047.2	583.2	464.0	104.7	0.0	0.0	0.0	359.3	0.0	0.0	-15,208.5	--	--
2058	50	879.4	176.8	1,056.2	585.9	470.3	105.6	0.0	0.0	0.0	364.7	0.0	0.0	-15,452.1	--	--
2059	51	887.2	178.1	1,065.3	588.6	476.7	106.5	0.0	0.0	0.0	370.2	0.0	0.0	-15,700.0	--	--
2060	52	895.0	179.5	1,074.5	591.3	483.2	107.5	0.0	0.0	0.0	375.8	0.0	0.0	-15,952.3	--	--
Total		39,758.2	8,611.7	48,369.9	29,230.0	19,140.0	4,837.0	4,428.9	6,366.6	10,795.4	3,507.5	2,179.1	0.0			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-14. Single Lane High-Rise Lock Canal 200,000 DWT: Financial Analysis, 2008-2060 Assuming a Panama Canal Authority and Existing Panama Canal Tolls (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
	2008						67.0	67.0
1	2009	190.1	190.1	0.0	95.7	-95.7	62.7	-33.0
2	2010	194.6	194.6	0.0	97.8	-97.8	196.8	99.0
3	2011	199.2	199.2	0.0	297.7	-297.7	669.0	371.3
4	2012	203.9	203.9	0.0	924.3	-924.3	889.4	-34.9
5	2013	208.6	208.6	0.0	1,295.7	-1,295.7	751.7	-544.0
6	2014	213.4	213.4	0.0	1,283.9	-1,283.9	676.9	-607.0
7	2015	218.2	218.2	0.0	1,295.9	-1,295.9	560.7	-735.2
8	2016	223.1	223.1	0.0	1,285.2	-1,285.2	208.2	-1,077.0
9	2017	228.1	228.1	0.0	990.7	-990.7	-21.0	-1,011.7
10	2018	233.1	233.1	0.0	795.9	-795.9	-586.3	-1,382.2
11	2019	238.2	238.2	0.0	182.9	-182.9	-765.2	-948.1
12	2020	279.2	243.4	35.8	0.0	35.8	-792.3	-756.5
13	2021	283.1	245.7	37.4	0.0	37.4	-812.6	-775.2
14	2022	287.0	248.0	39.0	0.0	39.0	-783.5	-744.5
15	2023	291.0	250.3	40.7	0.0	40.7	-734.4	-693.7
16	2024	295.0	252.6	42.4	0.0	42.4	-670.6	-628.2
17	2025	299.1	255.0	44.1	0.0	44.1	-590.4	-546.2
18	2026	303.2	257.3	45.9	0.0	45.9	-517.9	-472.0
19	2027	307.5	259.7	47.7	0.0	47.7	-446.7	-399.0
20	2028	311.7	262.1	49.6	0.0	49.6	-375.6	-326.0
21	2029	316.1	264.6	51.5	0.0	51.5	-321.1	-269.6
22	2030	320.5	267.0	53.4	0.0	53.4	-270.6	-217.2
23	2031	324.9	269.5	55.4	0.0	55.4	-231.7	-176.3
24	2032	329.4	272.0	57.4	0.0	57.4	-189.9	-132.5
25	2033	334.0	274.5	59.5	0.0	59.5	-148.6	-89.1
26	2034	338.6	277.1	61.6	0.0	61.6	-108.3	-46.8
27	2035	343.3	279.6	63.7	0.0	63.7	-74.3	-10.6
28	2036	348.1	282.2	65.9	0.0	65.9	-43.6	22.2
29	2037	352.9	284.8	68.1	0.0	68.1	-20.8	47.3
30	2038	357.8	287.5	70.4	0.0	70.4	-5.7	64.7
31	2039	362.8	290.1	72.7	0.0	72.7	0.0	72.7
32	2040	367.8	292.8	75.0	0.0	75.0	0.0	75.0
33	2041	372.9	295.5	77.4	0.0	77.4	0.0	77.4
34	2042	378.1	298.2	79.9	0.0	79.9	0.0	79.9
35	2043	383.3	301.0	82.3	0.0	82.3	0.0	82.3
36	2044	388.6	303.7	84.9	0.0	84.9	0.0	84.9
37	2045	394.0	306.5	87.4	0.0	87.4	0.0	87.4
38	2046	399.4	309.3	90.1	0.0	90.1	0.0	90.1
39	2047	404.9	312.2	92.7	0.0	92.7	0.0	92.7
40	2048	410.5	315.0	95.5	0.0	95.5	0.0	95.5

Table 6-14 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
41	2049	416.1	317.9	98.2	0.0	98.2	0.0	98.2
42	2050	421.9	320.8	101.0	0.0	101.0	0.0	101.0
43	2051	427.7	323.8	103.9	0.0	103.9	0.0	103.9
44	2052	433.5	326.7	106.8	0.0	106.8	0.0	106.8
45	2053	439.5	329.7	109.8	0.0	109.8	0.0	109.8
46	2054	445.5	332.7	112.8	0.0	112.8	0.0	112.8
47	2055	451.6	335.8	115.8	0.0	115.8	0.0	115.8
48	2056	457.8	338.8	118.9	0.0	118.9	0.0	118.9
49	2057	464.0	341.9	122.1	0.0	122.1	0.0	122.1
50	2058	470.3	345.0	125.3	0.0	125.3	0.0	125.3
51	2059	476.7	348.1	128.6	0.0	128.6	0.0	128.6
52	2060	483.2	351.3	131.9	0.0	131.9	0.0	131.9
Total		17,623.0	14,420.6	3,202.4	8,545.7	-5,343.3		-9,772.2
				Financial Internal Rate of Return:		-3.1%		-5.4%
				Net Present Value at 8 percent discount rate:		-4,881.6		-4,308.1

a/ From Table 6-13.

b/ From Table 6-6.

c/ From Appendix H.

d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-15. Single Lane High-Rise Lock Canal 200,000 DWT: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and a 50 Percent Increase in Tolls (1990 US$ millions)

Year	Project Year	Revenues			Oper & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2000		411.9	97.1	509.0	349.7	159.3	50.9	0.0	0.0	0.0	108.4	0.0	0.0	108.4	--	--
2001		423.1	98.6	521.7	350.8	170.9	52.2	0.0	0.0	0.0	118.7	0.0	0.0	231.4	--	--
2002		434.5	100.2	534.7	351.9	182.8	53.5	0.0	0.0	0.0	129.3	0.0	0.0	370.0	--	--
2003		446.2	101.7	548.0	353.0	195.0	54.8	0.0	0.0	0.0	140.2	0.0	0.0	525.0	--	--
2004		458.3	103.3	561.6	354.0	207.6	56.2	0.0	0.0	0.0	151.4	0.0	0.0	697.5	--	--
2005		470.7	105.0	575.6	355.1	220.5	57.6	0.0	0.0	0.0	163.0	0.0	0.0	888.3	--	--
2006		483.4	106.6	590.0	356.2	233.8	59.0	0.0	0.0	0.0	174.8	0.0	0.0	1,098.7	--	--
2007		496.4	108.3	604.7	357.2	247.5	60.5	0.0	0.0	0.0	187.0	0.0	0.0	1,329.6	--	--
2008		509.8	110.0	619.8	358.3	261.5	62.0	0.0	0.0	0.0	199.5	0.0	0.0	1,582.3	--	--
2009	1	523.6	111.7	635.3	359.4	275.9	63.5	5.0	0.8	5.8	206.6	28.7	0.0	1,823.5	36.8	352.9
2010	2	537.7	113.5	651.2	360.5	290.7	65.1	10.0	1.6	11.6	214.0	29.3	0.0	2,081.1	19.4	198.8
2011	3	552.3	115.3	667.5	361.5	306.0	66.8	25.3	4.2	29.4	209.8	89.3	0.0	2,284.9	8.1	85.8
2012	4	567.2	117.1	684.2	362.6	321.6	68.4	74.8	22.8	97.6	155.6	225.8	0.0	2,306.0	2.6	26.2
2013	5	582.5	118.9	701.4	363.7	337.7	70.1	143.3	50.7	194.0	73.6	308.7	0.0	2,163.1	1.4	12.5
2014	6	598.2	120.8	719.0	364.8	354.2	71.9	208.0	75.7	283.8	-1.4	338.2	0.0	1,910.0	1.0	7.7
2015	7	614.4	122.7	737.1	365.8	371.2	73.7	271.4	126.2	397.7	-100.1	335.2	0.0	1,551.1	0.7	4.6
2016	8	631.0	124.6	755.6	366.9	388.7	75.6	330.5	200.2	530.7	-217.6	326.9	0.0	1,068.6	0.6	2.6
2017	9	648.0	126.5	774.6	368.0	406.6	77.5	368.9	257.8	626.6	-297.5	251.7	0.0	562.1	0.5	1.4
2018	10	665.5	128.5	794.1	369.1	425.0	79.4	392.9	321.4	714.3	-368.7	190.3	0.0	25.6	0.5	0.5
2019	11	683.5	130.5	814.1	370.1	443.9	81.4	378.4	386.8	765.2	-402.7	54.9	0.0	-430.9	0.5	-0.1
2020	12	904.0	132.6	1,036.6	483.4	553.2	103.7	349.8	442.6	792.3	-342.8	0.0	0.0	-790.9	0.6	-0.4
2021	13	912.6	133.6	1,046.2	486.1	560.1	104.6	317.1	495.5	812.6	-357.1	0.0	0.0	-1,179.6	0.6	-0.9
2022	14	921.2	134.6	1,055.9	488.8	567.1	105.6	281.3	502.2	783.5	-322.0	0.0	0.0	-1,548.9	0.6	-1.4
2023	15	930.0	135.6	1,065.6	491.5	574.1	106.6	245.3	489.2	734.4	-266.8	0.0	0.0	-1,877.7	0.6	-1.9
2024	16	938.8	136.7	1,075.5	494.2	581.3	107.5	210.2	460.4	670.6	-196.9	0.0	0.0	-2,149.7	0.7	-2.5
2025	17	947.7	137.7	1,085.4	496.9	588.5	108.5	177.5	412.8	590.4	-110.4	0.0	0.0	-2,346.0	0.8	-3.2
2026	18	956.7	138.8	1,095.5	499.6	595.9	109.5	148.1	369.8	517.9	-31.6	0.0	0.0	-2,471.4	0.9	-3.8
2027	19	965.8	139.8	1,105.6	502.3	603.3	110.6	121.6	325.1	446.7	46.0	0.0	0.0	-2,524.2	1.1	-4.5
2028	20	975.0	140.9	1,115.8	505.0	610.9	111.6	98.5	277.1	375.6	123.7	0.0	0.0	-2,501.5	1.3	-5.3
2029	21	984.2	141.9	1,126.2	507.7	618.5	112.6	78.6	242.5	321.1	184.8	0.0	0.0	-2,416.8	1.6	-6.0
2030	22	993.5	143.0	1,136.6	510.4	626.2	113.7	61.4	209.2	270.6	241.9	0.0	0.0	-2,271.6	1.9	-6.5
2031	23	1,003.0	144.1	1,147.1	513.1	634.0	114.7	46.5	185.2	231.7	287.6	0.0	0.0	-2,074.8	2.2	-6.7
2032	24	1,012.5	145.2	1,157.7	515.8	641.9	115.8	33.5	156.4	189.9	336.3	0.0	0.0	-1,821.6	2.8	-6.8
2033	25	1,022.1	146.3	1,168.4	518.5	649.9	116.8	22.8	126.8	148.6	384.5	0.0	0.0	-1,509.9	3.6	-6.6
2034	26	1,031.8	147.4	1,179.2	521.2	658.1	117.9	14.4	93.9	108.3	431.8	0.0	0.0	-1,138.5	5.0	-5.5
2035	27	1,041.6	148.5	1,190.1	523.9	666.3	119.0	8.2	66.2	74.3	472.9	0.0	0.0	-711.1	7.4	-2.2
2036	28	1,051.5	149.7	1,201.2	526.6	674.6	120.1	3.9	39.7	43.6	510.9	0.0	0.0	-228.7	12.7	7.5
2037	29	1,061.5	150.8	1,212.3	529.3	683.0	121.2	1.4	19.4	20.8	541.0	0.0	0.0	303.2	27.0	41.6
2038	30	1,071.5	152.0	1,223.5	532.0	691.5	122.3	0.3	5.4	5.7	563.5	0.0	0.0	878.8	--	--
2039	31	1,081.7	153.1	1,234.8	534.7	700.2	123.5	0.0	0.0	0.0	576.7	0.0	955.4	535.2	--	--
2040	32	1,092.0	154.3	1,246.2	537.4	708.9	124.6	0.0	0.0	0.0	584.3	0.0	619.4	521.4	--	--

Table 6-15 (continued)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2041	33	1,102.3	155.5	1,257.8	540.0	717.7	125.8	0.0	0.0	0.0	592.0	0.0	613.4	520.9	--	--
2042	34	1,112.8	156.6	1,269.4	542.7	726.7	126.9	0.0	0.0	0.0	599.7	0.0	620.6	520.8	--	--
2043	35	1,123.3	157.8	1,281.2	545.4	735.7	128.1	0.0	0.0	0.0	607.6	0.0	628.4	520.8	--	--
2044	36	1,134.0	159.0	1,293.0	548.1	744.9	129.3	0.0	0.0	0.0	615.6	0.0	636.4	520.8	--	--
2045	37	1,144.8	160.2	1,305.0	550.8	754.2	130.5	0.0	0.0	0.0	623.7	0.0	644.5	520.8	--	--
2046	38	1,155.6	161.4	1,317.1	553.5	763.5	131.7	0.0	0.0	0.0	631.8	0.0	652.7	520.8	--	--
2047	39	1,166.6	162.7	1,329.3	556.2	773.0	132.9	0.0	0.0	0.0	640.1	0.0	661.0	520.8	--	--
2048	40	1,177.7	163.9	1,341.6	558.9	782.7	134.2	0.0	0.0	0.0	648.5	0.0	669.3	520.8	--	--
2049	41	1,188.8	165.2	1,354.0	561.6	792.4	135.4	0.0	0.0	0.0	657.0	0.0	677.8	520.8	--	--
2050	42	1,200.1	166.4	1,366.5	564.3	802.2	136.7	0.0	0.0	0.0	665.6	0.0	686.4	520.8	--	--
2051	43	1,211.5	167.7	1,379.2	567.0	812.2	137.9	0.0	0.0	0.0	674.3	0.0	695.1	520.8	--	--
2052	44	1,223.0	169.0	1,392.0	569.7	822.3	139.2	0.0	0.0	0.0	683.1	0.0	703.9	520.8	--	--
2053	45	1,234.6	170.2	1,404.9	572.4	832.4	140.5	0.0	0.0	0.0	692.0	0.0	712.8	520.8	--	--
2054	46	1,246.3	171.5	1,417.9	575.1	842.8	141.8	0.0	0.0	0.0	701.0	0.0	721.8	520.8	--	--
2055	47	1,258.2	172.8	1,431.0	577.8	853.2	143.1	0.0	0.0	0.0	710.1	0.0	730.9	520.8	--	--
2056	48	1,270.1	174.1	1,444.3	580.5	863.7	144.4	0.0	0.0	0.0	719.3	0.0	740.2	520.8	--	--
2057	49	1,282.2	175.5	1,457.6	583.2	874.4	145.8	0.0	0.0	0.0	728.7	0.0	749.5	520.8	--	--
2058	50	1,294.3	176.8	1,471.1	585.9	885.2	147.1	0.0	0.0	0.0	738.1	0.0	758.9	520.8	--	--
2059	51	1,306.6	178.1	1,484.8	588.6	896.2	148.5	0.0	0.0	0.0	747.7	0.0	768.5	520.8	--	--
2060	52	1,319.0	179.5	1,498.5	591.3	907.2	149.9	0.0	0.0	0.0	757.4	0.0	778.2	520.8	--	--
Total		55,788.9	8,611.7	64,400.6	29,230.0	35,170.7	6,440.1	4,428.9	6,366.6	10,795.4	17,935.2	2,179.1	15,425.1			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-16. Single Lane High-Rise Lock Canal 200,000 DWT: Financial Analysis, 2008-2060 Assuming a Panama Canal Authority and a 50 Percent Increase in Tolls (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
	2008						67.0	67.0
1	2009	275.9	190.1	85.8	95.7	-9.9	62.7	52.8
2	2010	290.7	194.6	96.1	97.8	-1.7	196.8	195.1
3	2011	306.0	199.2	106.8	297.7	-190.9	669.0	478.1
4	2012	321.6	203.9	117.8	924.3	-806.5	889.4	82.8
5	2013	337.7	208.6	129.1	1,295.7	-1,166.6	751.7	-414.9
6	2014	354.2	213.4	140.9	1,283.9	-1,143.0	676.9	-466.1
7	2015	371.2	218.2	153.0	1,295.9	-1,142.9	560.7	-582.2
8	2016	388.7	223.1	165.6	1,285.2	-1,119.6	208.2	-911.4
9	2017	406.6	228.1	178.5	990.7	-812.2	-21.0	-833.2
10	2018	425.0	233.1	191.9	795.9	-604.0	-586.3	-1,190.3
11	2019	443.9	238.2	205.7	182.9	22.8	-765.2	-742.4
12	2020	553.2	243.4	309.8	0.0	309.8	-792.3	-482.5
13	2021	560.1	245.7	314.4	0.0	314.4	-812.6	-498.1
14	2022	567.1	248.0	319.1	0.0	319.1	-783.5	-464.4
15	2023	574.1	250.3	323.9	0.0	323.9	-734.4	-410.6
16	2024	581.3	252.6	328.7	0.0	328.7	-670.6	-342.0
17	2025	588.5	255.0	333.6	0.0	333.6	-590.4	-256.8
18	2026	595.9	257.3	338.6	0.0	338.6	-517.9	-179.3
19	2027	603.3	259.7	343.6	0.0	343.6	-446.7	-103.1
20	2028	610.9	262.1	348.7	0.0	348.7	-375.6	-26.9
21	2029	618.5	264.6	353.9	0.0	353.9	-321.1	32.8
22	2030	626.2	267.0	359.2	0.0	359.2	-270.6	88.6
23	2031	634.0	269.5	364.5	0.0	364.5	-231.7	132.8
24	2032	641.9	272.0	369.9	0.0	369.9	-189.9	180.0
25	2033	649.9	274.5	375.4	0.0	375.4	-148.6	226.8
26	2034	658.1	277.1	381.0	0.0	381.0	-108.3	272.7
27	2035	666.3	279.6	386.6	0.0	386.6	-74.3	312.3
28	2036	674.6	282.2	392.4	0.0	392.4	-43.6	348.7
29	2037	683.0	284.8	398.2	0.0	398.2	-20.8	377.4
30	2038	691.5	287.5	404.1	0.0	404.1	-5.7	398.4
31	2039	700.2	290.1	410.0	0.0	410.0	0.0	410.0
32	2040	708.9	292.8	416.1	0.0	416.1	0.0	416.1
33	2041	717.7	295.5	422.2	0.0	422.2	0.0	422.2
34	2042	726.7	298.2	428.5	0.0	428.5	0.0	428.5
35	2043	735.7	301.0	434.8	0.0	434.8	0.0	434.8
36	2044	744.9	303.7	441.2	0.0	441.2	0.0	441.2
37	2045	754.2	306.5	447.6	0.0	447.6	0.0	447.6
38	2046	763.5	309.3	454.2	0.0	454.2	0.0	454.2
39	2047	773.0	312.2	460.9	0.0	460.9	0.0	460.9
40	2048	782.7	315.0	467.6	0.0	467.6	0.0	467.6

Table 6-16 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
41	2049	792.4	317.9	474.4	0.0	474.4	0.0	474.4
42	2050	802.2	320.8	481.4	0.0	481.4	0.0	481.4
43	2051	812.2	323.8	488.4	0.0	488.4	0.0	488.4
44	2052	822.3	326.7	495.5	0.0	495.5	0.0	495.5
45	2053	832.4	329.7	502.7	0.0	502.7	0.0	502.7
46	2054	842.8	332.7	510.0	0.0	510.0	0.0	510.0
47	2055	853.2	335.8	517.4	0.0	517.4	0.0	517.4
48	2056	863.7	338.8	524.9	0.0	524.9	0.0	524.9
49	2057	874.4	341.9	532.5	0.0	532.5	0.0	532.5
50	2058	885.2	345.0	540.2	0.0	540.2	0.0	540.2
51	2059	896.2	348.1	548.0	0.0	548.0	0.0	548.0
52	2060	907.2	351.3	555.9	0.0	555.9	0.0	555.9
Total		33,291.8	14,420.6	18,871.2	8,545.7	10,325.5		5,896.6
				Financial Internal Rate of Return:		3.7%		2.3%
				Net Present Value at 8 percent discount rate:		-2,337.1		-1,952.0

a/ From Table 6-15.

b/ From Table 6-6.

c/ From Appendix H.

d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-17. Single Lane High-Rise Lock Canal 200,000 DWT: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and an Optimal Toll System (1990 US$ millions)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2000		417.6	97.1	514.7	349.7	164.9	51.5	0.0	0.0	0.0	113.5	0.0	0.0	113.5	--	--
2001		434.7	98.6	533.4	350.8	182.6	53.3	0.0	0.0	0.0	129.2	0.0	0.0	247.2	--	--
2002		452.6	100.2	552.8	351.9	200.9	55.3	0.0	0.0	0.0	145.6	0.0	0.0	402.7	--	--
2003		471.2	101.7	572.9	353.0	220.0	57.3	0.0	0.0	0.0	162.7	0.0	0.0	581.5	--	--
2004		490.5	103.3	593.9	354.0	239.9	59.4	0.0	0.0	0.0	180.5	0.0	0.0	785.3	--	--
2005		510.7	105.0	615.7	355.1	260.6	61.6	0.0	0.0	0.0	199.0	0.0	0.0	1,015.7	--	--
2006		531.7	106.6	638.3	356.2	282.1	63.8	0.0	0.0	0.0	218.3	0.0	0.0	1,274.6	--	--
2007		553.5	108.3	661.8	357.2	304.6	66.2	0.0	0.0	0.0	238.4	0.0	0.0	1,564.0	--	--
2008		576.3	110.0	686.3	358.3	327.9	68.6	0.0	0.0	0.0	259.3	0.0	0.0	1,885.9	--	--
2009	1	599.9	111.7	711.7	359.4	352.3	71.2	5.0	0.8	5.8	275.3	28.7	0.0	2,207.9	48.7	431.4
2010	2	624.6	113.5	738.1	360.5	377.6	73.8	10.0	1.6	11.6	292.2	29.3	0.0	2,559.1	26.2	246.7
2011	3	650.3	115.3	765.5	361.5	404.0	76.6	25.3	4.2	29.4	298.0	89.3	0.0	2,870.1	11.1	108.6
2012	4	677.0	117.1	794.0	362.6	431.4	79.4	74.8	22.8	97.6	254.4	225.8	0.0	3,013.5	3.6	34.5
2013	5	704.8	118.9	823.7	363.7	460.0	82.4	143.3	50.7	194.0	183.6	308.7	0.0	3,008.9	1.9	17.5
2014	6	733.7	120.8	854.5	364.8	489.7	85.5	208.0	75.7	283.8	120.5	338.2	0.0	2,911.6	1.4	11.7
2015	7	763.9	122.7	886.5	365.8	520.7	88.7	271.4	126.2	397.7	34.4	335.2	0.0	2,727.2	1.1	7.9
2016	8	795.3	124.6	919.9	366.9	552.9	92.0	330.5	200.2	530.7	-69.8	326.9	0.0	2,439.7	0.9	5.5
2017	9	827.9	126.5	954.5	368.0	586.5	95.4	368.9	257.8	626.6	-135.6	251.7	0.0	2,150.0	0.8	4.2
2018	10	862.0	128.5	990.5	369.1	621.4	99.0	392.9	321.4	714.3	-191.9	190.3	0.0	1,853.8	0.7	3.3
2019	11	897.4	130.5	1,027.9	370.1	657.8	102.8	378.4	386.8	765.2	-210.2	54.9	0.0	1,662.8	0.7	2.9
2020	12	1,186.0	132.6	1,318.6	483.4	835.2	131.9	349.8	442.6	792.3	-89.0	0.0	0.0	1,640.3	0.9	3.0
2021	13	1,197.3	133.6	1,330.9	486.1	844.8	133.1	317.1	495.5	812.6	-100.9	0.0	0.0	1,605.1	0.9	2.9
2022	14	1,208.7	134.6	1,343.3	488.8	854.5	134.3	281.3	502.2	783.5	-63.3	0.0	0.0	1,606.0	0.9	3.0
2023	15	1,220.2	135.6	1,355.8	491.5	864.3	135.6	245.3	489.2	734.4	-5.7	0.0	0.0	1,664.5	1.0	3.3
2024	16	1,231.8	136.7	1,368.4	494.2	874.3	136.8	210.2	460.4	670.6	66.8	0.0	1,231.3	566.6	1.1	1.9
2025	17	1,243.5	137.7	1,381.2	496.9	884.3	138.1	177.5	412.8	590.4	155.8	0.0	222.4	522.7	1.3	2.1
2026	18	1,255.3	138.8	1,394.1	499.6	894.5	139.4	148.1	369.8	517.9	237.2	0.0	259.9	520.9	1.5	2.5
2027	19	1,267.3	139.8	1,407.1	502.3	904.8	140.7	121.6	325.1	446.7	317.3	0.0	338.2	520.8	1.7	2.9
2028	20	1,279.3	140.9	1,420.2	505.0	915.2	142.0	98.5	277.1	375.6	397.6	0.0	418.4	520.8	2.1	3.4
2029	21	1,291.5	141.9	1,433.4	507.7	925.8	143.3	78.6	242.5	321.1	461.3	0.0	482.1	520.8	2.4	4.1
2030	22	1,303.8	143.0	1,446.8	510.4	936.4	144.7	61.4	209.2	270.6	521.1	0.0	542.0	520.8	2.9	4.9
2031	23	1,316.2	144.1	1,460.3	513.1	947.2	146.0	46.5	185.2	231.7	569.5	0.0	590.3	520.8	3.5	5.7
2032	24	1,328.7	145.2	1,473.9	515.8	958.1	147.4	33.5	156.4	189.9	620.8	0.0	641.7	520.8	4.3	7.0
2033	25	1,341.3	146.3	1,487.6	518.5	969.2	148.8	22.8	125.8	148.6	671.8	0.0	692.7	520.8	5.5	9.0
2034	26	1,354.1	147.4	1,501.5	521.2	980.3	150.2	14.4	93.9	108.3	721.9	0.0	742.7	520.8	7.7	12.5
2035	27	1,367.0	148.5	1,515.5	523.9	991.6	151.6	8.2	66.2	74.3	765.8	0.0	786.6	520.8	11.3	18.3
2036	28	1,380.0	149.7	1,529.6	526.6	1,003.1	153.0	3.9	39.7	43.6	806.5	0.0	827.3	520.8	19.5	31.4
2037	29	1,393.1	150.8	1,543.9	529.3	1,014.6	154.4	1.4	19.4	20.8	839.4	0.0	860.3	520.8	41.3	66.3
2038	30	1,406.3	152.0	1,558.3	532.0	1,026.3	155.8	0.3	5.4	5.7	864.8	0.0	885.7	520.8	--	--
2039	31	1,419.7	153.1	1,572.8	534.7	1,038.2	157.3	0.0	0.0	0.0	880.9	0.0	901.7	520.8	--	--
2040	32	1,433.2	154.3	1,587.5	537.4	1,050.2	158.8	0.0	0.0	0.0	891.4	0.0	912.2	520.8	--	--

Table 6-17 (continued)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2041	33	1,446.9	155.5	1,602.3	540.0	1,062.3	160.2	0.0	0.0	0.0	902.0	0.0	922.9	520.8	--	--
2042	34	1,460.6	156.6	1,617.3	542.7	1,074.5	161.7	0.0	0.0	0.0	912.8	0.0	933.6	520.8	--	--
2043	35	1,474.5	157.8	1,632.3	545.4	1,086.9	163.2	0.0	0.0	0.0	923.7	0.0	944.5	520.8	--	--
2044	36	1,488.5	159.0	1,647.6	548.1	1,099.4	164.8	0.0	0.0	0.0	934.7	0.0	955.5	520.8	--	--
2045	37	1,502.7	160.2	1,662.9	550.8	1,112.1	166.3	0.0	0.0	0.0	945.8	0.0	966.6	520.8	--	--
2046	38	1,517.0	161.4	1,678.4	553.5	1,124.9	167.8	0.0	0.0	0.0	957.1	0.0	977.9	520.8	--	--
2047	39	1,531.4	162.7	1,694.1	556.2	1,137.9	169.4	0.0	0.0	0.0	968.5	0.0	989.3	520.8	--	--
2048	40	1,546.0	163.9	1,709.9	558.9	1,151.0	171.0	0.0	0.0	0.0	980.0	0.0	1,000.8	520.8	--	--
2049	41	1,560.7	165.2	1,725.9	561.6	1,164.2	172.6	0.0	0.0	0.0	991.6	0.0	1,012.5	520.8	--	--
2050	42	1,575.5	166.4	1,742.0	564.3	1,177.6	174.2	0.0	0.0	0.0	1,003.4	0.0	1,024.3	520.8	--	--
2051	43	1,590.5	167.7	1,758.2	567.0	1,191.2	175.8	0.0	0.0	0.0	1,015.4	0.0	1,036.2	520.8	--	--
2052	44	1,605.7	169.0	1,774.6	569.7	1,204.9	177.5	0.0	0.0	0.0	1,027.4	0.0	1,048.3	520.8	--	--
2053	45	1,620.9	170.2	1,791.2	572.4	1,218.7	179.1	0.0	0.0	0.0	1,039.6	0.0	1,060.5	520.8	--	--
2054	46	1,636.3	171.5	1,807.9	575.1	1,232.8	180.8	0.0	0.0	0.0	1,052.0	0.0	1,072.8	520.8	--	--
2055	47	1,651.9	172.8	1,824.7	577.8	1,246.9	182.5	0.0	0.0	0.0	1,064.5	0.0	1,085.3	520.8	--	--
2056	48	1,667.6	174.1	1,841.8	580.5	1,261.3	184.2	0.0	0.0	0.0	1,077.1	0.0	1,097.9	520.8	--	--
2057	49	1,683.5	175.5	1,859.0	583.2	1,275.7	185.9	0.0	0.0	0.0	1,089.9	0.0	1,110.7	520.8	--	--
2058	50	1,699.5	176.8	1,876.3	585.9	1,290.4	187.6	0.0	0.0	0.0	1,102.8	0.0	1,123.6	520.8	--	--
2059	51	1,715.7	178.1	1,893.8	588.6	1,305.2	189.4	0.0	0.0	0.0	1,115.8	0.0	1,136.7	520.8	--	--
2060	52	1,732.0	179.5	1,911.5	591.3	1,320.2	191.2	0.0	0.0	0.0	1,129.1	0.0	1,149.9	520.8	--	--
Total		71,707.1	8,611.7	80,318.8	29,230.0	51,088.9	8,031.9	4,428.9	6,366.6	10,795.4	32,261.5	2,179.1	31,985.1			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-18. Single Lane High-Rise Lock Canal 200,000 DWT: Financial Analysis, 2008-2060 Assuming a Panama Canal Authority and an Optimal Toll System (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
	2008						67.0	67.0
1	2009	352.3	190.1	162.2	95.7	66.5	62.7	129.2
2	2010	377.6	194.6	183.0	97.8	85.2	196.8	282.0
3	2011	404.0	199.2	204.7	297.7	-93.0	669.0	576.1
4	2012	431.4	203.9	227.5	924.3	-696.8	889.4	192.6
5	2013	460.0	208.6	251.4	1,295.7	-1,044.3	751.7	-292.6
6	2014	489.7	213.4	276.4	1,283.9	-1,007.5	676.9	-330.6
7	2015	520.7	218.2	302.5	1,295.9	-993.4	560.7	-432.7
8	2016	552.9	223.1	329.8	1,285.2	-955.4	208.2	-747.1
9	2017	586.5	228.1	358.4	990.7	-632.3	-21.0	-653.3
10	2018	621.4	233.1	388.3	795.9	-407.6	-586.3	-993.8
11	2019	657.8	238.2	419.6	182.9	236.7	-765.2	-528.6
12	2020	835.2	243.4	591.8	0.0	591.8	-792.3	-200.5
13	2021	844.8	245.7	599.1	0.0	599.1	-812.6	-213.4
14	2022	854.5	248.0	606.5	0.0	606.5	-783.5	-177.0
15	2023	864.3	250.3	614.0	0.0	614.0	-734.4	-120.4
16	2024	874.3	252.6	621.7	0.0	621.7	-670.6	-49.0
17	2025	884.3	255.0	629.4	0.0	629.4	-590.4	39.0
18	2026	894.5	257.3	637.2	0.0	637.2	-517.9	119.3
19	2027	904.8	259.7	645.1	0.0	645.1	-446.7	198.3
20	2028	915.2	262.1	653.1	0.0	653.1	-375.6	277.5
21	2029	925.8	264.6	661.2	0.0	661.2	-321.1	340.1
22	2030	936.4	267.0	669.4	0.0	669.4	-270.6	398.8
23	2031	947.2	269.5	677.7	0.0	677.7	-231.7	446.0
24	2032	958.1	272.0	686.1	0.0	686.1	-189.9	496.2
25	2033	969.2	274.5	694.6	0.0	694.6	-148.6	546.1
26	2034	980.3	277.1	703.3	0.0	703.3	-108.3	595.0
27	2035	991.6	279.6	712.0	0.0	712.0	-74.3	637.7
28	2036	1003.1	282.2	720.9	0.0	720.9	-43.6	677.2
29	2037	1014.6	284.8	729.8	0.0	729.8	-20.8	709.0
30	2038	1026.3	287.5	738.9	0.0	738.9	-5.7	733.2
31	2039	1038.2	290.1	748.1	0.0	748.1	0.0	748.1
32	2040	1050.2	292.8	757.4	0.0	757.4	0.0	757.4
33	2041	1062.3	295.5	766.8	0.0	766.8	0.0	766.8
34	2042	1074.5	298.2	776.3	0.0	776.3	0.0	776.3
35	2043	1086.9	301.0	785.9	0.0	785.9	0.0	785.9
36	2044	1099.4	303.7	795.7	0.0	795.7	0.0	795.7
37	2045	1112.1	306.5	805.6	0.0	805.6	0.0	805.6
38	2046	1124.9	309.3	815.6	0.0	815.6	0.0	815.6
39	2047	1137.9	312.2	825.7	0.0	825.7	0.0	825.7
40	2048	1151.0	315.0	835.9	0.0	835.9	0.0	835.9

Table 6-18 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
41	2049	1164.2	317.9	846.3	0.0	846.3	0.0	846.3
42	2050	1177.6	320.8	856.8	0.0	856.8	0.0	856.8
43	2051	1191.2	323.8	867.4	0.0	867.4	0.0	867.4
44	2052	1204.9	326.7	878.1	0.0	878.1	0.0	878.1
45	2053	1218.7	329.7	889.0	0.0	889.0	0.0	889.0
46	2054	1232.8	332.7	900.0	0.0	900.0	0.0	900.0
47	2055	1246.9	335.8	911.2	0.0	911.2	0.0	911.2
48	2056	1261.3	338.8	922.4	0.0	922.4	0.0	922.4
49	2057	1275.7	341.9	933.8	0.0	933.8	0.0	933.8
50	2058	1290.4	345.0	945.4	0.0	945.4	0.0	945.4
51	2059	1305.2	348.1	957.1	0.0	957.1	0.0	957.1
52	2060	1320.2	351.3	968.9	0.0	968.9	0.0	968.9
Total		48,905.4	14,420.6	34,484.8	8,545.7	25,939.1		21,510.2
				Financial Internal Rate of Return:		8.4%		9.8%
				Net Present Value at 8 percent discount rate:		193.1		390.8

a/ From Table 6-17.

b/ From Table 6-6.

c/ From Appendix H.

d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-19. Sea-Level Canal Case A: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and Existing Panama Canal Tolls (1990 US$ millions)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2000		404.6	97.1	501.7	349.7	152.0	50.2	0.0	0.0	0.0	101.8	0.0	0.0	101.8	--	--
2001		408.2	98.6	506.8	350.8	156.0	50.7	0.0	0.0	0.0	105.3	0.0	0.0	211.2	--	--
2002		411.8	100.2	512.0	351.9	160.1	51.2	0.0	0.0	0.0	108.9	0.0	0.0	328.6	--	--
2003		415.4	101.7	517.1	353.0	164.2	51.7	0.0	0.0	0.0	112.5	0.0	0.0	454.2	--	--
2004		419.0	103.3	522.4	354.0	168.4	52.2	0.0	0.0	0.0	116.1	0.0	0.0	588.5	--	--
2005	1	422.7	105.0	527.7	355.1	172.6	52.8	4.4	0.7	5.1	114.7	25.4	0.0	701.4	23.5	161.2
2006	2	426.4	106.8	533.1	356.2	176.9	53.3	8.8	1.5	10.3	113.3	26.1	0.0	816.6	12.0	91.3
2007	3	430.2	108.3	538.5	357.2	181.2	53.8	13.0	2.2	15.2	112.2	24.9	0.0	936.6	8.4	70.0
2008	4	434.0	110.0	544.0	358.3	185.6	54.4	29.9	5.0	34.9	96.4	98.7	0.0	971.7	3.8	31.6
2009	5	437.8	111.7	549.5	359.4	190.1	54.9	151.5	66.6	218.2	-83.0	457.3	0.0	470.2	0.6	2.8
2010	6	441.6	113.5	555.1	360.5	194.6	55.5	215.9	96.5	312.4	-173.3	310.7	0.0	5.0	0.4	0.5
2011	7	445.5	115.3	560.8	361.5	199.2	56.1	263.0	114.9	377.9	-234.8	277.9	0.0	-507.5	0.4	-1.0
2012	8	449.4	117.1	566.5	362.6	203.9	56.6	317.2	231.0	548.2	-401.0	328.0	0.0	-1,256.7	0.3	-2.0
2013	9	453.4	118.9	572.3	363.7	208.6	57.2	345.9	290.0	635.9	-484.5	247.0	0.0	-2,038.4	0.2	-3.0
2014	10	457.4	120.8	578.1	364.8	213.4	57.8	381.4	322.5	703.9	-548.4	286.8	0.0	-2,955.1	0.2	-4.0
2015	11	461.4	122.7	584.0	365.8	218.2	58.4	408.9	376.2	785.0	-625.2	261.7	0.0	-3,960.2	0.2	-4.8
2016	12	465.4	124.6	590.0	366.9	223.1	59.0	437.0	434.0	871.0	-706.9	276.2	0.0	-5,101.7	0.2	-5.7
2017	13	469.5	126.5	596.1	368.0	228.1	59.6	472.0	513.9	985.9	-817.4	301.4	0.0	-6,424.5	0.2	-6.3
2018	14	473.6	128.5	602.2	369.1	233.1	60.2	491.4	576.1	1,067.5	-894.6	281.2	0.0	-7,857.3	0.2	-7.2
2019	15	477.8	130.5	608.3	370.1	238.2	60.8	502.3	583.5	1,085.7	-908.3	252.3	0.0	-9,332.2	0.2	-8.4
2020	16	637.0	132.6	769.6	525.8	243.8	77.0	459.5	620.5	1,080.0	-913.1	0.0	0.0	-10,618.6	0.2	-9.7
2021	17	642.7	133.6	776.3	528.3	248.0	77.6	415.1	593.4	1,008.4	-838.1	0.0	0.0	-11,881.4	0.2	-11.6
2022	18	648.4	134.6	783.0	530.8	252.3	78.3	371.8	595.2	967.0	-793.0	0.0	0.0	-13,149.7	0.2	-13.4
2023	19	654.2	135.6	789.8	533.2	256.6	79.0	328.2	601.9	930.1	-752.5	0.0	0.0	-14,428.2	0.2	-15.3
2024	20	660.0	136.7	796.7	535.7	260.9	79.7	284.4	588.0	872.4	-691.1	0.0	0.0	-15,696.5	0.2	-17.8
2025	21	665.9	137.7	803.6	538.2	265.4	80.4	241.8	555.3	797.1	-612.1	0.0	0.0	-16,936.5	0.2	-21.0
2026	22	671.8	138.8	810.5	540.7	269.9	81.1	202.0	513.5	715.4	-526.6	0.0	0.0	-18,140.5	0.3	-25.1
2027	23	677.8	139.8	817.6	543.2	274.4	81.8	165.4	459.6	625.0	-432.3	0.0	0.0	-19,298.5	0.3	-30.6
2028	24	683.8	140.9	824.7	545.6	279.0	82.5	132.7	406.8	539.5	-342.9	0.0	0.0	-20,413.4	0.4	-37.5
2029	25	689.9	141.9	831.8	548.1	283.7	83.2	104.3	328.5	432.9	-232.3	0.0	0.0	-21,462.2	0.5	-49.1
2030	26	696.0	143.0	839.1	550.6	288.5	83.9	81.1	280.0	361.0	-156.5	0.0	0.0	-22,477.2	0.6	-61.7
2031	27	702.2	144.1	846.3	553.1	293.3	84.6	61.4	229.9	291.3	-82.7	0.0	0.0	-23,459.0	0.7	-79.8
2032	28	708.5	145.2	853.7	555.6	298.1	85.4	45.4	187.9	233.2	-20.5	0.0	0.0	-24,417.8	0.9	-103.8
2033	29	714.8	146.3	861.1	558.0	303.1	86.1	32.3	151.2	183.6	33.4	0.0	0.0	-25,361.2	1.2	-137.0
2034	30	721.1	147.4	868.6	560.5	308.0	86.9	22.1	114.0	136.1	85.1	0.0	0.0	-26,290.6	--	--
2035	31	727.6	148.5	876.1	563.0	313.1	87.6	14.4	90.9	105.3	120.2	0.0	0.0	-27,222.0	--	--
2036	32	734.0	149.7	883.7	565.5	318.2	88.4	8.3	67.4	75.7	154.1	0.0	0.0	-28,156.7	--	--
2037	33	740.6	150.8	891.4	568.0	323.4	89.1	3.9	44.7	48.6	185.7	0.0	0.0	-29,097.3	--	--
2038	34	747.2	152.0	899.1	570.4	328.7	89.9	1.1	20.9	22.0	216.7	0.0	0.0	-30,044.5	--	--
2039	35	753.8	153.1	906.9	572.9	334.0	90.7	0.0	0.0	0.0	243.3	0.0	0.0	-31,002.9	--	--
2040	36	760.5	154.3	914.8	575.4	339.4	91.5	0.0	0.0	0.0	247.9	0.0	0.0	-31,995.1	--	--
2041	37	767.3	155.5	922.7	577.9	344.9	92.3	0.0	0.0	0.0	252.6	0.0	0.0	-33,022.3	--	--
2042	38	774.1	156.6	930.8	580.4	350.4	93.1	0.0	0.0	0.0	257.3	0.0	0.0	-34,085.9	--	--

Table 6-19 (continued)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2043	39	781.0	157.8	938.8	582.8	356.0	93.9	0.0	0.0	0.0	262.1	0.0	0.0	-35,187.2	--	--
2044	40	788.0	159.0	947.0	585.3	361.7	94.7	0.0	0.0	0.0	267.0	0.0	0.0	-36,327.8	--	--
2045	41	795.0	160.2	955.2	587.8	367.4	95.5	0.0	0.0	0.0	271.9	0.0	0.0	-37,509.0	--	--
2046	42	802.1	161.4	963.5	590.3	373.2	96.3	0.0	0.0	0.0	276.9	0.0	0.0	-38,732.5	--	--
2047	43	809.2	162.7	971.9	592.8	379.1	97.2	0.0	0.0	0.0	281.9	0.0	0.0	-39,999.9	--	--
2048	44	816.4	163.9	980.3	595.2	385.1	98.0	0.0	0.0	0.0	287.0	0.0	0.0	-41,312.8	--	--
2049	45	823.7	165.2	988.8	597.7	391.1	98.9	0.0	0.0	0.0	292.2	0.0	0.0	-42,673.1	--	--
2050	46	831.0	166.4	997.4	600.2	397.2	99.7	0.0	0.0	0.0	297.5	0.0	0.0	-44,082.6	--	--
2051	47	838.4	167.7	1,006.1	602.7	403.4	100.6	0.0	0.0	0.0	302.8	0.0	0.0	-45,543.1	--	--
2052	48	845.8	169.0	1,014.8	605.2	409.6	101.5	0.0	0.0	0.0	308.2	0.0	0.0	-47,056.7	--	--
2053	49	853.4	170.2	1,023.6	607.6	416.0	102.4	0.0	0.0	0.0	313.6	0.0	0.0	-48,625.3	--	--
2054	50	861.0	171.5	1,032.5	610.1	422.4	103.3	0.0	0.0	0.0	319.1	0.0	0.0	-50,251.2	--	--
2055	51	868.6	172.8	1,041.5	612.6	428.9	104.1	0.0	0.0	0.0	324.7	0.0	0.0	-51,936.5	--	--
2056	52	876.4	174.1	1,050.5	615.1	435.4	105.1	0.0	0.0	0.0	330.4	0.0	0.0	-53,683.6	--	--
2057	53	884.2	175.5	1,059.6	617.6	442.1	106.0	0.0	0.0	0.0	336.1	0.0	0.0	-55,494.8	--	--
2058	54	892.0	176.8	1,068.8	620.0	448.8	106.9	0.0	0.0	0.0	341.9	0.0	0.0	-57,372.7	--	--
2059	55	900.0	178.1	1,078.1	622.5	455.6	107.8	0.0	0.0	0.0	347.8	0.0	0.0	-59,319.8	--	--
2060	56	908.0	179.5	1,087.5	625.0	462.5	108.8	0.0	0.0	0.0	353.8	0.0	0.0	-61,338.9	--	--
	Total	40,158.1	8,611.7	48,769.9	30,790.0	17,979.9	4,877.0	7,017.8	10,063.9	17,081.7	-3,978.8	3,455.5	0.0			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-20. Sea-Level Canal Case A: Financial Analysis, 2004-2060 Assuming a Panama Canal Authority and Existing Panama Canal Tolls (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2004							59.2	59.2
2005	1	172.6	172.6	0.0	84.5	-84.5	55.9	-28.6
2006	2	176.9	176.9	0.0	87.1	-87.1	47.8	-39.3
2007	3	181.2	181.2	0.0	83.0	-83.0	215.2	132.2
2008	4	185.6	185.6	0.0	329.1	-329.1	1,713.2	1,384.1
2009	5	190.1	190.1	0.0	2,205.4	-2,205.4	749.1	-1,456.3
2010	6	194.6	194.6	0.0	1,277.9	-1,277.9	428.2	-849.7
2011	7	199.2	199.2	0.0	1,018.5	-1,018.5	502.0	-516.5
2012	8	203.9	203.9	0.0	1,207.9	-1,207.9	74.0	-1,133.9
2013	9	208.6	208.6	0.0	869.1	-869.1	137.5	-731.6
2014	10	213.4	213.4	0.0	1,060.1	-1,060.1	-1.5	-1,061.6
2015	11	218.2	218.2	0.0	964.1	-964.1	-15.0	-979.1
2016	12	223.1	223.1	0.0	1,046.2	-1,046.2	68.9	-977.3
2017	13	228.1	228.1	0.0	1,241.2	-1,241.2	-196.5	-1,437.7
2018	14	233.1	233.1	0.0	1,070.6	-1,070.6	-345.1	-1,415.7
2019	15	238.2	238.2	0.0	974.7	-974.7	-1,085.7	-2,060.4
2020	16	243.8	243.4	0.4	0.0	0.4	-1,080.0	-1,079.6
2021	17	248.0	245.7	2.3	0.0	2.3	-1,008.4	-1,006.1
2022	18	252.3	248.0	4.3	0.0	4.3	-967.0	-962.7
2023	19	256.6	250.3	6.3	0.0	6.3	-930.1	-923.8
2024	20	260.9	252.6	8.3	0.0	8.3	-872.4	-864.1
2025	21	265.4	255.0	10.4	0.0	10.4	-797.1	-786.7
2026	22	269.9	257.3	12.5	0.0	12.5	-715.4	-702.9
2027	23	274.4	259.7	14.7	0.0	14.7	-625.0	-610.3
2028	24	279.0	262.1	16.9	0.0	16.9	-539.5	-522.6
2029	25	283.7	264.6	19.1	0.0	19.1	-432.9	-413.7
2030	26	288.5	267.0	21.4	0.0	21.4	-361.0	-339.6
2031	27	293.3	269.5	23.7	0.0	23.7	-291.3	-267.6
2032	28	298.1	272.0	26.1	0.0	26.1	-233.2	-207.1
2033	29	303.1	274.5	28.5	0.0	28.5	-183.6	-155.0
2034	30	308.0	277.1	31.0	0.0	31.0	-136.1	-105.1
2035	31	313.1	279.6	33.5	0.0	33.5	-105.3	-71.8
2036	32	318.2	282.2	36.0	0.0	36.0	-75.7	-39.7
2037	33	323.4	284.8	38.6	0.0	38.6	-48.6	-10.0
2038	34	328.7	287.5	41.2	0.0	41.2	-22.0	19.2
2039	35	334.0	290.1	43.9	0.0	43.9	0.0	43.9
2040	36	339.4	292.8	46.6	0.0	46.6	0.0	46.6
2041	37	344.9	295.5	49.4	0.0	49.4	0.0	49.4
2042	38	350.4	298.2	52.2	0.0	52.2	0.0	52.2
2043	39	356.0	301.0	55.0	0.0	55.0	0.0	55.0
2044	40	361.7	303.7	57.9	0.0	57.9	0.0	57.9
2045	41	367.4	306.5	60.9	0.0	60.9	0.0	60.9
2046	42	373.2	309.3	63.9	0.0	63.9	0.0	63.9

Table 6-20 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2047	43	379.1	312.2	66.9	0.0	66.9	0.0	66.9
2048	44	385.1	315.0	70.0	0.0	70.0	0.0	70.0
2049	45	391.1	317.9	73.2	0.0	73.2	0.0	73.2
2050	46	397.2	320.8	76.4	0.0	76.4	0.0	76.4
2051	47	403.4	323.8	79.6	0.0	79.6	0.0	79.6
2052	48	409.6	326.7	82.9	0.0	82.9	0.0	82.9
2053	49	416.0	329.7	86.3	0.0	86.3	0.0	86.3
2054	50	422.4	332.7	89.7	0.0	89.7	0.0	89.7
2055	51	428.9	335.8	93.1	0.0	93.1	0.0	93.1
2056	52	435.4	338.8	96.6	0.0	96.6	0.0	96.6
2057	53	442.1	341.9	100.2	0.0	100.2	0.0	100.2
2058	54	448.8	345.0	103.8	0.0	103.8	0.0	103.8
2059	55	455.6	348.1	107.5	0.0	107.5	0.0	107.5
2060	56	462.5	351.3	111.2	0.0	111.2	0.0	111.2
	Total	17,179.2	15,136.9	2,042.3	13,519.4	-11,477.1		-18,494.9
				Financial Internal Rate of Return:		-5.1%		-7.6%
				Net Present Value at 8 percent discount rate:		-6,802.6		-6,014.3

a/ From Table 6-19.

b/ From Table 6-6.

c/ From Appendix H.

d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-21. Sea-Level Canal Case A: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and a 50 Percent Increase in Tolls (1990 US$ millions)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int.	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2000		411.9	97.1	509.0	349.7	159.3	50.9	0.0	0.0	0.0	108.4	0.0	0.0	108.4	--	--
2001		423.1	98.6	521.7	350.8	170.9	52.2	0.0	0.0	0.0	118.7	0.0	0.0	231.4	--	--
2002		434.5	100.2	534.7	351.9	182.8	53.5	0.0	0.0	0.0	129.3	0.0	0.0	370.0	--	--
2003		446.2	101.7	548.0	353.0	195.0	54.8	0.0	0.0	0.0	140.2	0.0	0.0	525.0	--	--
2004		458.3	103.3	561.6	354.0	207.6	56.2	0.0	0.0	0.0	151.4	0.0	0.0	697.5	--	--
2005	1	470.7	105.0	575.6	355.1	220.5	57.6	4.4	0.7	5.1	157.9	25.4	0.0	857.9	32.0	200.4
2006	2	483.4	106.6	590.0	356.2	233.8	59.0	8.8	1.5	10.3	164.5	26.1	0.0	1,030.6	17.0	117.1
2007	3	496.4	108.3	604.7	357.2	247.5	60.5	13.0	2.2	15.2	171.8	24.9	0.0	1,218.7	12.3	92.5
2008	4	509.8	110.0	619.8	358.3	261.5	62.0	29.9	5.0	34.9	164.6	98.7	0.0	1,333.4	5.7	44.0
2009	5	523.6	111.7	635.3	359.4	275.9	63.5	151.5	66.6	218.2	-5.8	457.3	0.0	923.6	1.0	5.2
2010	6	537.7	113.5	651.2	360.5	290.7	65.1	215.9	96.5	312.4	-86.8	310.7	0.0	563.1	0.7	2.5
2011	7	552.3	115.3	667.5	361.5	306.0	66.8	263.0	114.9	377.9	-138.7	277.9	0.0	169.0	0.6	1.1
2012	8	567.2	117.1	684.2	362.6	321.6	68.4	317.2	231.0	548.2	-295.0	328.0	0.0	-447.2	0.5	-0.4
2013	9	582.5	118.9	701.4	363.7	337.7	70.1	345.9	290.0	635.9	-368.3	247.0	0.0	-1,080.3	0.4	-1.3
2014	10	598.2	120.8	719.0	364.8	354.2	71.9	381.4	322.5	703.9	-421.6	286.8	0.0	-1,831.9	0.4	-2.2
2015	11	614.4	122.7	737.1	365.8	371.2	73.7	408.9	376.2	785.0	-487.5	261.7	0.0	-2,654.3	0.4	-3.0
2016	12	631.0	124.6	755.6	366.9	388.7	75.6	437.0	434.0	871.0	-557.9	276.2	0.0	-3,594.5	0.4	-3.8
2017	13	648.0	126.5	774.6	368.0	406.6	77.5	472.0	513.9	985.9	-656.7	301.4	0.0	-4,696.4	0.3	-4.4
2018	14	665.5	128.5	794.1	369.1	425.0	79.4	491.4	576.1	1,067.5	-721.9	281.2	0.0	-5,887.3	0.3	-5.2
2019	15	683.5	130.5	814.1	370.1	443.9	81.4	502.3	583.5	1,085.7	-723.2	252.3	0.0	-7,098.3	0.3	-6.2
2020	16	938.0	132.6	1,070.6	525.8	544.8	107.1	459.5	620.5	1,080.0	-642.2	0.0	0.0	-8,024.5	0.4	-7.0
2021	17	946.3	133.6	1,079.9	528.3	551.6	108.0	415.1	593.4	1,008.4	-564.8	0.0	0.0	-8,910.2	0.4	-8.4
2022	18	954.7	134.6	1,089.3	530.8	558.6	108.9	371.8	595.2	967.0	-517.4	0.0	0.0	-9,784.0	0.5	-9.7
2023	19	963.2	135.6	1,098.8	533.2	565.6	109.9	328.2	601.9	930.1	-474.4	0.0	0.0	-10,649.8	0.5	-11.0
2024	20	971.7	136.7	1,108.4	535.7	572.7	110.8	284.4	588.0	872.4	-410.6	0.0	0.0	-11,486.4	0.5	-12.6
2025	21	980.3	137.7	1,118.0	538.2	579.8	111.8	241.8	555.3	797.1	-329.1	0.0	0.0	-12,274.9	0.6	-14.8
2026	22	989.0	138.8	1,127.8	540.7	587.1	112.8	202.0	513.5	715.4	-241.1	0.0	0.0	-13,007.1	0.7	-17.5
2027	23	997.8	139.8	1,137.6	543.2	594.4	113.8	165.4	459.6	625.0	-144.3	0.0	0.0	-13,671.7	0.8	-21.1
2028	24	1,006.6	140.9	1,147.5	545.6	601.8	114.7	132.7	406.8	539.5	-52.4	0.0	0.0	-14,271.0	0.9	-25.5
2029	25	1,015.5	141.9	1,157.5	548.1	609.4	115.7	104.3	328.5	432.9	60.7	0.0	0.0	-14,781.1	1.1	-33.0
2030	26	1,024.5	143.0	1,167.5	550.6	616.9	116.8	81.1	280.0	361.0	139.2	0.0	0.0	-15,233.1	1.4	-40.8
2031	27	1,033.6	144.1	1,177.7	553.1	624.6	117.8	61.4	229.9	291.3	215.5	0.0	0.0	-15,626.9	1.7	-51.9
2032	28	1,042.8	145.2	1,188.0	555.6	632.4	118.8	45.4	187.9	233.2	280.4	0.0	0.0	-15,971.6	2.2	-66.3
2033	29	1,052.0	146.3	1,198.3	558.0	640.3	119.8	32.3	151.2	183.6	336.9	0.0	0.0	-16,273.6	2.8	-85.8
2034	30	1,061.3	147.4	1,208.7	560.5	648.2	120.9	22.1	114.0	136.1	391.2	0.0	0.0	-16,533.3	--	--
2035	31	1,070.7	148.5	1,219.3	563.0	656.3	121.9	14.4	90.9	105.3	429.0	0.0	0.0	-16,765.6	--	--
2036	32	1,080.2	149.7	1,229.9	565.5	664.4	123.0	8.3	67.4	75.7	465.7	0.0	0.0	-16,970.5	--	--
2037	33	1,089.8	150.8	1,240.6	568.0	672.6	124.1	3.9	44.7	48.6	500.0	0.0	0.0	-17,149.3	--	--
2038	34	1,099.4	152.0	1,251.4	570.4	681.0	125.1	1.1	20.9	22.0	533.8	0.0	0.0	-17,301.5	--	--
2039	35	1,109.2	153.1	1,262.3	572.9	689.4	126.2	0.0	0.0	0.0	563.2	0.0	0.0	-17,430.4	--	--
2040	36	1,119.0	154.3	1,273.3	575.4	697.9	127.3	0.0	0.0	0.0	570.6	0.0	0.0	-17,557.1	--	--
2041	37	1,128.9	155.5	1,284.4	577.9	706.5	128.4	0.0	0.0	0.0	578.1	0.0	0.0	-17,681.3	--	--
2042	38	1,138.9	156.6	1,295.6	580.4	715.2	129.6	0.0	0.0	0.0	585.7	0.0	0.0	-17,802.9	--	--

Table 6-21 (continued)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2043	39	1,149.0	157.8	1,306.9	582.8	724.0	130.7	0.0	0.0	0.0	593.3	0.0	0.0	-17,921.7	--	--
2044	40	1,159.2	159.0	1,318.2	585.3	732.9	131.8	0.0	0.0	0.0	601.1	0.0	0.0	-18,037.4	--	--
2045	41	1,169.5	160.2	1,329.7	587.8	741.9	133.0	0.0	0.0	0.0	608.9	0.0	0.0	-18,150.0	--	--
2046	42	1,179.9	161.4	1,341.3	590.3	751.0	134.1	0.0	0.0	0.0	616.9	0.0	0.0	-18,259.1	--	--
2047	43	1,190.3	162.7	1,353.0	592.8	760.2	135.3	0.0	0.0	0.0	624.9	0.0	0.0	-18,364.5	--	--
2048	44	1,200.9	163.9	1,364.8	595.2	769.5	136.5	0.0	0.0	0.0	633.1	0.0	0.0	-18,466.1	--	--
2049	45	1,211.5	165.2	1,376.7	597.7	778.9	137.7	0.0	0.0	0.0	641.3	0.0	0.0	-18,563.4	--	--
2050	46	1,222.2	166.4	1,388.7	600.2	788.5	138.9	0.0	0.0	0.0	649.6	0.0	0.0	-18,656.4	--	--
2051	47	1,233.1	167.7	1,400.7	602.7	798.1	140.1	0.0	0.0	0.0	658.0	0.0	0.0	-18,744.7	--	--
2052	48	1,244.0	169.0	1,412.9	605.2	807.8	141.3	0.0	0.0	0.0	666.5	0.0	0.0	-18,827.9	--	--
2053	49	1,255.0	170.2	1,425.3	607.6	817.6	142.5	0.0	0.0	0.0	675.1	0.0	0.0	-18,906.0	--	--
2054	50	1,266.1	171.5	1,437.7	610.1	827.6	143.8	0.0	0.0	0.0	683.8	0.0	0.0	-18,978.4	--	--
2055	51	1,277.4	172.8	1,450.2	612.6	837.6	145.0	0.0	0.0	0.0	692.6	0.0	0.0	-19,045.0	--	--
2056	52	1,288.7	174.1	1,462.8	615.1	847.8	146.3	0.0	0.0	0.0	701.5	0.0	0.0	-19,105.3	--	--
2057	53	1,300.1	175.5	1,475.6	617.6	858.0	147.6	0.0	0.0	0.0	710.5	0.0	0.0	-19,159.1	--	--
2058	54	1,311.6	176.8	1,488.4	620.0	868.4	148.8	0.0	0.0	0.0	719.5	0.0	0.0	-19,205.9	--	--
2059	55	1,323.2	178.1	1,501.4	622.5	878.9	150.1	0.0	0.0	0.0	728.7	0.0	0.0	-19,245.4	--	--
2060	56	1,335.0	179.5	1,514.5	625.0	889.5	151.5	0.0	0.0	0.0	738.1	0.0	0.0	-19,277.2	--	--
	Total	56,868.5	8,611.7	65,480.2	30,790.0	34,690.2	6,548.0	7,017.8	10,063.9	17,081.7	11,060.6	3,455.5	0.0			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-22. Sea-Level Canal Case A: Financial Analysis, 2004-2060 Assuming a Panama Canal Authority and a 50 Percent Increase in Tolls (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2004							59.2	59.2
2005	1	220.5	172.6	47.9	84.5	-36.6	55.9	19.3
2006	2	233.8	176.9	56.9	87.1	-30.2	47.8	17.6
2007	3	247.5	181.2	66.2	83.0	-16.8	215.2	198.4
2008	4	261.5	185.6	75.9	329.1	-253.2	1,713.2	1,460.0
2009	5	275.9	190.1	85.8	2,205.4	-2,119.6	749.1	-1,370.5
2010	6	290.7	194.6	96.1	1,277.9	-1,181.8	428.2	-753.6
2011	7	306.0	199.2	106.8	1,018.5	-911.7	502.0	-409.7
2012	8	321.6	203.9	117.8	1,207.9	-1,090.1	74.0	-1,016.2
2013	9	337.7	208.6	129.1	869.1	-740.0	137.5	-602.5
2014	10	354.2	213.4	140.9	1,060.1	-919.2	-1.5	-920.7
2015	11	371.2	218.2	153.0	964.1	-811.1	-15.0	-826.1
2016	12	388.7	223.1	165.6	1,046.2	-880.6	68.9	-811.8
2017	13	406.6	228.1	178.5	1,241.2	-1,062.7	-196.5	-1,259.2
2018	14	425.0	233.1	191.9	1,070.6	-878.7	-345.1	-1,223.8
2019	15	443.9	238.2	205.7	974.7	-769.0	-1,085.7	-1,854.7
2020	16	544.8	243.4	301.4	0.0	301.4	-1,080.0	-778.6
2021	17	551.6	245.7	306.0	0.0	306.0	-1,008.4	-702.5
2022	18	558.6	248.0	310.6	0.0	310.6	-967.0	-656.4
2023	19	565.6	250.3	315.3	0.0	315.3	-930.1	-614.8
2024	20	572.7	252.6	320.0	0.0	320.0	-872.4	-552.4
2025	21	579.8	255.0	324.9	0.0	324.9	-797.1	-472.3
2026	22	587.1	257.3	329.7	0.0	329.7	-715.4	-385.7
2027	23	594.4	259.7	334.7	0.0	334.7	-625.0	-290.3
2028	24	601.8	262.1	339.7	0.0	339.7	-539.5	-199.8
2029	25	609.4	264.6	344.8	0.0	344.8	-432.9	-88.1
2030	26	616.9	267.0	349.9	0.0	349.9	-361.0	-11.1
2031	27	624.6	269.5	355.1	0.0	355.1	-291.3	63.8
2032	28	632.4	272.0	360.4	0.0	360.4	-233.2	127.2
2033	29	640.3	274.5	365.7	0.0	365.7	-183.6	182.2
2034	30	648.2	277.1	371.2	0.0	371.2	-136.1	235.0
2035	31	656.3	279.6	376.6	0.0	376.6	-105.3	271.3
2036	32	664.4	282.2	382.2	0.0	382.2	-75.7	306.5
2037	33	672.6	284.8	387.8	0.0	387.8	-48.6	339.2
2038	34	681.0	287.5	393.5	0.0	393.5	-22.0	371.5
2039	35	689.4	290.1	399.3	0.0	399.3	0.0	399.3
2040	36	697.9	292.8	405.1	0.0	405.1	0.0	405.1
2041	37	706.5	295.5	411.0	0.0	411.0	0.0	411.0
2042	38	715.2	298.2	417.0	0.0	417.0	0.0	417.0
2043	39	724.0	301.0	423.0	0.0	423.0	0.0	423.0
2044	40	732.9	303.7	429.2	0.0	429.2	0.0	429.2
2045	41	741.9	306.5	435.4	0.0	435.4	0.0	435.4
2046	42	751.0	309.3	441.7	0.0	441.7	0.0	441.7

Table 6-22 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2047	43	760.2	312.2	448.0	0.0	448.0	0.0	448.0
2048	44	769.5	315.0	454.5	0.0	454.5	0.0	454.5
2049	45	778.9	317.9	461.0	0.0	461.0	0.0	461.0
2050	46	788.5	320.8	467.6	0.0	467.6	0.0	467.6
2051	47	798.1	323.8	474.3	0.0	474.3	0.0	474.3
2052	48	807.8	326.7	481.0	0.0	481.0	0.0	481.0
2053	49	817.6	329.7	487.9	0.0	487.9	0.0	487.9
2054	50	827.6	332.7	494.8	0.0	494.8	0.0	494.8
2055	51	837.6	335.8	501.8	0.0	501.8	0.0	501.8
2056	52	847.8	338.8	508.9	0.0	508.9	0.0	508.9
2057	53	858.0	341.9	516.1	0.0	516.1	0.0	516.1
2058	54	868.4	345.0	523.4	0.0	523.4	0.0	523.4
2059	55	878.9	348.1	530.7	0.0	530.7	0.0	530.7
2060	56	889.5	351.3	538.2	0.0	538.2	0.0	538.2
	Total	33,774.7	15,136.9	18,637.7	13,519.4	5,118.3		-1,899.4
				Financial Internal Rate of Return:		1.3%		-0.5%
				Net Present Value at 8 percent discount rate:		-4,648.1		-4,019.4

a/ From Table 6-21.
b/ From Table 6-6.
c/ From Appendix H.
d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-23. Sea-Level Canal Case A: Estimated Net Income After Debt Service, 2000-2060 Assuming a Panama Canal Authority and an Optimal Toll System (1990 US$ millions)

Year	Project Year	Revenues			Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/			Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund			Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
		Tolls a/	Other b/	Total				Int	Princ.	Total		Contribution to Capital Costs f/	Dividend Distributions g/	Trust Fund Balance h/		
2000		417.6	97.1	514.7	349.7	164.9	51.5	0.0	0.0	0.0	113.5	0.0	0.0	113.5	--	--
2001		434.7	98.6	533.4	350.8	182.6	53.3	0.0	0.0	0.0	129.2	0.0	0.0	247.2	--	--
2002		452.6	100.2	552.8	351.9	200.9	55.3	0.0	0.0	0.0	145.6	0.0	0.0	402.7	--	--
2003		471.2	101.7	572.9	353.0	220.0	57.3	0.0	0.0	0.0	162.7	0.0	0.0	581.5	--	--
2004		490.5	103.3	593.9	354.0	239.9	59.4	0.0	0.0	0.0	180.5	0.0	0.0	785.3	--	--
2005	1	510.7	105.0	615.7	355.1	260.6	61.6	4.4	0.7	5.1	193.9	25.4	0.0	985.3	39.1	232.5
2006	2	531.7	106.6	638.3	356.2	282.1	63.8	8.8	1.5	10.3	208.0	26.1	0.0	1,206.5	21.2	138.4
2007	3	553.5	108.3	661.8	357.2	304.6	66.2	13.0	2.2	15.2	223.2	24.9	0.0	1,453.1	15.7	111.4
2008	4	576.3	110.0	686.3	358.3	327.9	68.6	29.9	5.0	34.9	224.4	98.7	0.0	1,636.9	7.4	54.4
2009	5	599.9	111.7	711.7	359.4	352.3	71.2	151.5	66.6	218.2	62.9	457.3	0.0	1,308.0	1.3	7.3
2010	6	624.6	113.5	738.1	360.5	377.6	73.8	215.9	96.5	312.4	-8.6	310.7	0.0	1,041.0	1.0	4.3
2011	7	650.3	115.3	765.5	361.5	404.0	76.6	263.0	114.9	377.9	-50.5	277.9	0.0	754.3	0.9	2.9
2012	8	677.0	117.1	794.0	362.6	431.4	79.4	317.2	231.0	548.2	-196.2	328.0	0.0	260.3	0.6	1.1
2013	9	704.8	118.9	823.7	363.7	460.0	82.4	345.9	290.0	635.9	-258.2	247.0	0.0	-234.5	0.6	0.2
2014	10	733.7	120.8	854.5	364.8	489.7	85.5	381.4	322.5	703.9	-299.6	286.8	0.0	-830.3	0.6	-0.6
2015	11	763.9	122.7	886.5	365.8	520.7	88.7	408.9	376.2	785.0	-353.0	261.7	0.0	-1,478.1	0.6	-1.3
2016	12	795.3	124.6	919.9	366.9	552.9	92.0	437.0	434.0	871.0	-410.0	276.2	0.0	-2,223.4	0.5	-2.0
2017	13	827.9	126.5	954.5	368.0	586.5	95.4	472.0	513.9	985.9	-494.8	301.4	0.0	-3,108.5	0.5	-2.7
2018	14	862.0	128.5	990.5	369.1	621.4	99.0	491.4	576.1	1,067.5	-545.1	281.2	0.0	-4,059.2	0.5	-3.3
2019	15	897.4	130.5	1,027.9	370.1	657.8	102.8	502.3	583.5	1,085.7	-530.7	252.3	0.0	-5,004.6	0.5	-4.1
2020	16	1,221.0	132.6	1,353.6	525.8	827.8	135.4	459.5	620.5	1,080.0	-387.5	0.0	0.0	-5,592.3	0.6	-4.5
2021	17	1,232.1	133.6	1,365.7	528.3	837.4	136.6	415.1	593.4	1,008.4	-307.6	0.0	0.0	-6,123.6	0.7	-5.4
2022	18	1,243.3	134.6	1,377.9	530.8	847.2	137.8	371.8	595.2	967.0	-257.6	0.0	0.0	-6,626.1	0.7	-6.1
2023	19	1,254.6	135.6	1,390.3	533.2	857.0	139.0	328.2	601.9	930.1	-212.1	0.0	0.0	-7,103.3	0.8	-6.9
2024	20	1,266.0	136.7	1,402.7	535.7	867.0	140.3	284.4	588.0	872.4	-145.7	0.0	0.0	-7,533.1	0.8	-7.8
2025	21	1,277.6	137.7	1,415.3	538.2	877.1	141.5	241.8	555.3	797.1	-61.6	0.0	0.0	-7,896.0	0.9	-9.0
2026	22	1,289.2	138.8	1,427.9	540.7	887.3	142.8	202.0	513.5	715.4	29.0	0.0	0.0	-8,182.8	1.0	-10.4
2027	23	1,300.9	139.8	1,440.7	543.2	897.6	144.1	165.4	459.6	625.0	128.5	0.0	0.0	-8,381.6	1.2	-12.2
2028	24	1,312.7	140.9	1,453.6	545.6	908.0	145.4	132.7	406.8	539.5	223.1	0.0	0.0	-8,493.7	1.4	-14.3
2029	25	1,324.7	141.9	1,466.6	548.1	918.5	146.7	104.3	328.5	432.9	339.0	0.0	0.0	-8,494.5	1.8	-17.8
2030	26	1,336.7	143.0	1,479.8	550.6	929.2	148.0	81.1	280.0	361.0	420.2	0.0	0.0	-8,414.1	2.2	-21.1
2031	27	1,348.9	144.1	1,493.0	553.1	939.9	149.3	61.4	229.9	291.3	499.3	0.0	0.0	-8,251.4	2.7	-25.6
2032	28	1,361.2	145.2	1,506.4	555.6	950.8	150.6	45.4	187.9	233.2	566.9	0.0	0.0	-8,014.5	3.4	-30.9
2033	29	1,373.5	146.3	1,519.9	558.0	961.8	152.0	32.3	151.2	183.6	626.3	0.0	0.0	-7,708.8	4.4	-37.6
2034	30	1,386.0	147.4	1,533.5	560.5	972.9	153.3	22.1	114.0	136.1	683.5	0.0	0.0	-7,333.7	--	--
2035	31	1,398.7	148.5	1,547.2	563.0	984.2	154.7	14.4	90.9	105.3	724.2	0.0	0.0	-6,902.9	--	--
2036	32	1,411.4	149.7	1,561.1	565.5	995.6	156.1	8.3	67.4	75.7	763.8	0.0	0.0	-6,415.2	--	--
2037	33	1,424.2	150.8	1,575.0	568.0	1,007.1	157.5	3.9	44.7	48.6	801.0	0.0	0.0	-5,870.9	--	--
2038	34	1,437.2	152.0	1,589.1	570.4	1,018.7	158.9	1.1	20.9	22.0	837.7	0.0	0.0	-5,268.0	--	--
2039	35	1,450.2	153.1	1,603.4	572.9	1,030.4	160.3	0.0	0.0	0.0	870.1	0.0	0.0	-4,608.6	--	--
2040	36	1,463.4	154.3	1,617.7	575.4	1,042.3	161.8	0.0	0.0	0.0	880.5	0.0	0.0	-3,912.4	--	--
2041	37	1,476.7	155.5	1,632.2	577.9	1,054.3	163.2	0.0	0.0	0.0	891.1	0.0	0.0	-3,177.8	--	--
2042	38	1,490.2	156.6	1,646.8	580.4	1,066.5	164.7	0.0	0.0	0.0	901.8	0.0	0.0	-2,403.1	--	--

Table 6-23 (continued)

Year	Project Year	Revenues: Tolls a/	Revenues: Other b/	Revenues: Total	Oper. & Maint. c/	Net Income from Operations	Payment to Panama d/	Debt Service Requirements e/: Int.	Debt Service Requirements e/: Princ.	Debt Service Requirements e/: Total	Net Income After Debt Service and Payment to Panama	Toll Reserve Trust Fund: Contribution to Capital Costs f/	Toll Reserve Trust Fund: Dividend Distributions g/	Toll Reserve Trust Fund: Trust Fund Balance h/	Current Debt Service Coverage Ratio i/	Overall Debt Service Coverage Ratio j/
2043	39	1,503.7	157.8	1,661.6	582.8	1,078.7	166.2	0.0	0.0	0.0	912.6	0.0	0.0	-1,586.7	--	--
2044	40	1,517.4	159.0	1,676.4	585.3	1,091.1	167.6	0.0	0.0	0.0	923.5	0.0	0.0	-726.7	--	--
2045	41	1,531.2	160.2	1,691.5	587.8	1,103.7	169.1	0.0	0.0	0.0	934.5	0.0	0.0	178.8	--	--
2046	42	1,545.2	161.4	1,706.6	590.3	1,116.3	170.7	0.0	0.0	0.0	945.7	0.0	0.0	1,131.6	--	--
2047	43	1,559.2	162.7	1,721.9	592.8	1,129.1	172.2	0.0	0.0	0.0	956.9	0.0	1,588.5	545.3	--	--
2048	44	1,573.4	163.9	1,737.3	595.2	1,142.1	173.7	0.0	0.0	0.0	968.3	0.0	1,013.6	521.8	--	--
2049	45	1,587.7	165.2	1,752.9	597.7	1,155.1	175.3	0.0	0.0	0.0	979.9	0.0	1,001.7	520.9	--	--
2050	46	1,602.1	166.4	1,768.6	600.2	1,168.4	176.9	0.0	0.0	0.0	991.5	0.0	1,012.4	520.8	--	--
2051	47	1,616.7	167.7	1,784.4	602.7	1,181.7	178.4	0.0	0.0	0.0	1,003.3	0.0	1,024.1	520.8	--	--
2052	48	1,631.4	169.0	1,800.4	605.2	1,195.2	180.0	0.0	0.0	0.0	1,015.2	0.0	1,036.0	520.8	--	--
2053	49	1,646.3	170.2	1,816.5	607.6	1,208.9	181.7	0.0	0.0	0.0	1,027.2	0.0	1,048.1	520.8	--	--
2054	50	1,661.2	171.5	1,832.8	610.1	1,222.7	183.3	0.0	0.0	0.0	1,039.4	0.0	1,060.2	520.8	--	--
2055	51	1,676.4	172.8	1,849.2	612.6	1,236.6	184.9	0.0	0.0	0.0	1,051.7	0.0	1,072.5	520.8	--	--
2056	52	1,691.6	174.1	1,865.8	615.1	1,250.7	186.6	0.0	0.0	0.0	1,064.1	0.0	1,084.9	520.8	--	--
2057	53	1,707.0	175.5	1,882.5	617.6	1,264.9	188.2	0.0	0.0	0.0	1,076.7	0.0	1,097.5	520.8	--	--
2058	54	1,722.5	176.8	1,899.3	620.0	1,279.3	189.9	0.0	0.0	0.0	1,089.4	0.0	1,110.2	520.8	--	--
2059	55	1,738.2	178.1	1,916.3	622.5	1,293.8	191.6	0.0	0.0	0.0	1,102.2	0.0	1,123.0	520.8	--	--
2060	56	1,754.0	179.5	1,933.5	625.0	1,308.5	193.4	0.0	0.0	0.0	1,115.2	0.0	1,136.0	520.8	--	--
	Total	72,921.4	8,611.7	81,533.1	30,790.0	50,743.1	8,153.3	7,017.8	10,063.9	17,081.7	25,508.2	3,455.5	15,408.7			

a/ Toll revenues from Table 6-5.

b/ Estimated from revenues for transit operations and Canal advance reservation service, which total $84.4 million in 1991. Revenues are increased by 1.57 percent annually through 2020 and 0.76 percent annually from 2020 to 2060 in accordance with the growth of total transits.

c/ Operation and maintenance costs from Tables 4-13 and 4-14.

d/ Assumed to be 10 percent of total revenues.

e/ From Appendix I.

f/ From Appendix H.

g/ Current year's net income (if positive) and prior year's cumulative net income in excess of $500 million.

h/ Includes earnings on the prior year's cumulative net income of 4 percent less contributions to capital costs and dividend distributions.

i/ Net income from operations less payments to Panama divided by total debt service requirements.

j/ Net income from operations less payments to Panama plus trust fund balance divided by total debt service requirements.

Table 6-24. Sea-Level Canal Case A: Financial Analysis, 2004-2060 Assuming a Panama Canal Authority and an Optimal Toll System (1990 US$ millions)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2004							59.2	59.2
2005	1	260.6	172.6	88.0	84.5	3.5	55.9	59.4
2006	2	282.1	176.9	105.2	87.1	18.1	47.8	66.0
2007	3	304.6	181.2	123.3	83.0	40.3	215.2	255.5
2008	4	327.9	185.6	142.3	329.1	-186.8	1,713.2	1,526.4
2009	5	352.3	190.1	162.2	2,205.4	-2,043.2	749.1	-1,294.2
2010	6	377.6	194.6	183.0	1,277.9	-1,094.9	428.2	-666.8
2011	7	404.0	199.2	204.7	1,018.5	-813.8	502.0	-311.8
2012	8	431.4	203.9	227.5	1,207.9	-980.4	74.0	-906.4
2013	9	460.0	208.6	251.4	869.1	-617.7	137.5	-480.2
2014	10	489.7	213.4	276.4	1,060.1	-783.7	-1.5	-785.2
2015	11	520.7	218.2	302.5	964.1	-661.6	-15.0	-676.6
2016	12	552.9	223.1	329.8	1,046.2	-716.4	68.9	-647.5
2017	13	586.5	228.1	358.4	1,241.2	-882.8	-196.5	-1,079.3
2018	14	621.4	233.1	388.3	1,070.6	-682.3	-345.1	-1,027.3
2019	15	657.8	238.2	419.6	974.7	-555.1	-1,085.7	-1,640.9
2020	16	827.8	243.4	584.4	0.0	584.4	-1,080.0	-495.6
2021	17	837.4	245.7	591.8	0.0	591.8	-1,008.4	-416.7
2022	18	847.2	248.0	599.2	0.0	599.2	-967.0	-367.8
2023	19	857.0	250.3	606.8	0.0	606.8	-930.1	-323.4
2024	20	867.0	252.6	614.4	0.0	614.4	-872.4	-258.0
2025	21	877.1	255.0	622.1	0.0	622.1	-797.1	-175.0
2026	22	887.3	257.3	629.9	0.0	629.9	-715.4	-85.5
2027	23	897.6	259.7	637.8	0.0	637.8	-625.0	12.9
2028	24	908.0	262.1	645.8	0.0	645.8	-539.5	106.3
2029	25	918.5	264.6	653.9	0.0	653.9	-432.9	221.1
2030	26	929.2	267.0	662.1	0.0	662.1	-361.0	301.1
2031	27	939.9	269.5	670.4	0.0	670.4	-291.3	379.1
2032	28	950.8	272.0	678.8	0.0	678.8	-233.2	445.6
2033	29	961.8	274.5	687.3	0.0	687.3	-183.6	503.7
2034	30	972.9	277.1	695.9	0.0	695.9	-136.1	559.8
2035	31	984.2	279.6	704.6	0.0	704.6	-105.3	599.3
2036	32	995.6	282.2	713.3	0.0	713.3	-75.7	637.6
2037	33	1,007.1	284.8	722.2	0.0	722.2	-48.6	673.6
2038	34	1,018.7	287.5	731.2	0.0	731.2	-22.0	709.2
2039	35	1,030.4	290.1	740.3	0.0	740.3	0.0	740.3
2040	36	1,042.3	292.8	749.5	0.0	749.5	0.0	749.5
2041	37	1,054.3	295.5	758.8	0.0	758.8	0.0	758.8
2042	38	1,066.5	298.2	768.2	0.0	768.2	0.0	768.2
2043	39	1,078.7	301.0	777.8	0.0	777.8	0.0	777.8
2044	40	1,091.1	303.7	787.4	0.0	787.4	0.0	787.4
2045	41	1,103.7	306.5	797.1	0.0	797.1	0.0	797.1
2046	42	1,116.3	309.3	807.0	0.0	807.0	0.0	807.0

Table 6-24 (continued)

Year	Project Year	Net Income from Operations: With Project a/	Net Income from Operations: Without Project b/	Net Income from Operations: Incremental Income	Project Capital Costs c/	Incremental Cash Flow Before Financing	Financing Stream d/	Incremental Cash Flow After Financing
2047	43	1,129.1	312.2	816.9	0.0	816.9	0.0	816.9
2048	44	1,142.1	315.0	827.0	0.0	827.0	0.0	827.0
2049	45	1,155.1	317.9	837.2	0.0	837.2	0.0	837.2
2050	46	1,168.4	320.8	847.5	0.0	847.5	0.0	847.5
2051	47	1,181.7	323.8	857.9	0.0	857.9	0.0	857.9
2052	48	1,195.2	326.7	868.5	0.0	868.5	0.0	868.5
2053	49	1,208.9	329.7	879.1	0.0	879.1	0.0	879.1
2054	50	1,222.7	332.7	889.9	0.0	889.9	0.0	889.9
2055	51	1,236.6	335.8	900.8	0.0	900.8	0.0	900.8
2056	52	1,250.7	338.8	911.9	0.0	911.9	0.0	911.9
2057	53	1,264.9	341.9	923.0	0.0	923.0	0.0	923.0
2058	54	1,279.3	345.0	934.3	0.0	934.3	0.0	934.3
2059	55	1,293.8	348.1	945.7	0.0	945.7	0.0	945.7
2060	56	1,308.5	351.3	957.2	0.0	957.2	0.0	957.2
	Total	49,734.9	15,136.9	34,597.9	13,519.4	21,078.5		14,060.8
				Financial Internal Rate of Return:		4.5%		3.3%
				Net Present Value at 8 percent discount rate:		-2,607.5		-2,130.0

a/ From Table 6-23.
b/ From Table 6-6.
c/ From Appendix H.
d/ Financing stream includes loan proceeds and debt service requirements. Loan proceeds from Appendix H and debt service requirements from Appendix I.

Table 6-25. Summary of Financial Results by Canal Alternative and Toll Scenario

Evaluation criteria	Target Result	High-Rise Lock Canal 150,000 DWT Tolls: Existing Tolls	High-Rise Lock Canal 150,000 DWT Tolls: Increased 50 percent	High-Rise Lock Canal 150,000 DWT Tolls: Optimal Tolls	High-Rise Lock Canal 200,000 DWT Tolls: Existing Tolls	High-Rise Lock Canal 200,000 DWT Tolls: Increased 50 percent	High-Rise Lock Canal 200,000 DWT Tolls: Optimal Tolls	Sea-Level Canal Case A Tolls: Existing Tolls	Sea-Level Canal Case A Tolls: Increased 50 percent	Sea-Level Canal Case A Tolls: Optimal Tolls
1. Trust Fund balance always positive	Yes	No	Yes	Yes	No	No	Yes	No	No	No
2. Financial internal rate of return before financing (%)	8-10	-3.2	4.6	10.1	-3.1	3.7	8.4	-5.1	1.3	4.5
3. Financial internal rate of return after financing (%)	12-15a/	-5.6	3.4	18.0	-5.4	2.3	9.8	-7.6	-0.5	3.3
4. Net present value before financing (US$MM) b/	Positive value	-4,314	-1,591	951	-4,882	-2,337	193	-6,803	-4,648	-2,608
5. Net present value after financing (US$MM) b/	Positive value	-3,806	-1,285	1,069	-4,308	-1,952	391	-6,014	-4,019	-2,130
6. Minimum debt service coverage ratio - current	1.3	0.3	0.6	0.9	0.2	0.5	0.7	0.2	0.3	0.5
7. Minimum debt service coverage ratio - overall	1.5-2.0	n.a.	1.1	1.8	n.a.	n.a.	1.9	n.a.	n.a.	n.a.
8. Debt/equity ratio	Below 4.0	3.0	3.0	3.0	2.9	2.9	2.9	2.9	2.9	2.9
9. Is the alternative financially viable with:										
a. Interest rates increased 25 percent	Yes	--	No	Yes	--	No	No	--	No	No
b. Capital costs increased 25 percent	Yes	--	No	No	--	No	No	--	No	No
c. Operation and Maintenance costs increased 25 percent	Yes	--	No	Yes	--	No	No	--	No	No
d. Status Quo Canal tolls increased 50 percent	Yes	--	--	No	--	--	No	--	--	No
Conclusion										
Is project financially feasible?		No	No	Yes	No	No	No	No	No	No

n.a.= not applicable

a/ With a Panama Canal Authority as the management entity,a rate of return of 12-15 percent would be acceptable. If foreign equity was sought, the return would need to be in the range of 15-20 percent.

b/ Based upon an interest rate of 8 percent.

Source: Tables 6-7 through 6-24 and Appendix J.

Table 6-26. Sensitivity Analyses: Financial Results by Canal Alternative and Toll Scenario

Sensitivity scenario and evaluation criteria	Target Result	High-Rise Lock Canal 150,000 DWT: Tolls Increased 50 percent	High-Rise Lock Canal 150,000 DWT: Optimal Tolls	High-Rise Lock Canal 200,000 DWT: Tolls Increased 50 percent	High-Rise Lock Canal 200,000 DWT: Optimal Tolls	Sea-Level Canal Case A: Tolls Increased 50 percent	Sea-Level Canal Case A: Optimal Tolls
Interest Rates Increased by 25 Percent a/							
1. Trust Fund balance always positive	Yes	No	Yes	No	Yes	No	No
2. Financial internal rate of return before financing (%)	8-10	4.6	10.1	3.7	8.4	1.3	4.5
3. Financial internal rate of return after financing (%)	12-15 c/	2.8	13.9	1.8	8.0	-0.9	2.7
4. Net present value before financing (US$MM) b/	Positive value	-1,591	951	-2,337	193	-4,648	-2,608
5. Net present value after financing (US$MM) b/	Positive value	-1,637	716	-2,353	-10	-4,552	-2,663
6. Minimum debt service coverage ratio - overall	1.3	0.5	0.8	0.4	0.6	0.3	0.4
7. Minimum debt service coverage ratio - current	1.5-2.0	n.a.	2.0	n.a.	1.7	n.a.	n.a.
8. Debt/equity ratio	Below 4.0	3.0	3.0	2.9	2.9	2.9	2.9
9. Is project financially viable?		No	Yes	No	No	No	No
Capital Costs Increased by 25 Percent							
1. Trust Fund balance always positive	Yes	No	Yes	No	No	No	No
2. Financial internal rate of return before financing (%)	8-10	3.3	7.7	2.5	6.4	0.4	3.1
3. Financial internal rate of return after financing (%)	12-15 c/	1.7	8.2	0.9	5.9	-1.5	1.6
4. Net present value before financing (US$MM) b/	Positive value	-2,732	-190	-3,630	-1,100	-7,023	-4,982
5. Net present value after financing (US$MM) b/	Positive value	-2,294	60	-3,096	-754	-6,120	-4,231
6. Minimum debt service coverage ratio - overall	1.3	0.5	0.7	0.4	0.6	0.2	0.4
7. Minimum debt service coverage ratio - current	1.5-2.0	n.a.	1.9	n.a.	n.a.	n.a.	n.a.
8. Debt/equity ratio	Below 4.0	3.0	3.0	2.9	2.9	2.9	2.9
9. Is project financially viable?		No	No	No	No	No	No
Capital Costs Decreased by 25 Percent							
1. Trust Fund balance always positive	Yes	Yes	Yes	Yes	Yes	No	No
2. Financial internal rate of return before financing (%)	8-10	6.7	15.1	5.5	11.9	2.6	6.4
3. Financial internal rate of return after financing (%)	12-15 c/	6.5	28.2	4.6	21.1	1.0	6.0
4. Net present value before financing (US$MM) b/	Positive value	-450	2,092	-1,044	1,486	-2,924	-883
5. Net present value after financing (US$MM) b/	Positive value	-275	2,078	-808	1,535	-2,494	-605
6. Minimum debt service coverage ratio - overall	1.3	0.8	1.2	0.6	1.0	0.4	0.7
7. Minimum debt service coverage ratio - current	1.5-2.0	2.3	2.3	2.3	2.0	n.a	n.a
8. Debt/equity ratio	Below 4.0	3.0	3.0	2.9	2.9	2.9	2.9
9. Is project financially viable?		No	Yes	No	Yes	No	No

Table 6-26 (continued)

Sensitivity scenario and evaluation criteria	Target Result	High-Rise Lock Canal 150,000 DWT: Tolls Increased 50 percent	High-Rise Lock Canal 150,000 DWT: Optimal Tolls	High-Rise Lock Canal 200,000 DWT: Tolls Increased 50 percent	High-Rise Lock Canal 200,000 DWT: Optimal Tolls	Sea-Level Canal Case A: Tolls Increased 50 percent	Sea-Level Canal Case A: Optimal Tolls
Operation and Maintenance Costs Increased by 25 Percent							
1. Trust Fund balance always positive	Yes	No	Yes	No	No	No	No
2. Financial internal rate of return before financing (%)	8-10	4.2	9.8	3.3	8.1	0.9	4.2
3. Financial internal rate of return after financing (%)	12-15 c/	2.8	17.0	1.8	9.1	-1.0	2.9
4. Net present value before financing (US$MM) b/	Positive value	-1,757	785	-2,502	29	-4,807	-2,766
5. Net present value after financing (US$MM) b/	Positive value	-1,438	915	-2,104	239	-4,166	-2,277
6. Minimum debt service coverage ratio - overall	1.3	0.4	0.7	0.4	0.6	0.2	0.4
7. Minimum debt service coverage ratio - current	1.5-2.0	n.a.	1.2	n.a.	n.a.	n.a.	n.a.
8. Debt/equity ratio	Below 4.0	3.0	3.0	2.9	2.9	2.9	2.9
9. Is project financially viable?		No	Yes	No	No	No	No
Interest Rates Increased by 25 Percent and Capital Cost Decreased By 25 Percent							
1. Trust Fund balance always positive	Yes	Yes	Yes	Yes	Yes	No	No
2. Financial internal rate of return before financing (%)	8-10	6.7	15.1	5.5	11.9	2.6	6.4
3. Financial internal rate of return after financing (%)	12-15 c/	5.3	24.6	3.9	19.0	0.6	5.1
4. Net present value before financing (US$MM) b/	Positive value	-450	2,092	-1,044	1,486	-2,924	-883
5. Net present value after financing (US$MM) b/	Positive value	-540	1,814	-1,109	1,234	-2,894	-1,004
6. Minimum debt service coverage ratio - overall	1.3	0.7	1.0	0.6	0.9	0.4	0.6
7. Minimum debt service coverage ratio - current	1.5-2.0	2.4	2.1	1.1	1.9	n.a.	n.a.
8. Debt/equity ratio	Below 4.0	3.0	3.0	2.9	2.9	2.9	2.9
9. Is project financially viable?		No	Yes	No	Yes	No	No
Status Quo Canal Tolls Increased 50 Percent d/							
1. Trust Fund balance always positive	Yes	--	Yes	--	Yes	--	No
2. Financial internal rate of return before financing (%)	8-10	--	5.4	--	4.7	--	2.1
3. Financial internal rate of return after financing (%)	12-15 c/	--	4.5	--	3.6	--	0.5
4. Net present value before financing (US$MM) b/	Positive value	--	-1,284	--	-1,956	--	-4,389
5. Net present value after financing (US$MM) b/	Positive value	--	-1,001	--	-1,599	--	-3,779
6. Minimum debt service coverage ratio - overall	1.3	--	0.9	--	0.7	--	0.5
7. Minimum debt service coverage ratio - current	1.5-2.0	--	1.8	--	1.9	--	n.a.
8. Debt/equity ratio	Below 4.0	--	3.0	--	2.9	--	2.9
9. Is project financially viable?			No		No		No

Table 6-26 (continued)

Sensitivity scenario and evaluation criteria	Target Result	High-Rise Lock Canal 150,000 DWT: Tolls Increased 50 percent	High-Rise Lock Canal 150,000 DWT: Optimal Tolls	High-Rise Lock Canal 200,000 DWT: Tolls Increased 50 percent	High-Rise Lock Canal 200,000 DWT: Optimal Tolls	Sea-Level Canal Case A: Tolls Increased 50 percent	Sea-Level Canal Case A: Optimal Tolls
Special Purpose Corporation Management Arrangement							
1. Trust Fund balance always positive	Yes	--	Yes	--	Yes	--	No
2. Financial internal rate of return before financing (%)	8-10	--	10.1	--	8.4	--	4.5
3. Financial internal rate of return after finahcing (%)	12-15 c/	--	17.2	--	9.6	--	3.2
4. Net present value before financing (US$MM) b/	Positive value	--	951	--	193	--	-2,608
5. Net present value after financing (US$MM) b/	Positive value	--	1,040	--	357	--	-2,174
6. Minimum debt service coverage ratio - overall	1.3	--	0.9	--	0.7	--	0.5
7. Minimum debt service coverage ratio - current	1.5-2.0	--	1.8	--	2.0	--	n.a.
8. Debt/equity ratio	Below 4.0	--	3.0	--	2.9	--	2.9
9. Is project financially viable?			Yes		No		No
Yachiyo Engineering Cost Flows- Unadjusted e/							
1. Trust Fund balance always positive	Yes	--	Yes	--	--	--	--
2. Financial internal rate of return before financing (%)	8-10	--	10.2	--	--	--	--
3. Financial internal rate of return after financing (%)	12-15 c/	--	17.8	--	--	--	--
4. Net present value before financing (US$MM) b/	Positive value	--	962	--	--	--	--
5. Net present value after financing (US$MM) b/	Positive value	--	1,058	--	--	--	--
6. Minimum debt service coverage ratio - overall	1.3	--	0.9	--	--	--	--
7. Minimum debt service coverage ratio - current	1.5-2.0	--	1.8	--	--	--	--
8. Debt/equity ratio	Below 4.0	--	2.7	--	--	--	--
9. Is project financially viable?			Yes				

n.a. = not applicable

a/ All interest rates were increased by 25 percent prior to any additional factor for currency swap costs.

b/ Based upon an interest rate of 8 percent.

c/ With a Panama Canal Authority as the management entity,a rate of return of 12-15 percent would be acceptable. If foreign equity was sought, the return would need to be in the range of 15-20 percent.

d/ Based on existing Panama Canal tolls increased by 50 percent from Table 6-5.

e/ Based on project costs on a unit-cost methodology from Table 4-1, and a revised financing scheme as presented in Appendix Table J-76.

Source: As noted above and from Appendix J.

7. RECOMMENDATIONS FOR OPTIMAL TOLL SYSTEM, MANAGEMENT ARRANGEMENT, FINANCING SCHEME, AND PANAMA CANAL ALTERNATIVE

Optimal Toll System

- The optimal toll system is based on vessel-earning capacity. It differs from the existing Panama Canal toll structure by differentiating among ship types and, within ship types, by size intervals of the ship's earning capacity.
- The optimal toll structure and rates are presented in Table 3-28 (p. 3-49). Container-breakbulk, chemical tankers, full container ships, general cargo ships, liquid gas carriers, passenger ships, refrigerated ships, RORQs, and vehicle carriers are assessed a toll of $4.02 per Panama Canal net ton, without variation across size intervals, and $3.20 in ballast. All other ships pay tolls at rates that vary depending on the year, Canal alternative, ship type, and size interval. All ballast movements are charged a toll on the basis of the increase in toll rates realized on each ship type's laden transits.
- Toll rate increases per Panama Canal net ton under the optimal schedule do not exceed 100 percent of the current rate on any ship type.

Management Arrangement

- A Panama Canal Authority has been identified as the preferred management arrangement suitable to handle the political, financial management, and operating efficiency requirements of the Canal alternative.
- According to this model, the Canal alternative would be set up as an independent authority by national Panamanian legislation (Authority Act). A strong Authority Act could be drafted to preserve all the necessary characteristics for effective operation and development of the Canal alternative in a competitive environment: financial integrity, insulation from political influence, management flexibility, labor productivity, and others.
  - The authority would have, among other powers, the capability to establish its own pricing and labor statute in order to meet the objectives it is established to serve.
  - A board of directors would be appointed to oversee the Authority. Although appointed by the President of the Republic, the directors would serve independently of him and would be sheltered from political pressure.

- From a Panamanian political point of view, a Panama Canal Authority is probably a more easily comprehensible and thus acceptable formula for organizing Panama's relationship to the Canal alternative. The Panama Canal Authority may well prove to be most similar organizationally to the form of institution that succeeds the present Panama Canal Commission after December 31, 1999. This similarity would ensure a smooth transition into the new pattern of activity featuring the simultaneous, integrated operations of the existing Canal and the eventual Canal alternative.
- The Panama Canal Authority model has the additional advantage of an ability to evolve toward being a special purpose corporation (SPC). If over time the ownership and operating characteristics of an SPC presented clear benefits for the development and management of the Canal alternative, an authority could easily establish and even invest in a SPC and contract out day-to-day operation and management of the Canal alternative to that entity.

Optimal Financing Scheme

- The optimal financing scheme identified for the Panama Canal Alternative combines a diverse set of nine sources of financing (Table 6-2, p. 6-21). The financing plan attempts to make maximum use of low-cost sources of financing and to blend sources with a variety of financing terms and conditions, including the provision for grace periods for the repayment of principal. The plan includes a capital contribution of 25 percent of total project costs from a toll reserve trust fund, which is to be accumulated during the 2000–2010 period.
- The optimal financing scheme makes maximum use of the availability of export-import bank financing and other sources of suppliers credit for construction and other equipment acquisition. Altogether, 26 percent of project costs for the 150,000-DWT High-Rise Lock Canal are to be financed from these sources.
- The financing plan draws on international development banks and institutions such as the World Bank, the Inter-American Development Bank, and the Japanese OECF/ODA for loans that are characterized by attractive interest rates and long duration, including grace periods of several years for repayment of principal. These sources of financing account for 21 percent of total project costs.
- Foreign bonds represent another source of financing accounting for 23 percent of total project costs. Commercial bank credits represent 3.4 percent of total project costs.

Panama Canal Alternative

- The 150,000-DWT High-Rise Lock Canal operated by a Panama Canal Authority and using an optimal toll system is recommended as the most attractive Canal alternative and management arrangement from a financing scheme and financial viability perspective.
- This alternative provides a financial internal rate of return commensurate with estimated requirements of public and private financing and has a positive net present value before and after financing. The balance of the toll reserve trust fund is always positive and is adequate during construction to cover substantial cost overruns.
- The sensitivity analyses indicate that the 150,000-DWT High-Rise Lock Canal under the optimal toll scenario is sufficiently robust to remain financially viable if either interest rates or operation and maintenance costs are increased 25 percent.