



# Proposal for the Expansion of the Panama Canal Third Set of Locks Project

April 24, 2006



# **Proposal for the Expansion of the Panama Canal**

## **Third Set of Locks Project**

Panama Canal Authority  
April 24, 2006

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## Proposal for the Expansion of the Panama Canal

### Third Set of Locks Project

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## Proposal for the Expansion of the Panama Canal

### Third Set of Locks Project

## PROLOGUE

After the historic struggle to recover the Canal, and given the efficient, profitable and safe manner in which the Canal has been managed since the moment of its turnover on December 31, 1999, today the Canal is a source of pride for all Panamanians.

Many generations of Panamanians have contributed to the Canal's success: first, during the construction of the Canal; then, through the amendments to improve conditions for Panama and the signing of the Treaty with the U.S. for the Canal's turnover; and finally, under the more than six years of exemplary Panamanian administration. Together, these generations forged a history of sacrifice, passion, and vision.

Today, the sustained increase in international trade and the consequent increase in the demand for transits through the Canal presents the waterway with new challenges and opportunities. Panama has demonstrated, both to the maritime community and to itself, that it is capable of managing the Canal at the highest levels of efficiency. Now we have to make the decisions that will optimize the operation of the Canal and thereby assure its growing profitability for present and future generations.

With the same long-term vision of those who built the Canal one hundred years ago, we must now prepare ourselves for the Canal of the 21<sup>st</sup> Century.









## Proposal for the Expansion of the Panama Canal

### Third Set of Locks Project

# **P**ROPOSAL FOR THE EXPANSION OF THE PANAMA CANAL THROUGH THE CONSTRUCTION OF THE THIRD SET OF LOCKS

The Panama Canal Authority (ACP) hereby submits the proposal to expand the Canal's capacity through the construction of the third set of locks for the consideration of the Executive Branch.

The third set of locks project is a plan to expand the Canal's capacity composed of three integrated components: (1) the construction of two lock facilities – one on the Atlantic side and another on the Pacific side – each with three chambers, each which include three water reutilization basins; (2) the excavation of new access channels to the new locks and the widening of existing navigational channels; and, (3) the deepening of the navigation channels and the elevation of Gatun Lake's maximum operating level.

## **Objectives of the expansion of the Canal's capacity through the construction of the third set of locks**

The objectives of the Canal expansion are to: (1) achieve long-term sustainability and growth for the Canal's contributions to Panamanian society through the payments it makes to the National Treasury<sup>1</sup>; (2) maintain the Canal's competitiveness as well as the value added by Panama's maritime route to the national economy; (3) increase the Canal's capacity to capture the growing tonnage demand with the appropriate

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<sup>1</sup> These direct payments to the National Treasury consist of a payment of \$0.75 per PCUMS, in concept of fee per net ton, a payment for public services, and payment of Canal operational surplus after the required reserves. In FY 2005, the payment of fee per net ton amounted to \$191 million, the payment for public services totaled \$29 million, and surplus payments totaled \$269 million, for total of direct payments of \$489 million.



levels of service for each market segment; and, (4) make the Canal more productive, safe and efficient.

It is most convenient for Panama to take advantage of the opportunity presented by the projected growth in maritime traffic through Panama's route. To those ends, the proposed canal expansion is fully and completely justified by the cargo volume that will be able to transit through the Canal, and not just by the vessels sizes it will be able to handle. Given the intention to build new locks, it is advantageous for Panama that they be able to handle the most appropriate vessel size for the routes that the Canal will serve. Moreover, a larger lock is the best solution because it will allow the Canal to handle more tonnage while using less water at lower costs.

The Canal is the country's main economic activity, and expanding it constitutes a fundamental step towards developing Panama's service cluster<sup>2</sup>, which takes advantage of the Isthmus's geographical position and has turned Panama into a world trade, transportation and logistics liaison center. Additionally, the expansion of this capacity ensures the integrated and sustained growth of all maritime activities to be developed in Panama, which is consistent with the national maritime strategy. In synthesis, it will drive the national economy and improve the quality of life for all Panamanians.



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<sup>2</sup> See section 9 for a description of the service cluster.



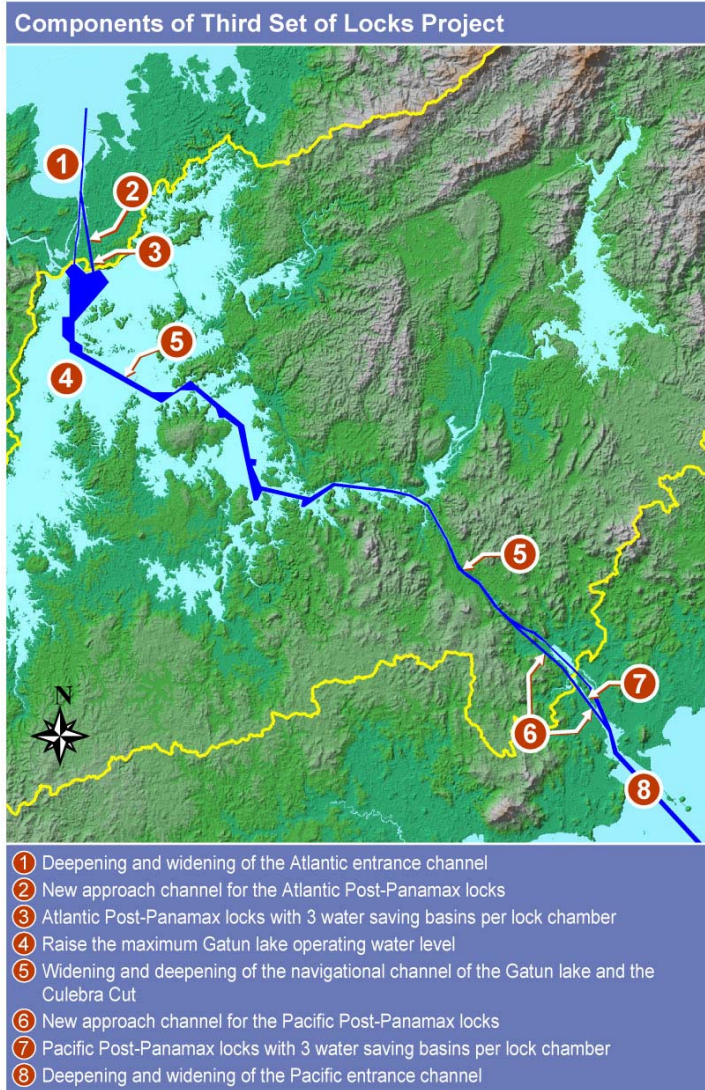
# 1 Explanation of the third set of locks project

Described below are the details of the components of the third set of locks project, which are duly supported by the 2005-2025 Master Plan of the Panama Canal<sup>3</sup> and the studies and investigations performed for such purposes.

## 1.1 Locks

The Canal today has two lock lanes<sup>4</sup>. The proposal consists of adding a third lane, through the construction of two lock facilities, one at each end of the Canal (see figure 1)<sup>5</sup>. Each of the new lock facilities will have three consecutive chambers, designed to move vessels from sea level to the level of Gatun Lake and back down again. Each chamber will have 3 lateral water reutilization basins, for a total of 9 basins per lock and 18 basins in total (see figures 2 and 3). Just like in the existing locks, the new locks and their basins will be filled and emptied by gravity, without the use of pumps.

Both lock facilities will be located within the patrimonial area of the ACP, adjacent to the existing locks. The new locks and their channels will form a navigation system which will be integrated



**Figure 1** The expansion program includes the construction of new locks in the Atlantic and Pacific, the excavation of new access channels and the widening of the existing channels. It also includes the deepening of the navigation channels in the Gaillard Cut and Gatun Lake and the raising of Gatun Lake's maximum operating level.

<sup>3</sup> The ACP developed a Master Plan with a 20-year horizon, which identifies actions to modernize the Canal and increase its capacity through a third set of locks. This Master Plan, and the studies supporting it, are available for consultation on ACP's webpage and information centers.

<sup>4</sup> Right now, the Canal has two lock lanes. Each of these two lanes uses three chambers or steps to allow the transit of vessels between sea level and Gatun Lake's level. The locks on the Pacific end of the Canal are separated in two complexes: one is located in Miraflores, with two steps, and the other is in Pedro Miguel, with a single step. The locks on the Atlantic end consist of a single complex in Gatun, which has three steps.

<sup>5</sup> The existing locks will continue to operate after the third set of locks is incorporated in the Canal. With the appropriate maintenance, the existing locks will continue to operate indefinitely.





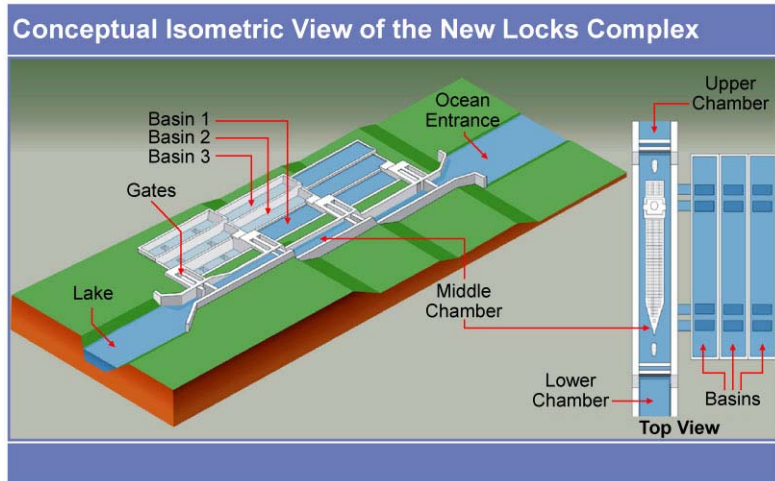
into the existing locks and channels system.

A lock facility will be located at the Atlantic end of the Canal, on the east side of Gatun locks (see figure 4). The other facility will be located at the Pacific end of the Canal, to the southwest of Miraflores Locks (see figure 5). The location of the new locks uses a significant portion of the excavations of the third set of locks project started by the U.S. in 1939<sup>6</sup> and suspended in 1942 when the U.S. entered World War II. The new locks will be connected to the existing channel system through new navigational channels.

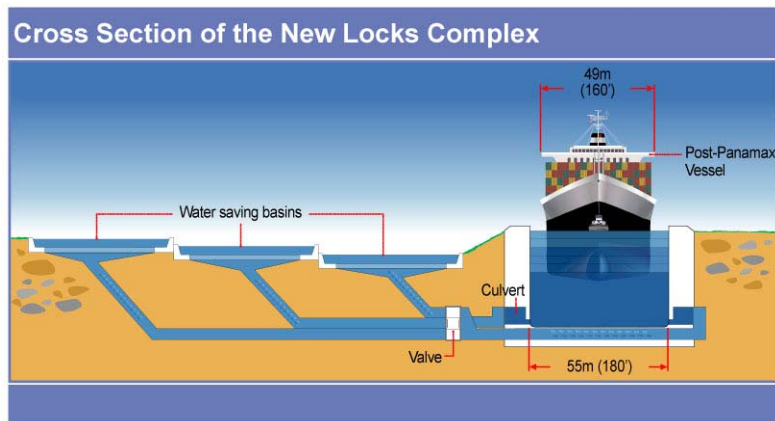
The new lock's chambers will be 427 m (1,400') long, by 55 m (180') wide, and 18.3 m (60') deep<sup>7</sup>. They will use rolling gates instead of the miter gates used by the existing locks. Rolling gates are used in almost all existing locks with dimensions similar to those being proposed<sup>8</sup> and are a well-proven technology. The new locks will use tugboats to position the vessels instead of locomotives. As in the case of the rolling gates, tugs are successfully and widely utilized for these purposes in locks of similar dimensions.

## 1.2 Navigational Channels

The third set of locks project includes the excavation of new navigational channels to connect the new locks with the existing channels. It also includes the deepening and widening of existing channels.



**Figure 2** Isometric view of the new lock facility with its gates and water reutilization basins. The image on the side shows a top view of a typical chamber with a vessel.



**Figure 3** Cross section of the new locks with its water saving basins, shown with a post-Panamax container vessel with a nominal capacity of 12,000 TEUs.

<sup>6</sup> Dredging works in the channel that is close to Miraflores locks initiated on July 1, 1940, after the U.S. Congress sanctioned a budget authorization law on June 14, 1940. Dry excavation of the third set of locks began in Gatun sector on February 19, 1941.

<sup>7</sup> The new locks will allow drafts of up to 15.2m (50') in tropical fresh water.

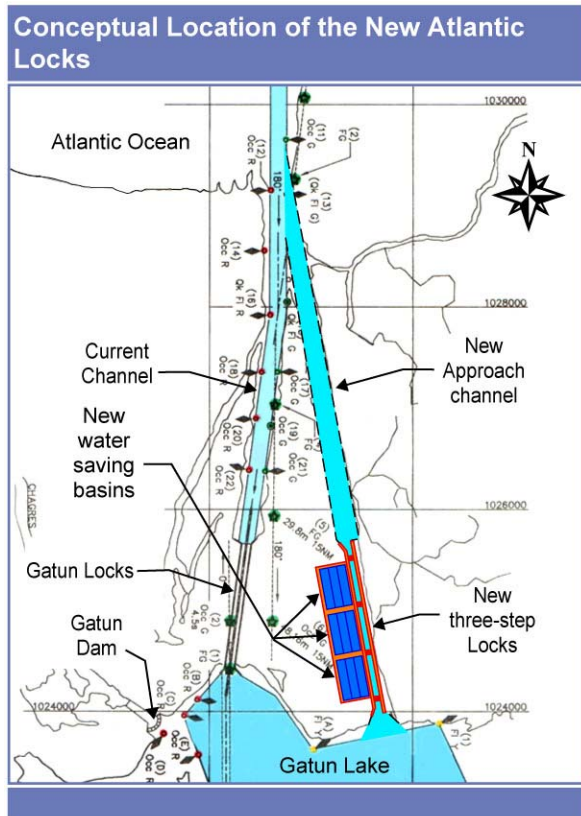
<sup>8</sup> For example, locks in Berendrecht and Zandvliet, Belgium; IJmuiden, The Netherlands; and Le Havre, France, among others.



A 3.2 km-long access channel will be excavated in order to connect the new Atlantic locks with the existing sea entrance of the Canal (see figure 4). To connect the new Pacific-side locks with the existing channels, two new access channels will be built: (1) the north access channel, which will connect the new Pacific-side lock with the Gaillard Cut<sup>9</sup>, circumventing Miraflores lake, and which will be 6.2 Km long; and, (2) the south access channel, which will connect the new lock with the existing sea entrance on the Pacific Ocean, and which will be 1.8 Km long (see figure 5). The new channels will be at least 218 m (715') wide, both on the Atlantic and Pacific sides, which will permit post-Panamax vessels to navigate in these channels in a single direction at any time.

As far as existing navigation channels are concerned, the project includes the deepening of Gaillard Cut's and Gatun Lake's navigation channels by 1.2 m (4'), up to a 9.2 m (30') PLD<sup>10</sup> level. The channel will then be able to accept vessel drafts of up to 15.2 m (50')<sup>11</sup> in tropical fresh water (TFW)<sup>12</sup>. Gatun lake's channels will also be widened to no less than 280 m (920') in their straight sections and 366 m (1,200') in the turns. These dimensions will permit post-Panamax encounters or cross-navigation in opposite directions in Gatun Lake. Additionally, the Canal's sea entrance navigation channels on the Atlantic and Pacific sides will be widened to no less than 225 m (740') and deepened to 15.5 m (51') deep below the level of the lowest tides. Widening and deepening the Canal entrances will allow post-Panamax vessels to navigate these channels and meet vessels of Panamax dimensions in them.

As part of the studies for the third set of locks, the ACP evaluated the technical, environmental, and economic viability of a vehicular crossing at the Atlantic end of the Canal, such as a tunnel or a bridge



**Figure 4** The Atlantic lock facility will be built to the east of Gatun Locks, and Hill use part of the 1939 excavation.

<sup>7</sup> The north access channel of the post-Panamax lock on the Pacific side will connect with the Gaillard Cut south of the Centennial Bridge.

<sup>10</sup> PLD stands for Precise Level Datum, in English. It is the geodesic reference level utilized in Canal.

<sup>11</sup> Once widened, the Canal will be able to offer a 15.2 m (50') draft when Gatun Lake rises to the 25.9 m (85') PLD level or higher.

<sup>12</sup> Fresh water is less dense than sea water; therefore, vessels displace more in fresh water than in sea water. For example, a Panamax container vessel 294 m (965') in length x 32.2m (106') in beam displaces approximately 0.30m (1') more in tropical fresh water than in salt water.



(see figure 6)<sup>13</sup>. During the execution of the third set of locks project, the studies on the vehicular crossing options for the Atlantic side – either a tunnel or a bridge, whichever is deemed more suitable – will be finalized, and construction will begin no later than upon the completion of the expansion project. The vehicular crossing will include all water, electrical and communications conduits required for promotion of the development of the areas on the west side of the Canal.

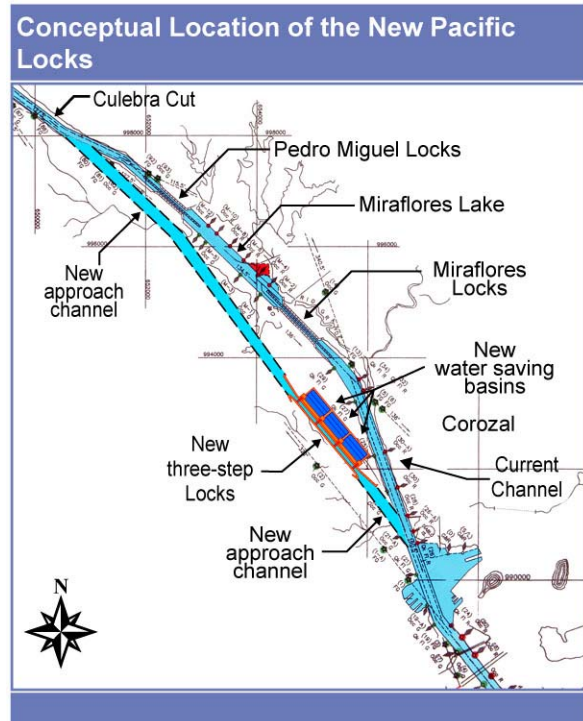
### 1.3 Elevation of highest operational level of Gatun Lake

The maximum operational level of Gatun Lake will be raised by approximately 0.45 m (1.5'), from the present 26.7 m (87.5') PLD level to a 27.1 m (89') PLD level. Combined with the widening and deepening of the navigational channels, this component will increase Gatun Lake's usable water reserve capacity and will allow the Canal's water system to supply a daily average of 165 million gallons (625 million liters) of additional water. This additional water volume is enough to provide an annual average of approximately 1,100 additional lockages without affecting the water supply for human use that is provided from Gatun and Alhajuela Lakes.

Elevating the maximum operational level of Gatun Lake will require changes to some ACP operational structures located on Gatun Lake's banks, such as the south end of Gatun locks, the northern portion of Pedro Miguel locks, Gatun spillway, and small vessel piers located in Gatun Lake.

## 2 Estimated schedule for the construction of the third set of locks

The construction of the third set of locks project will take between seven to eight years. The new locks could begin operations between fiscal years 2014 and 2015, assuming the project is approved in the



**Figure 5** The Pacific lock facility will be built to the south-west of the Miraflores Locks, with two new access channels that will connect it to the Gaillard Cut and to the Pacific sea entrant.

<sup>13</sup> Preliminary engineering feasibility studies on a crossing over the Panama Canal's Atlantic side, ACP July 2004.

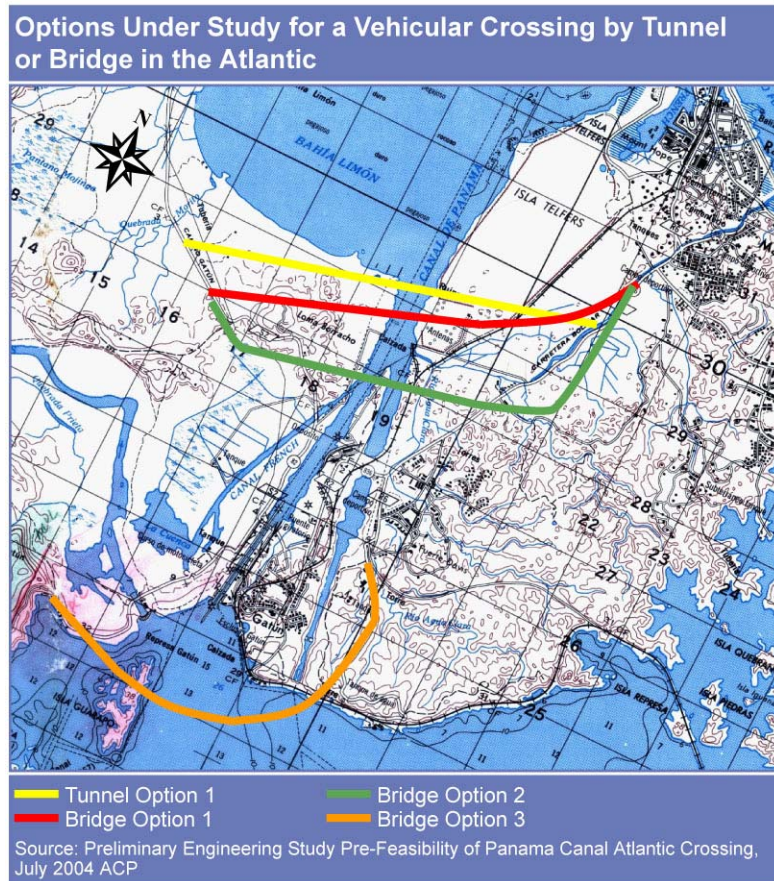




required national referendum during calendar year 2006 (see figure 7). The project's program schedule was developed based on a thorough and detailed construction feasibility study performed pursuant to the most advanced practices of the construction industry and taking into account the most appropriate equipment, technology and building processes for the program's scope and type. The construction plan, which was used as a basis for the cost estimate, was also evaluated using a complex risk analysis model, and includes sufficient and adequate time contingencies to cover possible delays and interruptions. It also includes an appropriate period for commissioning, personnel training, inspections, testing of operations, and commencement of transit operations.

Based on the integrated manner by which project costs and construction times were analyzed and developed, the construction schedule is reliable. The schedule reflects adequate execution speeds that allow for completion of the project in the shortest time possible, in accordance with an efficient and productive progress plan to be executed with the use of proven construction technology. The schedule is divided in two main phases: the preconstruction phase and the construction phase.

The preconstruction phase includes the development of final designs, physical models, specifications and contracts, contractor preclassification (if required), and finally, contractor selection. For the locks component of the project, this phase could last between two and three years. Dry excavation and the dredging of channels will commence immediately upon project approval and before the locks preconstruction phase is completed.

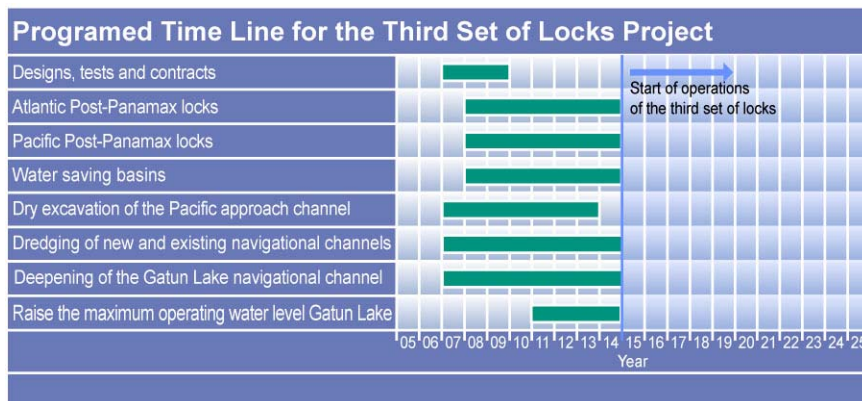


**Figure 6** As part of the third set of locks studies, the ACP assessed the feasibility of a vehicular crossing on the Atlantic. Different options were studied, including bridges and tunnels.



The construction phase includes the simultaneous construction of both lock facilities with their water reutilization basins, dry excavation of the new access channels, and dredging of both new lock access channels and Gatun Lake navigational channels, as well as of the sea entrances. Building the locks will take between five and six years<sup>14</sup>, and will start in the year 2008, after final designs are concluded. Dry excavation and dredging works will begin in 2007 and will require approximately seven or eight years. During the second half of the construction period, that is, during the year 2011, Gatun Lake’s maximum operational level will begin to be raised, which will require adjusting both the existing locks as well as Canal facilities located on Gatun Lake’s banks; this, in turn, will take approximately four years.

Because the project is composed of multiple components, it is anticipated that the construction of certain elements will begin while the preconstruction phase for other components is still ongoing. Thus, it is foreseen that dredging activities, specifically those that will be executed by the ACP, will start right after the project is approved. Other actions, such as those related to mobilization, infrastructure construction, and materials disposal sites preparation and dry excavation works, will also be initiated and may be significantly advanced while the locks final design is being completed. The project implementation activities will not affect normal Canal operations.



**Figure 7** Implementation schedule for the third set of locks project. The third set of locks would start operation between 2014 and 2015.

### 3 Estimated cost for the construction of the third set of locks

The construction cost for the third set of locks has been estimated with the most rigorous methods of analysis with the participation of renowned international specialists. ACP personnel developed the cost estimate and schedule, under the guidance of consultants from Parson Brinkerhoff International (specialists in cost estimates), as

<sup>14</sup> The execution schedule includes an additional year for locks works as contingency for possible unforeseen events, according to the project’s risk analysis.



well as construction experts from Montgomery Watson Harza and Clair Murdock Consultants. The results were reviewed by a special technical committee which included experts from Arizona State University, the University of California and the University of Colorado.

The level of soundness and reliability of the cost estimate derives from three main pillars. First, the cost estimate is based on a detailed lock and navigational channels conceptual design<sup>15</sup>. Second, this conceptual design was thoroughly analyzed in terms of the feasibility of its construction, to determine the sequence and interdependency of activities, and to accurately estimate the requirement for manpower, equipment, operating supplies, energy, administration and tests and materials, among other considerations. Third, the cost estimate was supplemented with the use of a state-of-the-art risk analysis model through which factors such as uncertainty and contingencies, and the probability of their occurrence during the project's execution, as well as their possible impact, were evaluated and weighed<sup>16</sup>.

The project's estimated cost considers potential increases in manpower, equipment, operating supplies and materials costs. Possible price fluctuations were estimated and analyzed, particularly for key operating supplies and materials, such as cement, steel, aggregates, fuels and lubricants, among others. A thorough analysis of circumstances and conditions that could produce delays in the construction was also performed, including productivity fluctuations in equipment and manpower, equipment failures, extreme weather events and design changes. The study also assessed the consequences and effects of shortages or timely availability of equipment, materials and personnel for the project.

The design of navigational channels and the pertinent dredging works were compared with international productivity standards and with yields obtained recently by the ACP for similar dredging works. The cost estimates for dredging works were also reviewed by international experts<sup>17</sup>. All of these factors were analyzed, individually

<sup>15</sup> The ACP contracted two separate consulting teams to design, individually, project concepts. Later on, it evaluated the concepts proposed, and configured a standardized design with the best elements from each concept. Said consultants were: (1) the Post-Panamax Consortium formed mainly by four European companies: Coyne-et-Bellier, Tractebel Engineering, Technum y Compagnie Nationale du Rhône; and (2) the U.S. Army Corps of Engineers.

<sup>16</sup> The risk analysis model was developed by the consulting firm *Aon Risk Services*, complemented by ACP and later reviewed in the study: *Project Risk Management, Development of Risk Based Contingency Values for a Baseline Project Budget Estimate, Panama Canal 3rd Lane Locks Atlantic and Pacific Locks, Pacific Access Channel, and Navigation Channel* developed by expert professors from the University of California, the University of Colorado and the *Universidad Pontificia Católica de Chile*.

<sup>17</sup> *Independent Technical Review of Navigation Channel Improvement Studies*, revision by experts from Great Lakes Dredging Company, April 2004





and in an interrelated manner, in order to determine their probability of occurrence and the impact that each individual factor or combinations thereof could have on the cost and construction schedule of the third set of locks project.

The construction cost of the third set of locks is estimated at approximately \$5,250 million (see figure 8). This estimate includes design, administrative, construction, testing, environmental mitigation and commissioning costs. Additionally, this cost includes contingencies to cover risks and unforeseen events such as those that might be caused by accidents, design changes, price increases, and possible delays, among others. This contingency level is adequate and sufficient for this type of project in its conceptual phase of design. The project's estimated cost also includes the effect of inflation during the construction period<sup>18</sup>.

The most relevant program cost is that of constructing the two new lock facilities – one on the Atlantic side and the other on the Pacific side – with estimated costs of approximately \$1,110 million and \$1,030 million each, plus a \$590 million provision for possible contingencies during their construction. These new

Cost Estimate for the Third Set of Locks Project	
Project Components	Investment Estimate*
<b>New Locks</b>	
Atlantic Locks	1,110
Pacific Locks	1,030
Contingency for New Locks**	590
<b>Total for New Locks</b>	<b>2,730</b>
<b>Water Saving Basins</b>	
Atlantic Water Saving Basins	270
Pacific Water Saving Basins	210
Contingency for Water Saving Basins**	140
<b>Total for Water Saving Basins</b>	<b>620</b>
<b>Access Channels for New Locks</b>	
Atlantic Access Channels (Dredging)	70
Pacific Access Channels (Dry Excavation)	400
Pacific Access Channels (Dredging)	180
Contingency for Access Channels**	170
<b>Total for New Locks Access Channels</b>	<b>820</b>
<b>Existing Navigational Channel Improvements</b>	
Deepening and Widening of Atlantic Entrance	30
Widening of the Gatun Lake Channels	90
Deepening and Widening of Pacific Entrance	120
Contingency for Existing Channel Improvements**	50
<b>Total for Navigational Channel Improvements</b>	<b>290</b>
<b>Water Supply Improvements</b>	
Increase the Maximum Level of Gatun Lake to 27.1m (89') PLD	30
Deepening of the Navigational Channels to 9.1m (30') PLD	150
Contingency for Water Supply Improvements**	80
<b>Total for Water Supply Improvements</b>	<b>260</b>
<b>Inflation During the Construction Period***</b>	<b>530</b>
<b>Total Investment</b>	<b>5,250 M*</b>
<small>*Millions of Balboas, rounded to the nearest tenths                      **The contingency includes possible variations for each component                      ***Assumes a general inflation of 2% per year above what is included in the contingency</small>	

**Figure 8** The expansion program cost will not exceed B/5,250 millions, including direct and indirect costs in design, administration, construction, contingencies, and inflation.

<sup>18</sup> The approximate total estimate cost incorporates an average annual inflation of 2% and does not include possible financing costs. Per information from the General Comptroller's Office and the *International Monetary Fund, World Economic Outlook Database*, of March 2006, Panama's average inflation has been approximately 1.10% during the last 16 years (between 1990 and 2005).



lock facilities will be provided with water reutilization basins, with an estimated cost of \$270 and \$210 million for the Atlantic and Pacific sides, respectively, plus a \$140 million provision for possible contingencies. In total, the estimated cost for the new locks, including their water reutilization basins and contingencies, is \$3,350 million.

Total estimated cost of building the new lock access channels will be \$820 million, which includes \$400 million for dry excavations and \$250 million for drilling, blasting and dredging works, plus a \$170 million provision for potential contingencies. The improvements to the existing navigational channels have an estimated cost of \$290 million, which includes \$90 million to widen Gatun Lake's navigational channels and \$150 million to deepen and widen Canal entrances, plus a \$50 million provision for contingencies.

Finally, water supply improvements have an estimated cost of \$260 million, including \$150 million to deepen the navigational channels and \$30 million to elevate Gatun Lake's maximum operational level plus an additional \$80 million for contingencies. These program components, added to an estimated \$530 million for inflation during the construction period, represent a total third set of locks project estimated cost of \$5,250 million (see figure 8).

The degree of detail achieved in estimating costs and contingencies makes it possible to ascertain that the estimate is sound and that the variations that have occurred in some other mega projects will not occur. The Canal's advantage in this area is that the main works, such as the dredging works, are not new to the ACP, which has vast experience in performing this type of works and a thorough knowledge of the project area's geological conditions.

The third set of locks project is, primarily, an open-sky excavation and dredging work in a thoroughly analyzed and previously intervened geological area. As mentioned before, the ACP has an extensive and successful history in the execution of dredging works in all Canal navigational channels, as well as in contracting and managing excavation and modernization projects. The third set of locks project does not involve underground or underwater construction works or tunnel drillings, and, therefore, has moderate risk and complexity levels that may be adequately managed with technology and proven construction methods.

The cost analysis offers a high level of reliability due to the level of thoroughness and detail with which it has been performed. By including sufficient and appropriate contingencies to compensate for



potential risks, uncertainty and unforeseen events, the estimate is sound and reliable, and therefore, the probability that the construction will be performed within the estimate, or less, is high.

## 4 Profitability and financial results

The third set of locks is financially profitable, producing a 12% internal rate of return. This investment will double Canal capacity, increase its operational efficiency and provide economic benefits to Panama, which will improve the quality of life for all Panamanians.

An increase in Canal operational capacity is required in order to handle the growing trade in the Panamanian route. It is anticipated that international trade will continue to grow during the next two decades at higher rates than the growth rate of the main world economies. Consequently, the Canal, expanded with the third set of locks, will be able to transit an additional 1,250 million PCUMS<sup>19</sup> tons during its first 11 years of operation, which will produce total revenues of over \$6,000 million in 2025.

The tolls policy for the execution of the third set of locks will focus on capturing the value that the Canal adds to each segment of the market it serves. Tolls will be set in a manner that will double them within the next 20 years considered in this proposal. In this way, the competitiveness of the Panama maritime route will be maintained at all times, the profitability achieved will be consistent with the amount invested, the loans required for financing the construction peaks will be paid rapidly and both the benefits to Panama and payments to the Treasury will be substantially increased.

The level of payments to the National Treasury will not be less than that paid in 2005 or than that are projected for 2006. These Canal payments to the National Treasury will continue and increase during the construction period, and will be even higher once the third set of locks begins operations. When compared to the \$489 million paid by the ACP to the Treasury in 2005, Canal contributions will triple by 2015 and be over eight times higher in 2025.

The third set of locks project is self-financiable and its financing will be separate from the Government's financing. The State will not guarantee or endorse any loans undertaken by the ACP for the project's execution. With the increasing of tolls at an annual 3.5% aver-

<sup>19</sup> The volume of cargo transiting the Canal is measured in PCUMS tons, acronym for Panama Canal Universal Measurement System. The PCUMS ton is the unit used at the Canal to establish tolls, and measures vessels volumetric cargo capacity. A PCUMS ton is equivalent to approximately 100 cubic feet of cargo space, and a 20-foot-long container is equivalent to approximately 13 PCUMS tons.





age rate for twenty years, and according to the most probable traffic demand forecast and the construction schedule, the external financing required will be mainly temporary and in the order of \$2,300 million to cover peak construction activities between 2009 and 2011. With the cash flows generated by the expanded Canal, investment costs will be recovered in less than ten years and financing could be repaid in approximately eight years.





## BASIS FOR THE PROPOSAL

### 1 Background information

Since the 1930's all of the Canal's widening studies have agreed that the most effective and efficient alternative to enhance Canal capacity is the construction of a third set of locks of bigger dimensions than those of the locks built in 1914. Thus, in 1939, the United States initiated the construction of locks designed to allow the transit of commercial and war ships whose dimensions exceeded the size of the existing locks. In 1942, after advancing the excavations significantly, the North Americans suspended the third set of locks works due to the outbreak of World War II<sup>20</sup>.

In the 1980's, the tripartite commission formed by Panama, Japan, and the U.S. took up the issue again, and like the North Americans in 1939, determined that a third set of locks with larger chambers was the most appropriate alternative for increasing Canal capacity. Today, the studies developed by the ACP as part of its 2005-2025 Master Plan confirm that a third set of locks, larger than those existing now, is the most suitable, profitable, and environmentally-responsible way to increase Canal capacity and allow the Panamanian maritime route to continue to grow.

Throughout its history, the Canal has continually transformed its structure and adjusted to trade requirements and international maritime transport technologies. In this manner, the Canal has managed to increase its competitiveness in a sustainable manner. Within the process of transforming and adjusting the Canal to the growing and changing demand, the following projects stand out for their successful execution: (1) the construction of Madden Dam between 1930 and 1936, a project aimed at increasing Canal water capacity and flood control in Chagres River; (2) the locks lighting projects of 1964 and 1977, aimed at increasing Canal capacity by permitting night lockages; (3) the renovation of the locomotives fleet, initiated in 1964, with the object of improving reliability and increasing Canal operational capacity by reducing lockage times and facilitating routine and safe transit of Panamax vessels; (4) the Gaillard Cut widening from 91.5 m (300') to 152 m (500') between 1957 and 1971, in response to increase in Panamax vessels transits; and, (5) the deepening of navigational channels in the 1970s, with the intention of main-

<sup>20</sup> By way of a directive dated May 25, 1942, the Secretary of War indefinitely postponed the third set of locks project construction works in order to join the war effort. As a result of this directive, blueprints were completed, U.S. personnel were freed to join the army, and the construction equipment was assigned to military tasks.



taining the route's competitiveness by offering its users a highly reliable depth that met their draft requirements.

In order to increase the capacity to handle the continuous growth in the number of transits and vessel size, the following works have been completed from the 1980s to the present: (1) the Gaillard Cut widening from 152 m (500') to 192 m (630'); (2) the replacement of all lock locomotive tracks; (3) the replacement and increase of the locomotives fleet with modern and powerful units; and, (4) the increase and modernization of the tugboat fleet. At present, the deepening of Gatun Lake's and Gaillard Cut's navigational channels is about to be completed; the objective of this project is to raise the system's usable water yield, as well as to deepen Canal's Pacific and Atlantic side entrances in order to enhance navigational safety. Also at present, the ACP is developing an improvements plan to maximize Canal capacity<sup>21</sup>. It is obvious that the Canal has systematically and successfully invested in increasing its capacity and its technology throughout its history, and that this has allowed it to handle the growing transit and cargo demand in a timely manner, as well as the evolution in its markets and vessel sizes, thus strengthening its advantageous competitive position.

Conscious that the Canal is the main economic resource of the Republic of Panama, the Board of Directors and administration of the ACP, in furtherance of their responsibilities, have developed a 20-year Master Plan, which has laid out the strategic foundations for the Canal's second century of operation. Beginning in 1998, the Canal administration initiated a program of studies and investigations directed toward identifying the future requirements of the waterway from a long-term perspective. As of 2000 these studies, which originally only included investigations of its water resources, were expanded to address a wide range of social, environmental, market, competitiveness, engineering, operational, financial, economic and legal issues. This extensive and complete research program, without precedent in Canal history, determined that there is an increasing, profitable and robust maritime transport demand for the Panamanian route. It also concluded that a great part of this growing demand uses, in Canal competitor routes, vessels that do not fit through the present Canal, on account of their dimensions. Consequently, the program of studies indicated the necessity to enhance Canal capacity to: (1) handle the increasing cargo volumes that are anticipated to use the maritime route through Panama; and, (2) allow the transit of larger vessels and thus take advantage of, to Panama's benefit, the economies of scale, productivity increases and efficiencies that han-

<sup>21</sup> See section 3 for a detailed description of the improvements plan.



dling these vessels entails. The ideal, most profitable and environmentally responsible means to respond to the growth opportunity of the Panamanian route and to increase Canal productivity is, as previously stated, the construction of a third set of locks of a larger size than the existing locks, together with the navigational channels required for larger vessels transits.

During its six years administrating the Canal, Panama has demonstrated that its management model for the waterway is exemplary and that, under Panamanian leadership, the Canal's administration has continuously improved, setting new records in operational and financial performance, navigational safety and productivity. The high reliability and superior level of service offered by the Canal make the Panama route one of the most competitive and utilized by the maritime industry. Consequently, today the Canal finds itself in a favorable situation, from the financial, operational and marketing standpoints, to successfully undertake a new capacity expansion, this time through the construction of a third set of locks.

## 2 Demand opportunities

**In the most probable demand scenario, during the next twenty years, cargo volume transiting the Canal will grow an average 3% per year, duplicating 2005's tonnage by 2025. Providing the Canal with the capacity to transit larger vessels will make it more efficient by allowing the transit of higher cargo volumes with relatively less transits and water utilization.**

### 2.1 The Canal's market

In order to better comprehend its market's commercial needs and offer the appropriate solutions to them, the Canal has classified its market into eight segments. These segments have been defined based on the type of cargo and the types of vessels used to transport said cargo in the routes using the Canal. These eight segments are: (1) the containership segment; (2) the dry bulk segment, moved in dry bulk vessels used for transporting grains as well as minerals or their derivatives; (3) the vehicle carrier segment; (4) the liquid bulk segment, which includes vessels transporting chemical products, gases and oil derivatives; (5) the reefer segment; (6) the cruise ship segment; (7) the general cargo vessel segment; and, (8) the miscellaneous vessel segment, which includes fishing boats, navy and research vessels, and dredges and barges, among the most frequent.

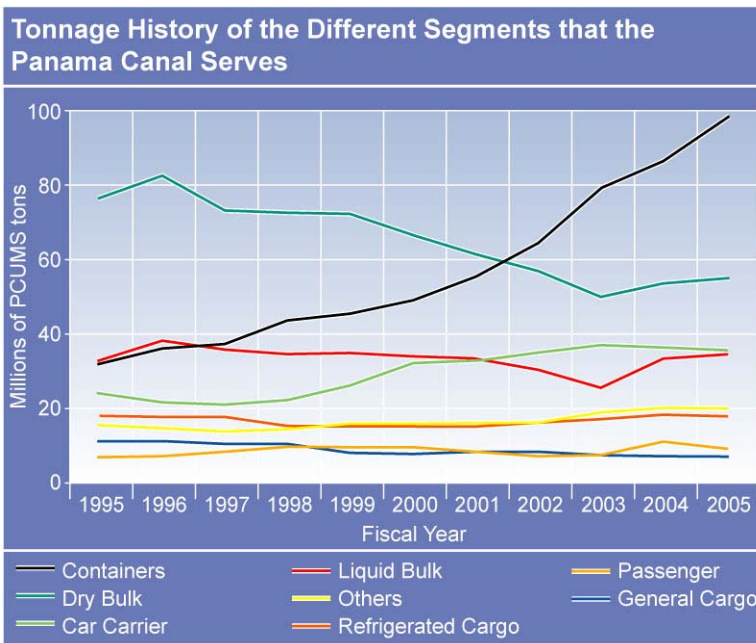


Historically, the dry and liquid bulk segments have generated most of the Canal’s revenues. Bulk cargo includes dry goods, such as grains (corn, soy, wheat, among others), minerals, fertilizers, coal, and liquid goods, such as chemical products, propane gas, crude oil, and oil derivatives. Recently, the containerized cargo segment has replaced the dry bulk segment as the Canal’s main income generator, moving it to the second place. On the other hand, the vehicle carriers segment has become the third income generator, replacing the liquid bulk segment (see figure 9).

## 2.2 Containerized cargo moved in the containership market segment

The containership segment constitutes the main driving force of Canal traffic growth. During fiscal year 2005, this segment represented, 98 million PCUMS<sup>22</sup> tons, 35% of the total PCUMS volume passing through the Canal and 40% of its revenues<sup>23</sup>. That same year, the dry bulk segment represented 55 million PCUMS tons volume and 19% of the revenues, while the vehicle carriers segment generated 35 million PCUMS tons or 11% of the income. In the containerized cargo segment, trade between Northeast Asia and the U.S. East Coast reflects the highest Canal transit growth rate<sup>24</sup>. This route now represents more than 50% of the PCUMS volume of the containerized cargo segment transiting the Canal and is anticipated to become a key Canal growth driver.

Containerships operate with regular itineraries, which follow a predefined series of port calls, similar to airline stops. Each itinerary is called a Liner Service and operates with a permanent rotation of vessels, usually weekly or



**Figure 9** Canal traffic trends per market segment from 1995 to 2005. Notice the growth of the container liner segment and the gradual decrease of the dry bulk segment that recently is showing a rebound. Other segments are relatively stable during the last ten years.

<sup>22</sup> The PCUMS ton is the unit of measure used in the Canal to establish tolls.

<sup>23</sup> Canal revenues per ship transit are divided in tolls revenues and other maritime services revenues. Toll revenues represent over 75% of revenues. These are established based on vessel PCUMS tonnage. Other maritime services include, among other, fees for the use of tugboat, launches, linehandlers, locomotive cables and booking slots.

<sup>24</sup> The Northeast of Asia includes Japan, Korea, China, Taiwan and Hong Kong.

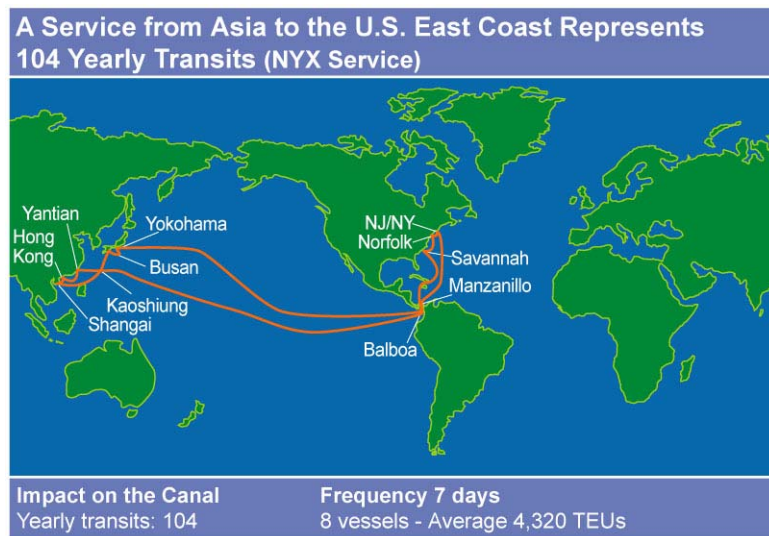




biweekly<sup>25</sup>. For example, a weekly containership service between Northeast Asia and the U.S. East Coast through the Panama Canal requires an 8-ship rotation to cover its port calls and sailing times without interruptions (see figure 10). Each 8-vessel rotation generates 2 Canal transits per week or 104 transits per year, which are predictable, programmed and confirmed, and generally require transiting on the same weekday, every week.

In order that a weekly service operator may avoid incurring additional expenses due to delays or the need to use additional vessels, reliability of service becomes one of the most important factors in the selection of the itineraries and routes to be used<sup>26</sup>. Service reliability is so important because any significant delay at any point in the route has costly impacts, which have repercussions on a vessel's subsequent port calls. One single capacity shortage will have a negative impact on the availability and reliability of the Panama route for this segment.

Because liner services operate with itineraries, they demand reliable time schedules from the different components of the transportation chain, whether it be ports, canals, or support services. Any delay or failure in this logistics chain results in higher costs and important potential losses, both for ship-owners and cargo owners. Besides higher costs, future delays in Canal transits will cause other delays due to the shipper's need to reprogram dockings for cargo unloading and loading as well as additional un-budgeted land transportation cargo needs in the event a vessel has to forego a port in order to get back on its itinerary. In short, delays and interruptions in Canal traffic cause the Panama route to become more expensive and affect Canal competitiveness. Therefore, in order to maintain the reliability of the Panama maritime route and the value added to its users and the transportation



**Figure 10** This map illustrates a typical containership service in the Asia to the U.S. East Coast route using the Panama Canal. For each weekly service in this route 8 vessels in rotation are deployed, which results in 104 annual transits and approximately B/.15 millions in yearly transit fees.

<sup>25</sup> Inasmuch as containerships operate in itineraries called Liner Services, they are known in the English jargon as "liners".

<sup>26</sup> A reliable service implies that users have great certainty regarding the transit date. This requires that Canal service be stable, safe, and highly predictable, with low variability, so users could schedule their transits with as much anticipation as they may require.





chains that they are part of, the Canal must have enough capacity to avoid delays and to respond to the needs of the maritime transport industry that operates on itineraries, such as containerized cargo services, cruise ships and vehicle carriers, among others. This capacity would also be required in order to avoid recurrent delays and unpredictable variability in the service level. Only with sufficient capacity will the Canal be able to offer expeditious, predictable, reliable and safe service, thereby adding value to the transportation chains it is a part of.

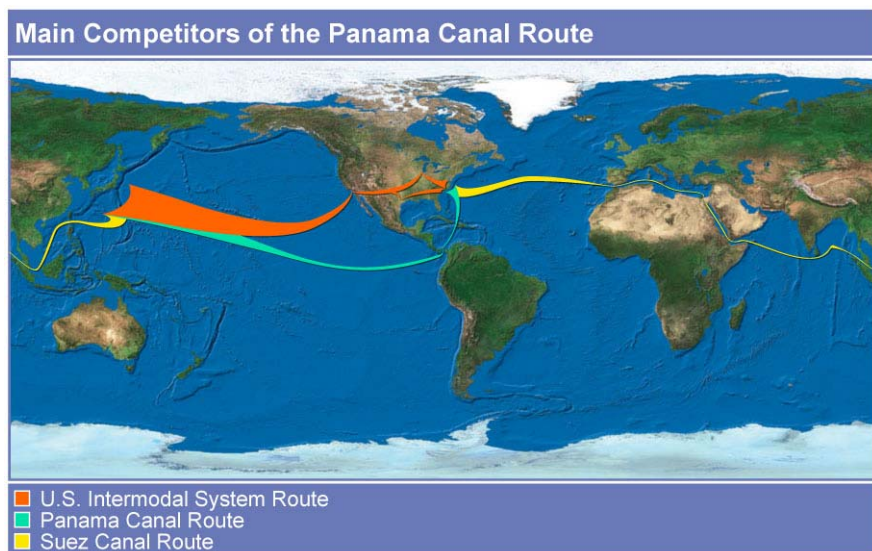
### 2.3 Competitive setting

The most direct competition to the Canal is from alternative routes which present options for the transport of cargo between the same geographical points of origin and destination. Among these competitors are the U.S. intermodal system, the Suez Canal and the maritime routes through the Cape of Good Hope and Cape Horn. Presently the two main competitors of the Panama Canal are the U.S. intermodal system and the Suez Canal (see figure 11).

### 2.4 The U.S. intermodal system

The Panama Canal competes with the U.S. intermodal system in the Northeast Asia – U.S. East Coast route, in which the client may choose between the route through the Canal, which is less costly and highly reliable but has larger navigation times, or the U.S. intermodal system route, which is a land extension of the transpacific route, with shorter times but higher costs and more variability in service dependability. At present, the Panama Canal has a 38% market share of the Northeast Asia – U.S. East Coast route, the intermodal system a 61% share, and the Suez Canal a 1% share (see figure 12).

The U.S. intermodal



**Figure 11** The transpacific maritime route in conjunction with the U.S. rail network constitutes the U.S. Intermodal System, which is the main Canal competitor in the maritime commerce between North East Asia and the U.S. East Coast. The route through the Panama Canal is an “all water” route while the Intermodal route runs partially on land.



system includes the transpacific maritime route<sup>27</sup>, the U.S. East Coast ports (Los Angeles, Long Beach and Seattle, among other) and its railroad and transcontinental road system. This system joins the above mentioned ports with the main consumer centers in the U.S. East Coast. This intermodal system is not an integrated operational unit, since it is comprised of diverse components with a large number of commercial operators (ports, railroads, trucks, transshipment areas, and municipal and state governments). During the last decade, the port and railroad components of the intermodal system have experienced congestions on account of the growth in Asian-originated trade. This growth has overwhelmed the system’s capacity, and this, added to labor conflicts, has affected the route’s reliability. Furthermore, pressure from environmentalist groups against infrastructure projects that might result in higher environmental pollution and the introduction of municipal, state or federal taxes and regulations, has contributed and will continue to contribute to the rise in the intermodal system’s prices.

One of the major advantages offered by the intermodal system to carriers on the transpacific route is the possibility of making the most of the economies of scale offered by the use of post-Panamax vessels. Additionally, it allows carriers to generate higher income with a better return on investment since the transpacific route only requires five ships for a weekly service rotation, as opposed to the eight ships required by the Panama Canal route. However, the route’s land component, in particular the U.S. Pacific coast ports and railroad system, face labor, environmental, community and capacity problems that may only be solved through substantial long-term investments.

The increase observed in the Canal’s share in the Northeast Asia – U.S. East Coast route market may be primarily attributed to the reduction in Canal transit times, simultaneous reduction in intermodal

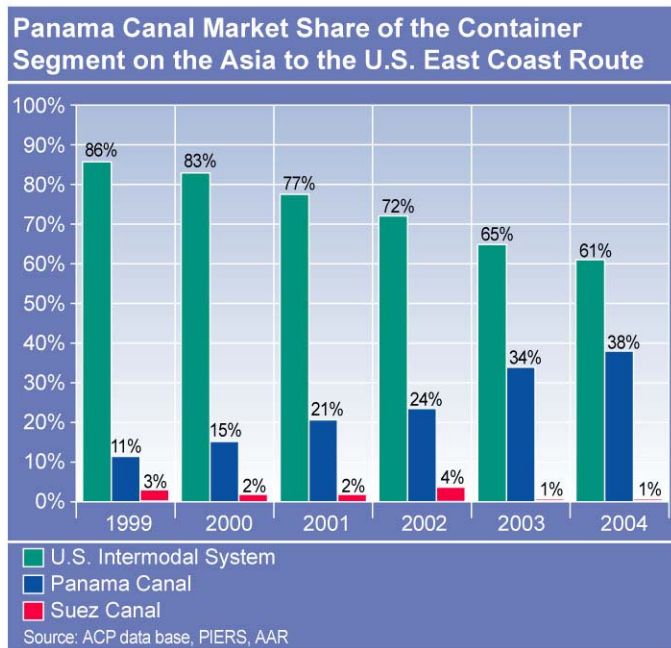


Figure 12 The Canal route is gaining market share in the Asia to the U.S. East Coast containerized cargo market segment.

<sup>27</sup> The transpacific route consists in containership services between Asia and U.S. West Coast. This route regularly utilizes post-Panamax containerships.



system reliability due to congestion problems, and an increase in the number of distribution centers for Asian-imported goods located in the U.S. East Coast, closer to the ports of entry and end-consumer areas.

## 2.5 The route through the Suez Canal

The Panama Canal also competes with the Suez Canal in the Asia – U.S. East Coast route. The Suez route is preferred for cargo originating mainly in South and Southeast Asia<sup>28</sup> heading to the U.S. East Coast, because it offers shorter sailing times than the Panama Canal route. For cargo originating in Northeast Asia, the Panama Canal route and the transpacific route connected to the intermodal system are more efficient. However, since the intermodal system continues to face growing costs and congestion, and the Panama Canal is not capable of handling growing demands, carriers will tend to choose the Suez route, even though its navigation times are longer.

At this moment the main advantage of the Suez route lies in that carriers are able to use post-Panamax vessels, which is not possible in the Panama route. A weekly containership service between Northeast Asia and the U.S. East Coast using the Suez Canal requires 11 vessels, depending on the number of scheduled port calls. As we have mentioned before, for the Canal, this same service requires 8 vessels. This means that on the Suez route each vessel will make 4.7 round trips per year, with a round trip travel time of 77 days. Through the Panama Canal, each vessel will make 6.5 round trips per year, with a 56 day round trip travel time. This indicates that the Panama Canal offers an important advantage in terms of vessel productivity, so long as the vessels used have similar capacities.

As the Suez Canal allows the transit of post-Panamax vessels, it reduces the advantage offered by the Panama Canal. For instance, a weekly service of 11 8,000-TEUs<sup>29</sup> post-Panamax vessels through the Suez Canal renders the shipper an annual productivity of nearly 38,000 TEUs per vessel and a total annual service capacity of over 410,000 TEUs. Through the Panama Canal, this same service using 8 4,800 TEU Panamax vessels allows the shipper an annual productivity of nearly 31,000 TEUs per ship, and a total service capacity of 248,000 TEUs. This means that the productivity per post-Panamax vessel through the Suez Canal is higher than that of Panamax vessels through the Panama Canal, which, in turn, offers the shipper the possibility to increase its revenues even though the operational cost of

<sup>28</sup> Cargo coming from South and Southeast Asia includes cargo originated in India, Malaysia, Indonesia and Bangladesh, among other countries.

<sup>29</sup> One TEU (*twenty-foot equivalent unit*) is the term employed to identify a 20-foot maritime container or its equivalent.



using more ships may be greater. In contrast, if the Panama Canal had the capacity to allow the transit of 8,000 TEUs containerships, this would permit carriers to obtain an annual productivity of 52,000 TEUs per vessel. This represents 14,000 TEUs more of annual vessel capacity over the Suez route and a total annual service capacity of over 410,000 TEUs, which would be attained with 8 vessels instead of the 11 vessels used by the Suez Canal.

Although the longer sailing times and the use of a larger number of vessels in the Suez route gives the Panama route an important competitive advantage, the use of post-Panamax vessels through Suez reduces that advantage. Right now the Panama Canal, compared to the Suez Canal, offers a 23% savings in total transportation cost per container (round trip) for Panamax<sup>30</sup> vessels. This advantage is reduced to 14% when comparing the cost of using a 6,000-TEU post-Panamax vessel in the Suez route versus a Panamax vessel in the Panama Canal route. When the Panama Canal can allow post-Panamax containership transits, the Panama route will again offer the maritime transport industry a 23% advantage on total transportation cost, compared to the Suez Canal route.

As a result, the Suez Canal will be the main beneficiary of the capacity shortage of the Panama Canal, since it will pick up the cargo that neither the intermodal system nor the Panama Canal may serve. With a third set of locks capable of handling post-Panamax vessels, the Canal will again maximize its comparative advantage with respect to the Suez route.

## 2.6 Other potential routes for cargo carried between Northeast Asia and the U.S. East Coast

The Panama Canal will possibly have to face new competitors that will try to capture part of the growing cargo demand that cannot be handled by the Canal or the U.S. intermodal system. Standing out among these potential routes is a possible intermodal connection between ports in the Pacific Coast of Mexico or Canada and the U.S., and the development of intermodal systems through the Central American Isthmus<sup>31</sup>. There are additional potential routes that do not have much chance of materializing as competitive routes, such as a hypothetical route through the Arctic.

- **Intermodal connection between ports in the West Coast of Mexico and Canada to the U.S.** From cost and efficiency

<sup>30</sup> R.K. Johns and Associates numbers for "total roundtrip cost per TEU," adjusted on the basis of \$54.00 per TEU plus other costs for Canal maritime services and, for Suez, it includes the 3% increase that Suez implemented in January 2006.

<sup>31</sup> An intermodal system through the Central American isthmus could be built through Nicaragua, Guatemala or Costa Rica.



standpoints, the transportation of containerized cargo between ports in the West Coast of Mexico or Canada and its integration into the U.S. railroad and road systems would seem like a viable alternative. Unlike to the so-called dry canal through the Central American Isthmus, this option does not require that containers be reloaded on board another vessel in order to get to its final destination. This means that cargo handling is reduced, and so are costs, transportation times and the need for additional vessels.

At the present time there are studies that analyze the possibility of a north-south intermodal system that would connect the ports in the Pacific Coast of Mexico or Canada with the U.S. through Dallas and Chicago, respectively. Of all potential routes, this is the only one that may be developed, since it represents the natural extension of the existing North American intermodal system. However, this route requires substantial investments and would have to cross borders and requires the coordination of different transportation systems, which reduces its appeal and competitiveness.

- **An intermodal system through the Central American isthmus.** There are numerous studies related to an intermodal system, usually referred to as a dry canal, through the Central American isthmus. This intermodal system would require the unloading of a vessel on one of the coasts, moving the cargo to the other coast via railroad or truck, to then load it on board another vessel that would complete the route up to the port of destination.

As for containerized cargo, the main disadvantage of a dry canal lies in the need to handle each container up to six times before it may be loaded on board a vessel that will take it to its final destination. The six movements of a container moved through a dry canal would be: (1) from the first vessel to a container yard; (2) from the yard to a truck; (3) from the truck to the train; (4) from the train to another truck; (5) from this truck to another yard; and, (6) from that yard to the second vessel. This could be reduced to four or five movements if there were enough trucks, trains and available space to unload and load a 4,000-TEU or bigger vessel without the need for temporary storage in the container yard, but this would increase investment costs significantly.

Each of these six movements required to transport containers through a dry canal raises the cost of the route and increases the possibility of the cargo being exposed to tampering and delays.





To put it into perspective, right now moving a container from the vessel to the yard costs an average of between \$80.00 and \$200.00<sup>32</sup> and moving a container via railroad from one port to another costs approximately \$175.00. In contrast, transiting that same container through the Canal now costs \$49.00. Furthermore, a train designed to transport containers has an average capacity of between 200 and 300 TEUs. Consequently, transporting the cargo equivalent to a 4,000-TEU Panamax vessel would require up to 20 train trips and moving containers from an 8,000-TEU post-Panamax vessel would require up to 40 train trips.

The intermodal system through the Central American isthmus would require you to double the amount of vessels necessary to handle the same amount of cargo through the Panama Canal route. Hence, each of the studies performed on this potential route eventually must confront the reality that the maritime route through the Panama Canal is the best alternative for transoceanic cargo transportation, from a cost, time, safety, and reliability point of view, because it requires a lower investment on ships, represents lower operational costs and less cargo movements. The intermodal system through the Central American isthmus would turn out to be slow and variable in service quality, as well as more costly and risky than the Canal, and, therefore, it is not a competitive or profitable option; it also presents substantial environmental impact considerations.

In contrast to the Central American intermodal system, the Panamanian intermodal connection complements the Panama Canal, repositioning cargo between its terminal ports. This adds even more value to the route, since it reinforces Panama's role as a containerized cargo storage and transshipment center. Likewise, the possible construction of other ports is conceived as a complement to the Canal, with its future closely related to the traffic that the expanded Canal would handle. There is very little cargo of local origin or destination, which represents less than 10% of what the ports move. The Canal attracts main line vessels and these unload a small portion of containers to be transferred to other main line vessels later on, or to feeder ships that distribute cargo in the region<sup>33</sup>. Consequently, the cargo transshipped in Panamanian ports comes from Canal traffic flows as a result of the synergy and connectivity of these ports with the Canal. The viability for increased port activity in Panama is closely associ-

<sup>32</sup> Source: Manzanillo International Terminal (MIT) and Panamá Ports.

<sup>33</sup> Under a transshipment scheme for cargo coming from post-Panamax mother vessels, a 4,000 TEU Panamax feeder might deliver or pick up between 300 and 400 containers in Panamanian ports.





ated with the increasing container traffic volumes at the Canal, which may only be sustained in the medium and long terms if it is expanded.

Not expanding the Canal's capacity would substantially diminish the growth potential of existing ports and the appeal of additional ports. What has allowed, so far, the Panamanian port business to flourish is precisely the fact that the Canal has kept and improved the route's reliability, something that would not be possible once the Canal reaches its maximum capacity.

- **The possibility of a route through the Arctic.** Many studies have been developed recently in relation to the phenomena of global warming, which indicate that the Arctic ice cover is gradually thinning, and that, by the end of the 21st century during the summer months, the Arctic might be partially free of ice. It is speculated that, by that time, a seasonal maritime commercial route might be opened between Asia and the U.S. East Coast through the Arctic, to the north of Canada.

In January 2005, a team of scientists<sup>34</sup> from the U.S. Arctic Research Commission presented to the ACP, in Panama, their analysis and conclusions on the possibility of future commercial navigation through the Arctic. These scientists concluded that during the 21<sup>st</sup> century the central Arctic and all its peripheral seas will continue to have a significant ice cover. It is probable that after the year 2050 the so-called Northwest Passage to the north of Canada could be ice-free during the three summer months and could be navigable to ships other than icebreakers during this short period. It is forecasted that the Central Arctic Ocean will have a significant ice cover during the rest of the year, which would hinder routine commercial navigation.

These results coincide with results from other studies, such as the one submitted in August 2005 by a team of scientist's from the University of Arizona<sup>35</sup> on the potential melting of the Arctic. This study concludes that with the present melting rate, the Arctic might lose its ice cap during the summer months at the end of this century. It is not probable that carriers who offer liner services itineraries between Northeast Asia and the U.S. East Coast, will divert services from the Panama or the transpacific routes to

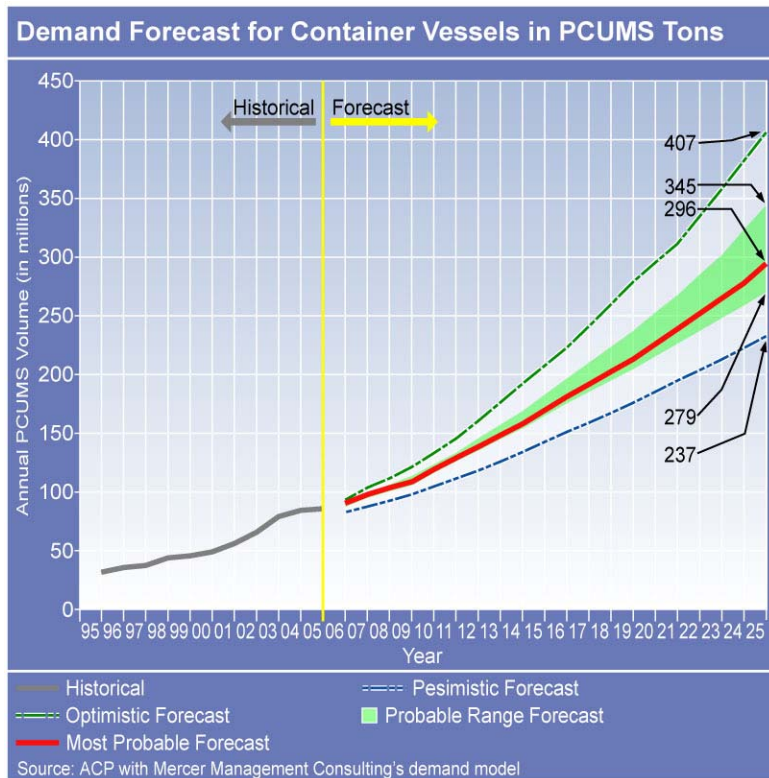
<sup>34</sup> The scientific team from the Arctic Research Commission is led by doctors George B. Newton and Lawson Brigham. Dr. Newton is the person designated by the President of the United States as Chairman of the *U.S. Arctic Research Commission*. Dr. Brigham has broad icebreaker vessels operation experience in the Arctic and the Antarctic. He was the commanding officer of icebreaker POLAR SEA and has been involved in Arctic issues and Arctic research matters for over three decades.

<sup>35</sup> Led by Jonathan T. Overpeck, *Arctic System on Trajectory to New, Seasonally Ice-Free State*, *Eos*, Vol. 86, No. 34, 23 August 2005.



the alleged Arctic route for two or three months every year, especially when the route's navigability and availability will be unpredictable, it will lack navigational aids, have little port connectivity and comprise Canadian jurisdictional waters, particularly when we consider that itinerary operated services are established in terms of route reliability, certainty and safety.

Consequently, a route through the Arctic is highly speculative given the present uncertainty about the magnitude of the ice cover and the phenomenon's seasonal characteristics. At any rate, the route would only be partially viable for commerce during very few months of the year and would not be dependable in terms of navigability, occurrence, and duration. Furthermore, it is speculated that this would only come about after the second half of this century, in 50 or 100 years, and even then, vessels would be exposed to the danger of floating ice.



**Figure 13** In the most probable demand scenario, the container market segment will grow an average of 5.6% per year in the next 20 years.

### 2.7 Demand opportunity

The Panama Canal has before it the opportunity to capture the growing flows of world trade for which Panama's maritime route represents an economically attractive, safe and reliable alternative. Marketing studies and projections indicate that in the most probable demand scenario<sup>36</sup>, the Canal's PCUMS tonnage volume will almost double in the next twenty years, increasing by an average of 3% per

<sup>36</sup> Canal market projections supporting this proposal are based on market research conducted by expert companies in this field. For traffic projections, for instance, a demand model developed by Mercer Management Consulting, based on economic studies performed by DRI-WEFA (Global Insight today) and market research by Fearnley Consultants, Richardson Laurie, Nathan Associates, Global Insight, Louis Berger Group, Mercer Management Consulting and Merge Global, among others. These studies projections have been confirmed by independent publications and thorough consultation with Canal clients and users, as well as with the Canal Advisory Board.



year. This scenario is consistent with a 3.5% annual increase of the Canal's tolls that would result in a doubling of present tolls by 2025.

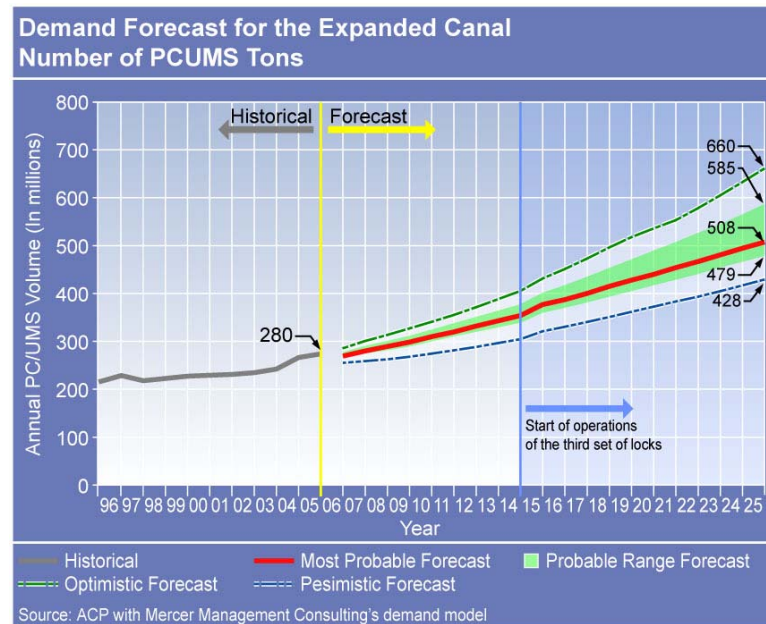
In the most probable scenario, Canal containerized cargo will increase at an average annual rate of approximately 5.6%, from 98 million PCUMS tons in 2005 to nearly 296 million in 2025. In the highest growth scenario, containerized cargo volume would grow to reach 345 million PCUMS tons in 2025, and in the lowest growth scenario it would reach 279 million PCUMS tons in 2025 (see figure 13). The drivers of containerized cargo growth are: (1) world trade growth; (2) growth of containerized cargo as a percentage of world trade; (3) manufacturing relocation to the northeast of Asia, particularly to China; and, (4) regional and intraregional demand growth<sup>37</sup>. In this sense, container shipping activities increased on average 10.4% per year between 1995 and 2005, which has caused the expansion of the container fleet by 11% per year during the last decade, with the highest growth being in the larger vessels, specially 7,000 TEUs vessels that do not fit through the Canal.

On the other hand, the vehicle carrier and cruise ships segments will have an average annual growth of between 2% and 3% in terms of PCUMS volume. The dry bulk segment will grow at an average annual rate of approximately 1% during the

Comparison of Tonnage Growth per Segment			
PCUMS Tons Per Market Segment*	Year 2005	Year 2025	
		Canal without an expansion	Canal with an expansion
Containers	98	185	296
Dry Bulk	55	49	73
Liquid Bulk	34	19	28
Passenger	10	13	19
Car Carrier	36	40	58
Refrigerated Cargo	19	15	22
General Cargo	7	3	4
Others	20	6	8
<b>Total PCUMS Tons</b>	<b>279</b>	<b>330</b>	<b>508</b>

\*Millions of PCUMS tons

**Figure 14** The liner container, dry bulk, and vehicle carrier market segments will comprise over 80% of PCUMS tons in the year 2025.



**Figure 15** In the most probable case scenario, a 3% annual growth in the Panama Canal traffic volume is expected. By the 2025 fiscal year, the annual PCUMS total will reach 508 million tons.

<sup>37</sup> The Large Containership Sector, April 6, 2006, Clarkson Research Services.

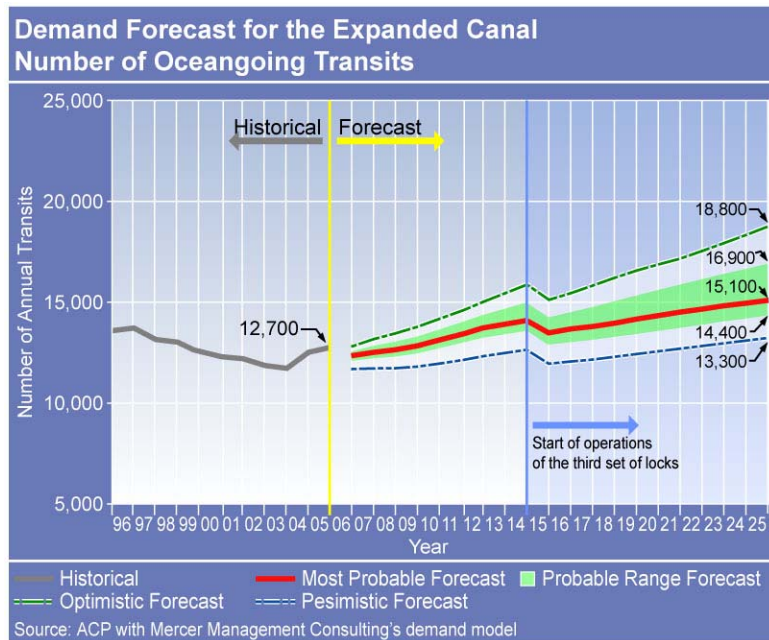


next twenty years (see figure 14). There is no indication in the studies performed that containership transits through the Panama Canal will decrease.

In the most probable scenario, Canal traffic volume will go up from the 279 million PCUMS tons that passed through the Canal during fiscal year 2005 to nearly 510 million PCUMS tons in fiscal year 2025, which represents an 82% increase. In the highest growth scenario, traffic will rise to 585 million PCUMS tons in 2025, while in the lowest growth scenario it will increase up to almost 480 million PCUMS tons in 2025. This represents a growth of between 72% and 110%, respectively (see figures 15 y 16).

With sufficient capacity, the Canal will strengthen its competitive position and Panama's role as the connectivity center for transportation, transshipping and logistics in the hemisphere. At present, 60% of the vessels using Panamanian ports transit the Canal, which highlights the Canal's importance as the driving force of the country's port activity. Therefore, any additional port development adjacent to the Canal, a mega port on the Pacific side, for instance, would only reach its real potential with the expansion of the Canal.

Strengthening its competitive position will increase the Canal's market share in regard to its competitors, such as the Suez Canal and the U.S. intermodal system, and will also discourage new potential competitors from entering the business. If the Canal were to have the capacity to serve the growing demand, Panama would be transformed into the most important connectivity hub in the continent by joining together at the isthmus the North-South continental routes with the East-West transcontinental routes. Accordingly, the Canal would continue to be viable and competitive in all of its routes and segments, and contribute significantly to Panama's development and growth while maintaining its position as one of the main world trade routes.



**Figure 16** The demand for the expanded Canal with the third set of locks will total approximately 15,000 transits annually by fiscal year 2025. After 2015, a rapid migration to vessels larger than Panamax is expected.





## 2.8 Opportunity to make the Canal more efficient, productive and competitive

The growing trend to use post-Panamax containerships in transcontinental routes competing with the Canal is irreversible<sup>38</sup>. The main ports and merchandise distribution centers in these routes are investing in capacity, location, and maritime and land infrastructure in order to serve these vessels and handle their cargo volumes.

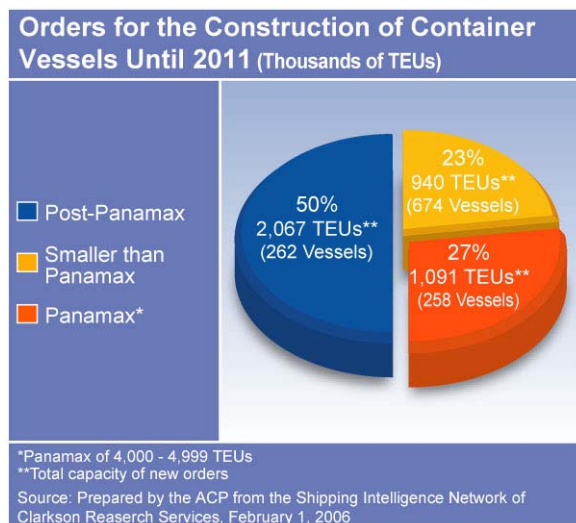
Main U.S. East Coast Ports						
Port	Movements Year 2005 (M. TEU)	Capacity (M. TEU)		Investment	Current Maximum Depth	Improvements
		Current	Future			
NY/NJ	4.40	4.60	6.20	B/. 1,700 M.	14m (46')	Channel deepening to 15.24m (50') of draft, additional space, 4 Post-Panamax cranes
Savannah	1.70	2.41	4.37	B/. 707 M.	12.8m (42')	640m (2,100') dock length, storage area, Post-Panamax cranes, deepening to 14.6m (48')
Charleston	1.98	2.00	4.00	B/. 823 M.	13.7m (45')	Construction of new terminal, 4 Super Post-Panamax cranes, yard equipment
Virginia	1.98	2.40	10.22	B/. 2,756 M.	13.7m (45')	APM terminal will be complete by July 2007, channel dredging from 15.2m (50') to 16.8, (55'), 29 Post-Panamax cranes, inland port, long term: construction of Craney Island terminal (2017 - 2032)

Source: Port Authorities, April 2006

**Figure 17** Expected infrastructure investments in some of the main ports in the U.S. East Coast for handling vessels larger than Panamax. If the Panama Canal does not expand, these vessels would use the Suez Canal route.

The main ports in the U.S. East Coast, with which the Canal shares interests and commercial objectives, are investing in the necessary infrastructure to handle post-Panamax vessels (see figure 17). As mentioned before, today these vessels can only be used in the Northeast Asia to U.S. East Coast route through the Suez Canal. If the Canal wants to maintain its present competitiveness in the presence of the advantage already offered by the Suez route, it will have to acquire the capacity to handle, within a relatively short time, growing trade volumes to be transported in post-Panamax vessels through the Panama route.

Right now, post-Panamax vessels that do not fit through the Canal<sup>39</sup> represent 27% of the world's capacity of containerized maritime shipping, while shipyards have con-



**Figure 18** Half of current container vessel construction capacity is in Post-Panamax vessels.

<sup>38</sup> Post-Panamax containerships are mainly placed on the transpacific route in combination with the intermodal system and the Suez Canal route.

<sup>39</sup> *The Drewry Container Market Quarterly, December 2005. Shipping Intelligence Network, February 1, 2006, Clarkson Research Services.*



tracts to build over 250 additional vessels of this size to be delivered in the next four years, between 2006 and 2011<sup>40</sup> (see figure 18). By the end of 2011, the total post-Panamax containership fleet will consist of approximately 670 ships with a total capacity of almost 4.6 million TEUs, close to double the capacity of the existing post-Panamax fleet (see figure 19)<sup>41</sup>. Therefore, for the year 2011, approximately 37% of the capacity of the world's containership fleet will consist of vessels that do not fit through the Canal, and a great part of this fleet will be placed in routes that compete with Panama's route, such as the transpacific-intermodal route and the Suez Canal route.

Post-Panamax Container Vessel Fleet								
Shipping Company	Existing Post-Panamax Vessel Fleet (Feb. 2006)			New Orders for Post-Panamax Container Vessels			Total Fleet in 2011	
	Total Capacity of existing Post-Panamax Vessels	TEU Range	Total Existing Post-Panamax Vessels	Total Capacity of New Orders	TEU Range	Total Post-Panamax Vessels on order	Number of Post-Panamax Vessels	TEU Capacity
Maersk Line*	409,066	3,700-9,200	62	388,108	12,000-6,500	42	104	797,174
Mediterranean Shipping (MSC)	146,525	9,200-5,500	20	95,000	9,200-5,500	13	33	241,525
CMA-CMG	107,074	9,160-5,700	16	42,920	9,160-8,200	5	21	149,994
Evergreen Mar. Co.	151,310	5,364-7,024	27	57,241	7,024	8	35	208,551
Hapag Lloyd Cont.	45,916	8,600-7,180	6	50,600	8,600-8,100	6	12	96,516
China Shipping	81,712	8,468-5,618	14	52,230	9,580-8,530	6	20	133,942
Hanjin Shipping Co.	37,126	5,308	7	52,000	6,500	8	15	89,126
APL	92,030	5,500-4,300	20				20	92,030
Coscon	84,978	5,270-5,576	16	80,000	10,000	8	24	164,978
Nippon Yusen Kaisha (NYK)	79,179	6,492-4,743	13	123,600	8,200-6,500	16	29	202,779
Mitsui O.S.K.	71,537	4,708-6,350	13	80,350	8,100-6,350	11	24	151,887
OOCL	115,632	8,063-4,960	20	32,252	8,063	4	24	147,884
K"Line"	78,220	5,500-5,624	14	87,546	8,120-5,624	12	26	165,766
Yang Ming	55,132	5,512	10	73,000	8,000	9	19	128,132
Hamburg Sud	33,312	5,552	6	55,560	5,500	10	16	88,872
Hyundai	32,315	4,411-5,700	6	116,400	8,600-6,800	15	21	148,715
Others	895,884	4,330-9,449	135	680,083	9,580-5,527	89	224	1,575,967
<b>Total</b>	<b>2,516,948</b>		<b>405</b>	<b>2,066,890</b>		<b>262</b>	<b>667</b>	<b>4,583,838</b>

\*Includes vessels from P&O Nedlloyd, now Maersk Line.  
Source: Shipping Intelligence Network, 1 February 2006, Clarkson Research Services

**Figure 19** By 2011 the cargo capacity will almost double with a fleet of 667 vessels larger than Panamax. Between 2006 and 2011, with 64% more vessels, the fleet cargo capacity will increase 82%. Most vessel construction orders are in the larger categories of greater than 7,000 TEUs.

Though it is true that both the existing amount of post-Panamax containerships and those on order is significant, the number of these

<sup>40</sup> Shipping Intelligence Network, February 1, 2006, Clarkson Research Services.

<sup>41</sup> Shipping Intelligence Network, February 1, 2006, Clarkson Research Services.





vessels becomes more relevant when we understand that they work on rotation and that one vessel travels the same route many times in a year. By way of example, in January 2006 there were 36 liner services<sup>42</sup> operating with 291 containerships, of which 168<sup>43</sup> were Panamax vessels, in the Northeast Asia – U.S. East Coast route through the Panama Canal. In 2005, these 291 Panamax vessels generated \$377 million or 33.8% of Canal revenues, 2,119 transits and over 85 million PCUMS tons<sup>44</sup>. In conclusion, a reduced number of large vessels, operating on permanent rotation, represent important traffic and revenue volumes for the Panama Canal.

The growing use of post-Panamax containerships offers the Canal the opportunity to: (1) be more profitable by handling larger cargo volumes with relatively less vessels; (2) be more efficient and flexible in handling its vessels mix<sup>45</sup>; (3) strengthen its competitive position by eliminating the restrictions that the Panama route imposes on the maritime industry today; and, (4) allow the transit of the most efficient vessels for each route.

Market analyses and the information gathered from the maritime industry conclude that if the Canal had locks with the dimensions required to transit post-Panamax vessels, carriers would place them regularly in the Canal route<sup>46</sup>. These ships will mainly operate in the East-West transcontinental routes and, initially, replace a portion of the services that use Panamax vessels, and, after that, they would add new services.

By having more capacity, post-Panamax vessels are more efficient and productive in the longest routes, with high cargo volumes, such as the Northeast Asia – U.S. East Coast route through the Canal. This is mainly due to the benefits obtained from the economies of

Percentage Cost Savings per TEU per Voyage - Post-Panamax Vessels (Compared with a Weekly 4,000 TEU Panamax Vessel Service)		
Route	6,000 TEU Vessel	8,000 TEU Vessel
Asia - U.S. East Coast	8%	16%
Asia - U.S. West Coast	8%	17%
Asia - U.S. East Coast through Suez	7%	17%

Source: Transpacific Vessel Deployment Options with an Expanded Panama Canal, R.K. Johns & Associates Inc. 2004

**Figure 20** 8000 TEUs container vessels have operating costs 16% to 17% lower than the 4000 TEUs Panamax size vessels.

<sup>42</sup> This fleet can transport 5.9 million TEU per year.

<sup>43</sup> Source: *Compair Data*, January 2006

<sup>44</sup> Representing approximately 47% of Canal transiting tonnage for FY2005 and nearly 86% of the containerships segment.

<sup>45</sup> The “vessel mix” concept refers to the ratio of vessel types and sizes that transit the Canal. This vessel mix is one of the factors that determine Canal capacity, since certain types of larger vessel, with greater operational restrictions, utilize a proportionately larger portion of the Canal Capacity.

<sup>46</sup> Information gathered by ACP through primary investigation on carriers and ports in Canal key routes. As from 2003, the Panama Canal Authority has undersigned mutual cooperation agreements with the most important ports of the U.S. East Coast and the Gulf of Mexico, which constitute the origin and destination of more than 60% of Canal transiting cargo. These agreements’ major purpose is to exchange critical information for making decisions, promoting the maritime route through the Canal destined to these ports, and take joint marketing actions. Agreements have been undersigned with the port authorities of New York/New Jersey, Georgia, Virginia, Massachusetts, South Carolina, Miami, Houston, New Orleans and Tampa. This includes extensive consultations with the Canal Advisory Board.



scale offered by these vessels, which reduce the operating cost per TEU to the shipper<sup>47</sup> by between 7% and 17%, thus making the use of post-Panamax vessels more appealing and advantageous (see figure 20). The possibility of the Canal being able to transit these vessels will increase the value of the route, intensify the country's connectivity, and consolidate the competitive advantage of Panama's maritime route over alternative routes.

The Canal, expanded with larger locks, besides allowing post-Panamax containerships to transit, will facilitate the transit of post-Panamax liquid bulk vessels (*Suezmax*)<sup>48</sup>, dry bulk vessels (*Capesize*), vessels for transporting liquefied natural gas and passenger vessels. Consequently, it will open the Panama route to new markets that, due to the present size of Canal locks, have not been able to develop. Among these new markets is the transport of coal from the U.S. and Colombia to East Asia, oil from Venezuela to East Asia, natural gas from Peru to the U.S. East and South Coasts, as well as post-Panamax cruise ships. For this reason, the Canal, with capacity to transit larger vessels, will: (1) increase the intensity and frequency of traffic through the Isthmus; (2) expand the variety and scope of the commerce that passes through the Canal; (3) multiply substantially the connectivity potential of the Panamanian Isthmus<sup>49</sup>; and, (4) intensify Panama's growth potential as a transcontinental transportation, transshipping and logistics center.

Other than representing an important competitive advantage for the Canal, post-Panamax vessel transits will allow the Panama route to handle growing cargo volumes with fewer transits. This, in turn, will allow the Canal to maximize revenues, reduce operating costs and water utilization, while maintaining more leeway in its operational and water capacity. Post-Panamax vessels can transport more than double the cargo of Panamax vessels; thus, in 2025, the Canal, expanded with a third set of locks, could transit over 3,000 post-Panamax containerships, which would be equivalent to transiting approximately 6,000 Panamax containerships.

Given that the Canal charges tolls according to vessel cargo capacity and not according to the number of transits, having the ability to serve post-Panamax vessels will allow the Canal to benefit from the economies of scale, efficiency, and productivity offered by these vessels. It would be necessary to build two Panamax lock lanes, like the existing ones, in order to equal the PCUMS tonnage capacity that

<sup>47</sup> As compared with a Panamax vessel with a 4,500 TEU capacity.

<sup>48</sup> Typical *Capesize* y *Suezmax* vessels have a deadweight of 130,000 - 140,000 tons; a 270 - 280 m length, and a 40 - 45 m width.

<sup>49</sup> Panama is listed among the top 20 countries in the world in terms of connectivity, mainly thanks to the fact that over 12,000 deep draft vessels transit the Canal annually, which has had an effect on the port and intermodal center's development.



could transit through the Canal in one single post-Panamax lock lane. Therefore, post-Panamax locks are financially sound because one post-Panamax lane requires a lower investment, lower operational and maintenance costs, and less water to satisfy Canal capacity requirements, while eliminating the restrictions that it imposes on the maritime industry, thus adding value to Panama's route and therefore strengthening the ability of the Canal to establish higher tolls.

Even though the advantages of using post-Panamax vessels are important to both the Canal and carriers, there are, and will continue to be, routes and segments for which using Panamax or smaller vessels will still be economically appropriate in the long term<sup>50</sup>. The benefits of an expanded Canal for these routes and segments is that, thanks to the increase in operational capacity brought about by a third set of locks, plus the replacement of Panama vessels for post-Panamax vessels in several segments, these routes and segments will be able to obtain more transit availability and better service levels. Should the new locks not be built, service levels and transit availability will start deteriorating after the existing Canal reaches its maximum capacity. The impact of the Canal working at its maximum capacity on these segments and routes is even worse, since already many of them do not have alternatives and depend on the Panama Canal to be able to develop.

The installation of the proposed third set of locks will mean more benefits for Panama since it will permit Canal users to utilize the size of ships that allow them to develop the most appropriate economies of scale for their routes<sup>51</sup>. The proposed locks require a lower investment than those of the size of the present locks in order to provide the Canal with the necessary capacity to make the most of demand. Additionally, they will allow the Canal to handle larger PCUMS tonnage volumes with each lockage, lowering the resources and water utilized and obtaining a more profitable and productive Canal. Furnishing the Canal with larger locks will place Panama in the route of merchandise carried in post-Panamax vessels, which will drive the country's growth as a transcontinental logistics and transportation center.

<sup>50</sup> The routes and segments for which Panama and smaller sized vessels will continue to be important include the following segments refrigerated cargo vessels, vehicle carriers, general cargo, fishing boats, oil derivative products regional routes, and containerized cargo regional routes, among others.

<sup>51</sup> The third set of locks will let the maritime industry make the most of Panamax vessels using the Panama route at present, by making it possible for them to be operated with over 12 m (39.5') maximum drafts in the present Canal's tropical fish waters, thus increasing their profitability and the value of the Panama route. Panamax vessels with over 12 m (39.5') drafts in tropical fresh water are called *Panamax Plus*.



### 3 The capacity challenge

The Canal will reach its maximum sustainable capacity between the years 2009 and 2012. Once it reaches this capacity it will not be able to continue to handle demand growth and service quality will deteriorate, resulting in a reduction in the competitiveness of the Panama maritime route.

The Panama Canal is the gateway for over 140 maritime routes that operates with vessels of various types and sizes. Just like any system that depends on mechanical devices, the Canal has a finite capacity determined by the operational times and cycles of the existing locks, with Pedro Miguel locks being the system's main bottleneck.

Aside from the physical aspects, there is a series of other market and weather factors that influence the Canal's maximum sustainable capacity. The most relevant of these factors is the mix of vessel sizes, configurations and types that transit the Canal. The larger the vessels, the smaller the number of transits the Canal will be able to handle. This is partially due to larger vessels taking more time to pass through locks and navigational channels. Additionally, these vessels have more operational restrictions, such as the need to navigate the Gaillard Cut by day and in a single direction.

During the last five years a 20% increase in average vessel size transiting the Canal has been recorded. Proof of this is that in 2005 nearly 45% of the vessels that passed were the maximum width allowed by the present locks, as opposed to a mere 35% percent in the year 2000 (see figure 21). Furthermore, over 10% of the vessels that transited the Canal in 2005 also were the maximum length allowed by the locks.

The vessel size increase was accompanied with a reduction in the number of transits and growing cargo volumes were handled with larger and larger vessels. For instance,

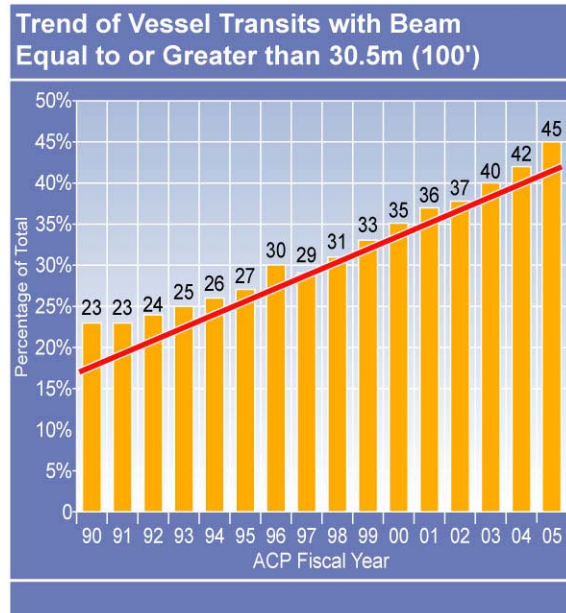


Figure 21 Shipping companies have migrated to Panamax size vessels in the Canal route.

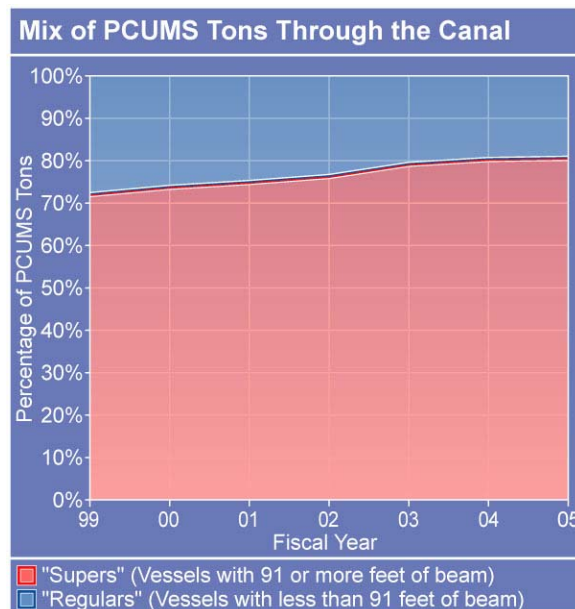


Figure 22 In 2005 80% of cargo transited in large vessels with beams greater than 27.7 m (91').

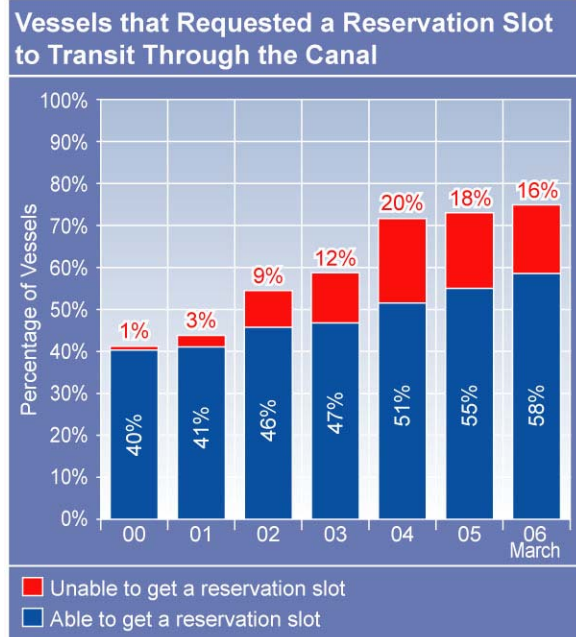




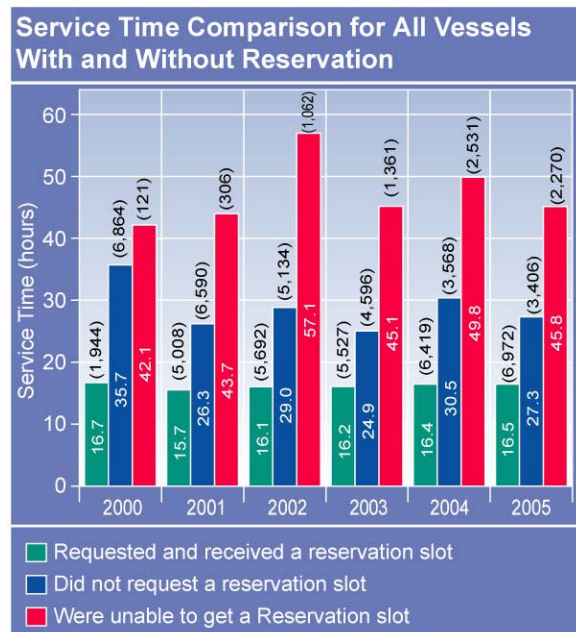
during FY 2005, more than 80% of the cargo transited in large vessels<sup>52</sup> (see figure 22). However, since 2004 PCUMS cargo volumes growth has coincided with an increase in transits, given that a large part of the cargo is already being transported by the most efficient vessels for each route. Consequently, with its present capacity, it will become harder for the Canal to handle growing traffic volumes in terms of size as well as vessel numbers. In other words, cargo can no longer migrate to larger vessels unless the Canal allows the transit of post-Panamax vessels by building larger locks.

Another factor influencing the Canal's maximum sustainable capacity is the level of service that its users require. For the Canal route to be competitive, international maritime commerce needs to be able to transit in an expeditious, reliable and safe manner. This necessity determines the reliability and quality of the service that the Canal must offer, which in turn determines its maximum sustainable capacity. The Canal service level is especially important to those segments that operate with itineraries and high-value cargos, such as the containership and vehicle carriers segments. At the same time, these are the segments that represent greater volume growth, and together, represent 50% of the income and 48% of PCUMS volume.

The Canal has improved the level of service that it offers to its clients thanks to the timely and successful execution of a modernization program of over \$1,000 million, implemented during the last 10 years, which increased Canal capacity by over 20% in terms of PCUMS tons. Despite these investments, it is irrefutable that the Canal is now operating very near to its maximum sustainable capacity. For example, during



**Figure 23** In fiscal year 2005, 73% of vessels requested transit booking slots. Of these, 18% did not receive them, compared to 1% in fiscal year 2000.



**Figure 24** Service time for booked vessels is approximately 16 hours. However, service time is a lot longer for vessels that did not get a booking slot.

<sup>52</sup> Large vessels are defined as those whose width exceeds 27.7 m (91'), and that are subject to greater operational restrictions at the Canal.





the last few years the Canal has experienced a significant reduction in its ability to perform the maintenance work required by the locks, as well as a major increase in the use of the booking system.

The Canal, which has been operating for over 91 years, requires periodic maintenance work in order to extend the life of its assets. The most intensive work involves temporarily closing a lane or the culvert system of one of the locks, which diminishes Canal operational capacity by 32% and increases the number of vessels waiting to transit. For example, the maintenance lane shutdown of 9 days performed in June 2004 created a cue of almost 120 vessels. Normalizing operations took more than 15 days, and during that period, the average waiting time of non-booked<sup>53</sup> vessels tripled. This shows that the Canal does not have the necessary leeway to carry out required maintenance works<sup>54</sup>, and as demand increases, these works will have an increasing impact on Canal service levels<sup>55</sup>.

An increase in the use of the booking system has also occurred, which proves that users perceive a capacity shortage<sup>56</sup>. For instance, during fiscal year 2000, 40% of users requested and obtained a reservation slot and only 1% of the requested slots were denied. In comparison, during fiscal year 2005, 73% of users requested a booking slot, and only 55% got them (see figure 23). In other words, 18% of users requesting booking slots in 2005 did not receive them and had to transit on a first-come-first-served basis, with a significantly longer waiting time and which reduced Canal reliability and competitiveness. This clearly indicates that the Canal is operating close to its maximum sustainable capacity (see figure 24).

<sup>53</sup> During lane shutdowns, some vessels have waited more than three days before being able to transit. Containerships have daily operational costs that may ascend to approximately \$40,000.

<sup>54</sup> The Canal closes lanes during low seasons, usually between June and September. Growth in transits by containerships that sail on regular itineraries throughout the year has reduced Canal transit seasonality and, therefore, low and high season variability has decreased.

<sup>55</sup> Between FY2000 and FY2005, the Canal performed an average of 5 maintenance lane shutdowns per year, for a total of 56 days per year, with an 11-day average per shutdown. Programmed maintenance lane shutdowns not exceeding a 7-day average each and 21-day shutdowns per year are projected for the 2007-2014 period. There may be other few-hour or one-day shutdowns not exceeding a total of 30 days per year. The Canal is 92 years old and it is likely that it will require even more maintenance work. Each lane shutdown reduces Canal capacity by an average of 32%. In addition to lane shutdowns, the Canal is programming one lock culvert inspection shutdown per year and one 10-day culvert shutdown every three years for intermediate valve repairs. These require the lane to be put out of service for 2 days to install bulkheads to dewater the culvert. Complete culvert overhauls are programmed every 10 years, which normally take 2-4 years to be completed, given that only 3 culverts may be repaired per year. Usually, the program is to complete all of these works in one year in Pedro Miguel, one to one-and-half years in Miraflores, and two years in Gatun. Lock culverts maintenance reduces lock transit capacity by 28%.

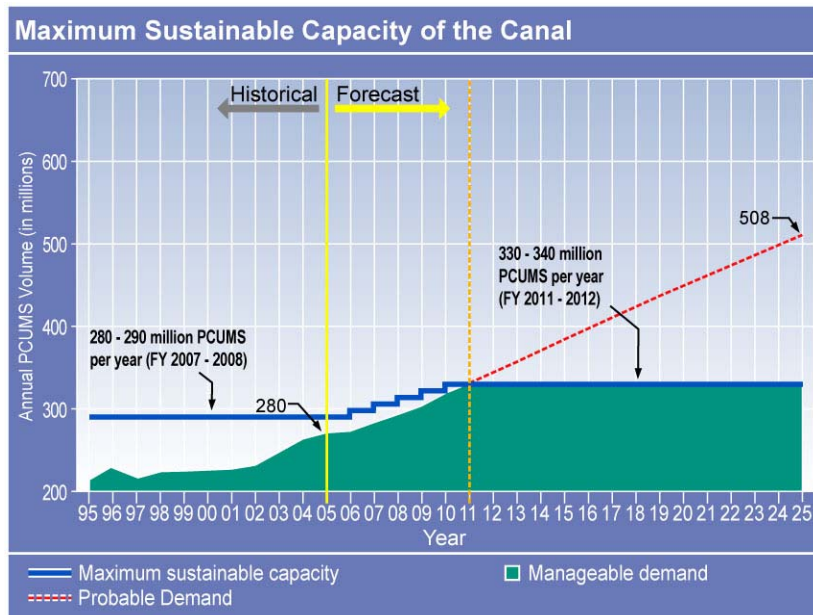
<sup>56</sup> Every vessel intending to transit the Canal may choose one of two service systems: (1) transit by order of arrival, which establishes transits on a first-come first-served basis; or (2) booked service, which guarantees the transit on a previously-agreed date. Booked vessel transits are guaranteed for a specific day and an 18-hour or less transit time, from their arrival in Canal waters until they leave the last lock. To the contrary, non-booked vessels transit as they arrive in Canal waters, pursuant to ACP priority rules. The main users of the booking system are the segments of containerships, vehicle carriers, passenger vessels, and non-containerized refrigerated cargo vessels, which operate on pre-established itinerary services. The booking system has an additional cost of approximately 15% of the toll.



To precisely determine Canal maximum sustainable capacity, the ACP performed a study that analyzed, rigorously and in detail, Canal operational capacity. As part of this study, and with the support of international experts, an advanced Canal capacity simulation model<sup>57</sup> was developed for the purpose of evaluating demand impact on Canal capacity and service levels under different scenarios. By applying this model to Canal demand projections, the ACP determined that the Canal has a maximum sustainable capacity of between 330 and 340 million PCUMS tons. Considering that in 2005 total vessel cargo capacity transiting the Canal amounted to 279 million PCUMS tons, it can be affirmed that today the Canal operates at nearly 85% of its maximum sustainable capacity.

In order to bring the present Canal to its maximum capacity, various projects were identified which, when integrated in an improvements program, will allow the Canal to increase its capacity by maximizing existing locks usage. Once the improvements program is completed, the Canal will have reached its maximum sustainable capacity. This program consists of:

- (1) implementation of an enhanced locks lighting system;
- (2) construction of two tie-up stations in Gaillard Cut;
- (3) Gaillard Cut widening from 192 to 218 m (from 630' to 715');
- (4) improvements to the tugboats fleet;
- (5) implementation of the carousel lockage system in Gatun locks;
- (6) development of an improved vessel scheduling system;
- (7) deepening of Gatun Lake navigational channels from 11.3 to 10.4 meters (from 37' to 34') PLD;
- (8) modification of all locks structures to allow an additional draft of about 0.30 m (1');
- (9) deepening of the Pacific and Atlantic entrances; and,
- (10) construction of a new spillway in Gatun, for flood control.



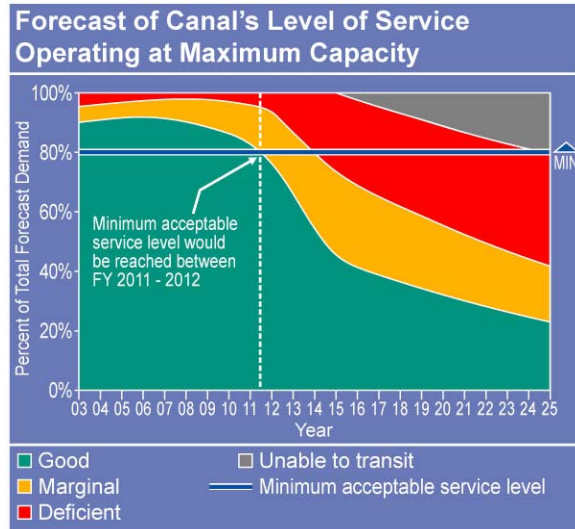
**Figure 25** When operating at full capacity, the Canal will be able to handle a demand of between 330 and 340 millions PCUMS tons annually. This capacity will be reached between fiscal year 2009 and 2012, depending on the behavior of the demand.

<sup>57</sup> The Canal capacity simulation model was developed by Rockwell Software from the U.S., associated with Paragon Consulting Solutions from Brazil, in collaboration with ACP experts.

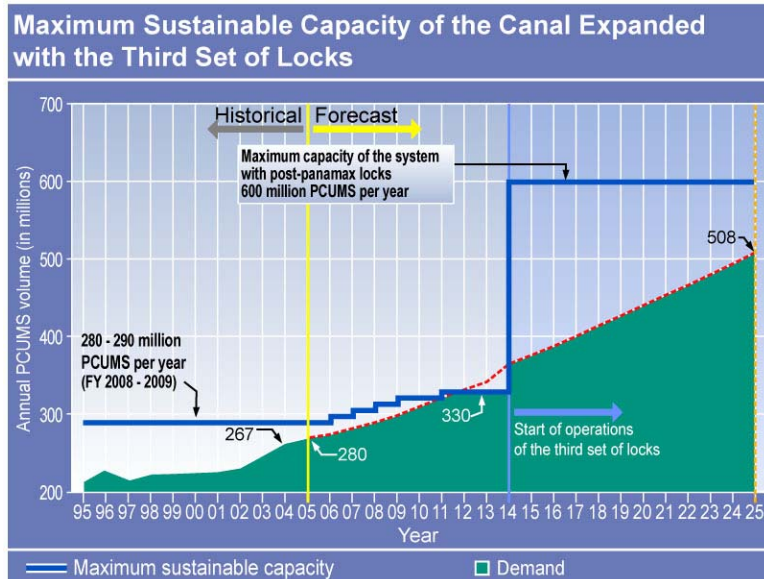


With these improvements, the Canal will maximize the use of the existing locks by allowing their uninterrupted use and will be able to transit Panamax vessels 24 hours a day. Once this program is completed between 2009 and 2010, the Canal will have a maximum sustainable capacity to manage between 330 and 340 million PCUMS tons, or 13,500 to 14,000 deep draft vessel transits per year<sup>58</sup> (see figure 25). With this capacity the Canal will be able to serve the projected demand until fiscal year 2012, at competitive service levels<sup>59</sup>. However, if demand behaves according to the highest growth scenario forecast, the Canal will reach its maximum sustainable capacity by 2009. At any rate, even after these improvements have concluded, Canal capacity will be limited by the physical structure and mechanical and hydraulic operation cycles of the existing locks, and particularly those of Pedro Miguel Locks. Consequently, the improvements program will provide the Canal with its maximum sustainable capacity and which will allow it to handle demand growth at competitive service levels up to 2009 – 2012 (see figure 26).

The challenge presented by the capacity of the Canal consists in being able to guarantee the uninterrupted transit availability and service levels required by users beyond 2012, as well as making it possible for them to use the most suitable vessel size for each route. This requires the implementation



**Figure 26** By 2012 the Canal will reach capacity and it will begin to provide marginal and deficient service to those vessels unable to obtain reservation.



**Figure 27** With the third set of locks, the expanded Canal will be able to transit over 600 million PCUMS tons annually. This represents approximately twice the capacity of the current Canal, and it is sufficient to meet demand beyond fiscal year 2025.

<sup>58</sup> Deep draft vessels do not include smaller vessels that do not use locomotives to transit the locks and pay fix tolls on the basis of their length rather than their PCUMS tonnage.

<sup>59</sup> The Canal uses two quality service level indicators: (1) average waiting time to transit the Canal; and (2) average transit time. Their combination is called Canal Waters Time (CWT). When you consider CWT average trends as well as their dispersion or variability, CWT becomes, additionally, a service reliability indicator.



of capacity expansion strategies that consolidate the route's competitiveness to sustain Canal income continuity and market share in the short and long terms. Additionally, the present locks have been operating without interruption for almost a century and depend on a steady and regular maintenance program. Through an expansion of its capacity, the Canal will be able to perform periodic maintenance on the present locks efficiently without adversely affecting service quality.

The proposed expansion of the Canal by the construction of a third set of locks will allow it to capture the entire demand projected through the year 2025 and beyond<sup>60</sup>. The new locks alone will have a capacity of over 300 million PCUMS tons per year. Thus, together, the existing and new locks will be able to serve over 600 million tons per year, in accordance with the mix and types of vessels forecasted which equals more than 16,000 transits per year. This means that the new system will have approximately double the capacity of the present Canal (see figure 27).

#### 4 The importance of expanding the Canal's capacity now

Canal competitiveness depends, more and more, on its ability to provide, at a high level of reliability, the levels of service required by each market segment. Once the Canal reaches its maximum sustainable capacity, it will lose all of its ability to handle additional transits, and with it, the possibility of managing demand growth. Furthermore, it will cease to offer a competitive and reliable service to an important and growing number of users. Therefore, the probability of chronic congestion in the waterway will go up, together with long wait times for transit in all segments, and in particular, for those vessels without booking slots.

The Canal's reaching its maximum capacity will not mean that ships will not be able to transit the Canal. It means that the Canal's growth capacity will stagnate and that it will not capture additional cargo volumes, thereby subjecting all revenue increases to toll increases, which bring with it the risk of driving clients away. It means service will deteriorate to non-competitive levels for those users who risk waiting for their turn to transit without a booking slot, with the aggravating circumstance that there will not be sufficient slots for all

<sup>60</sup> The year 2025 is the Master Plan's horizon. Therefore, the Master Plan uses 20-year demand projections, from 2005 to 2025. The additional capacity offered by the third set of locks project allows management of projected demand with competitive service levels, and provides the Canal with the additional capacity to handle demand growth after 2025. The time it will take to reach the system's new maximum capacity (approximately 600 million PCUMS tons), depends on demand growth rate after 2025.

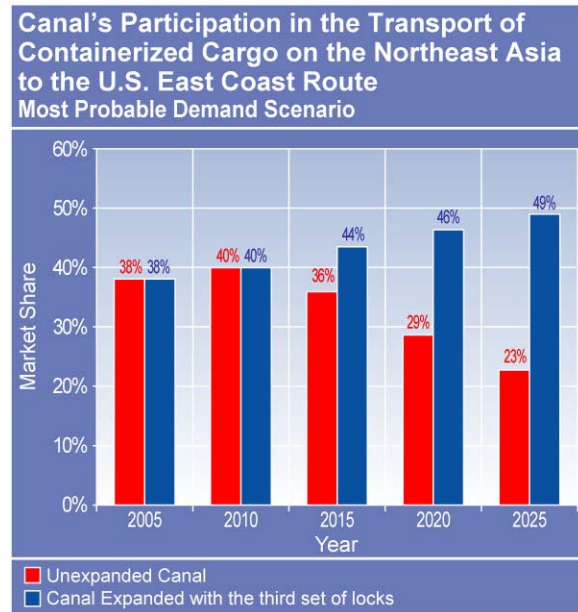




those who require them. The capacity shortage will adversely affect the competitiveness of the Canal route, strengthen its competitors and promote the birth of new competitor routes, with the subsequent alterations on trade patterns. Additionally, it means that the Canal will remain obsolete for those routes, which will use post-Panamax technology and dimensions for transcontinental routes.

For instance, if the Canal did not have the capacity required for meeting demand growth<sup>61</sup> in the Northeast Asia – U.S. East Coast route, the unexpanded Canal’s market share would go down from 38% in 2005 to 23% in 2025. Consequently, its competitors’ share would increase: the intermodal system would reach 65% and the Suez Canal 12%. It is not probable that the Canal would regain its lost market share once new competitor routes were established and transportation and trade patterns changed. In contrast, with the additional capacity generated by the third set of locks, the Canal’s market share will increase to 49% by the year 2025, while that of the intermodal system will decrease to 50% and Suez Canal’s will remain at 1% (see figure 28)<sup>62</sup>.

The longer it takes to start the construction of the third set of locks, the harder it will be for the Canal to maintain its competitive position. This is so because Canal users, if exposed to uncertainty regarding whether Canal capacity will be expanded or not, will have to make decisions and investments to increase their use of existing and potential alternative routes in order to guarantee the continuous and uninterrupted flow of the trade that they serve. Among these decisions is, for example, the planning of their fleets through future vessel construction contracts, and this decision will be influenced by that taken by Panama with regard to expanding its Canal. In other words, if Panama decides to not expand, the most probable reaction will be to develop alternative routes and plan their fleet with vessels designed to go around a Canal that will indefinitely operate at maximum capacity and limited to Panamax vessels. In the interim, world trade will keep



**Figure 28** The expanded Canal market share of the Northeast Asia to the U.S. East Coast route will reach almost 50% by 2025. Without an expansion, this market share will reach 23%.

<sup>61</sup> The intermodal system’s containerizations segment market share in the Northeast Asia – U.S. East Coast route for the year 2005 is estimated at approximately 61% and Suez’s is estimated in 1%.

<sup>62</sup> Cargo growth projections per segment and relative market shares were developed by ACP with the demand model developed by Mercer Management Consulting.





growing and Canal competitors will continue to develop additional capacity.

A capacity shortage would cause an adverse impact at multiple levels. Among the most important are: (1) gradual weakening of the Canal's economic capacity as the country's growth and development cornerstone, with the consequent negative impact on employment generation; (2) displacement of Panama as a key maritime route for world trade, with the subsequent reduction to the Isthmus's value as a continental connection center; (3) lack of growth of its payments to the National Treasury and their possible reduction in the medium and long term; and, (4) loss of the opportunity to obtain the benefits that the growing demand would generate.

Generally speaking, the Canal without the capacity to meet the forecasted demand will have a less diversified user base, becoming more vulnerable strategically by depending on less users and routes. On the other hand, not being able to serve the most efficient vessels will reduce the maneuvering space of the Canal in terms of tolls, with the subsequent decrease in competitiveness and profitability. It will go from a Canal that serves growing transcontinental routes to a stagnant Canal, depending on a few routes in which users will be more sensitive to tolls increases. Without an expansion, the Canal would face new competitors as well as permanent and irreversible changes in trade patterns in which Panama would stop being relevant as a global maritime route.

## **5 Basis for the configuration of the proposed third set of locks**

### **5.1 Configurations and technological options that were analyzed and discarded**

The ACP evaluated multiple technological options and configurations to increase Canal capacity, and also studied many alternatives for supplying and reutilizing water, which are described below. In that sense, alternatives were of two main tendencies: (1) a canal with sea level navigational channels; and, (2) a locks canal.

On one hand, prior sea-level canal proposals and studies, with multiple variations that included tide control locks with navigational channels separate from those in the present Canal and outside the patrimonial area of the ACP, were considered. On the other, expansion alternatives with additional locks, with variations of one, two, and three steps or levels and chambers of the same size as existing



chambers, as well as larger chambers, were also evaluated. Likewise, mechanical synchronized-lift systems were analyzed, which proved to be insufficient because available technology is appropriate to handle only relatively small vessels, of less than 30,000 deadweight tons.

It was concluded that a sea-level canal or its variations with bights, tidal gates or stacked basins, would entail investment and environmental mitigation costs significantly higher than those of a locks system utilizing existing Canal navigational channels<sup>63 64</sup>. In addition, a sea-level canal implies higher operational costs than other alternatives, since it eliminates the possibility of sharing resources and integrating the operation of channels, systems and infrastructures with the present Canal. Another conclusion is that all sea-level canal alternatives generate permanent and irreversible adverse environmental impacts of considerable magnitude, both to land and marine ecosystems, as well as to human populations and activities. Among the negative impacts that a sea-level canal would have are the relocation of thousands of families<sup>65</sup>, the loss of infrastructure, the loss of forest habitats and covers, and the migration of marine species between the Atlantic and Pacific Oceans<sup>66</sup>.

To furnish the Canal with the most profitable and environmentally responsible additional capacity, it is more advisable to develop an integrated locks system which shares existing Canal channels and other resources, rather than operating two separate systems, one at sea-level and the other with locks. The sea-level Canal proposal was thoroughly analyzed and then discarded, both at the time of the first construction of the Canal as well as later, upon the beginning of the

<sup>63</sup> The Tripartite Commission formed by Panama, the U.S., and Japan, in the final report of its study on the sea-level canal, concluded that, for the construction of Route 10, it would be necessary to excavate between 937 million cubic meters in the lowest excavation scenario, and 2,190 million cubic meters in the highest excavation scenario, approximately 9 and 20 times the excavations for the original Canal construction in 1914.

<sup>64</sup> A sea-level Canal with bights in the Puerto Caimito route on the Pacific Side and in the Lagarto route on the Atlantic side contemplates the construction of dams in the Trinidad, Ciri, Gatun, Indio and Manguito rivers, as well as the construction of a double ridge, formed by a filling on the Pacific ocean which projects into the sea for approximately 20 kilometers to approximately one mile from Taboga and two miles from Punta Chame, and another ridge of similar dimensions on the Atlantic ocean. The possible impact of these ridges on marine currents and fauna, fishing resources and wetlands remain unknown.

<sup>65</sup> Among the populations that will be affected by Route 10 of a sea-level canal, to be located to the west of the existing Canal, which was evaluated in the Canal Alternatives Study developed by Panama, Japan and the U.S., are: Puerto Caimito, La Chorrera, Vista Alegre, Quebrada del Carmen, San José, Fuente del Chace, Loma Alta, Río Congo, Ahoga Yegua, Bernardino, Río Pescado, Cerro Viejo, Caño Quebrado, Quebrada Lagarto, Calabacito, Pueblo Nuevo, La Laguna, Lagartera, Escobal, Palmas Bellas, Mateo Arriba, Paulina, Las Cruces and Los Negros, among other. The interoceanic canal project proposed for the Bayano Carti route, which includes a lake on the Rio Bayano channel, would affect populations such as El Llano, Platanares, Carti and La Loma, among other.

<sup>66</sup> The environmental impact on the marine ecosystem and Panama's fishing industry when marine species migrate from one ocean to the other through a level canal may not be measured.



construction of a third set of locks in 1939 and, more recently, as part of the Tripartite Canal Alternatives Study completed in 1993<sup>67</sup>.

Also evaluated were other technological options, such as: revolving locks with circulating gates; locks with stacked basins; vessel lifting basins; vessel band lifts; synchrolifts; electromagnetic systems for vessels positioning; and, airbag-based water saving systems. These options were discarded because they are based on experimental, untested concepts and, therefore, carry technological and operational risks that are unacceptable for the proposed project.

As mentioned before, the alternative of building a third set of locks of the same size as existing locks was analyzed as well, and this analysis determined that this alternative would only provide the Canal with sufficient capacity to handle projected demand until approximately the year 2020. Two new lock lanes with chambers of the same size as the present ones would be required to provide the Canal with the same cargo volume capacity as would be obtained with one lane with larger chambers, such as the one proposed. The construction of two lock lanes of the same size as the ones in existence is not a profitable or convenient option because it would have higher investment, operational and maintenance costs than those required for the single post-Panama lock lane proposed. Also, new locks with the same dimensions as the existing locks would not provide the Canal with the additional competitiveness that post-Panamax vessels transits bring about.

It was concluded that the option with the larger chamber locks alternative: (1) would contribute the necessary capacity to capture both cargo volume and vessels size of the demand; (2) presents the most efficient cost-benefit ratio; and, (3) would have smaller and easily manageable environmental impacts.

Characteristics of Post-Panamax Vessels Larger than 8000 TEUs							
Name	Company	Nominal TEUs	Length	Beam	Maximum Saltwater Draft	Dead weight	Container rows across
CMA CGM Hugo	CMA CGM	8,238	334m	43m	14.5m	102,000 t	17 rows
Axel Maersk	Maersk	7,900	352m	43m	14.5m	109,000 t	17 rows
Samsung 1509	MSC	9,200	334m	46m	14.5m	109,600 t	18 rows
Seaspan	Seaspan	9,600	335m	46m	14.5m	102,200 t	18 rows
Hyundai 1801	COSCO	10,000	349m	46m	14.5m	115,000 t	18 rows

**Figure 29** Examples of Post-Panamax container vessels that are in operation or about to enter operation in important commercial routes. Vessels with these dimensions are expected to dominate Canal routes once the infrastructure to service them is in operation.

<sup>67</sup> Panama Canal Alternative Study Commission, which prepared the Canal Alternatives Study developed by Panama, Japan and the U.S., the final results of which were presented in 1993.



## 5.2 Locks configuration

The proposed locks, as previously explained, were configured in two three-level facilities. Configurations of one to three levels were analyzed<sup>68</sup>. It was confirmed that the three-level configuration results in the best relation between initial investment, operational efficiency, maintenance, environmental impact, and water utilization. Locks with fewer levels would require larger gates, which are more costly, and pose greater operational and technological risk. Additionally, locks with fewer steps would use larger water volumes per lockage and have a higher environmental impact. On the other hand, locks with more than three levels have lower operational yields and are proportionally more expensive both in initial investment and maintenance, due to a higher number of components and equipment.

It was concluded that the concept of two similar three-level lock facilities was the best alternative since the same design may be used for both facilities, which reduces project costs and execution time. With this concept, a balance between capacity and efficiency is realized, which facilitates the standardization of equipment, processes and functions. Also, from the maintenance standpoint, spare parts inventories are reduced and standardized.

## 5.3 The size of locks chambers

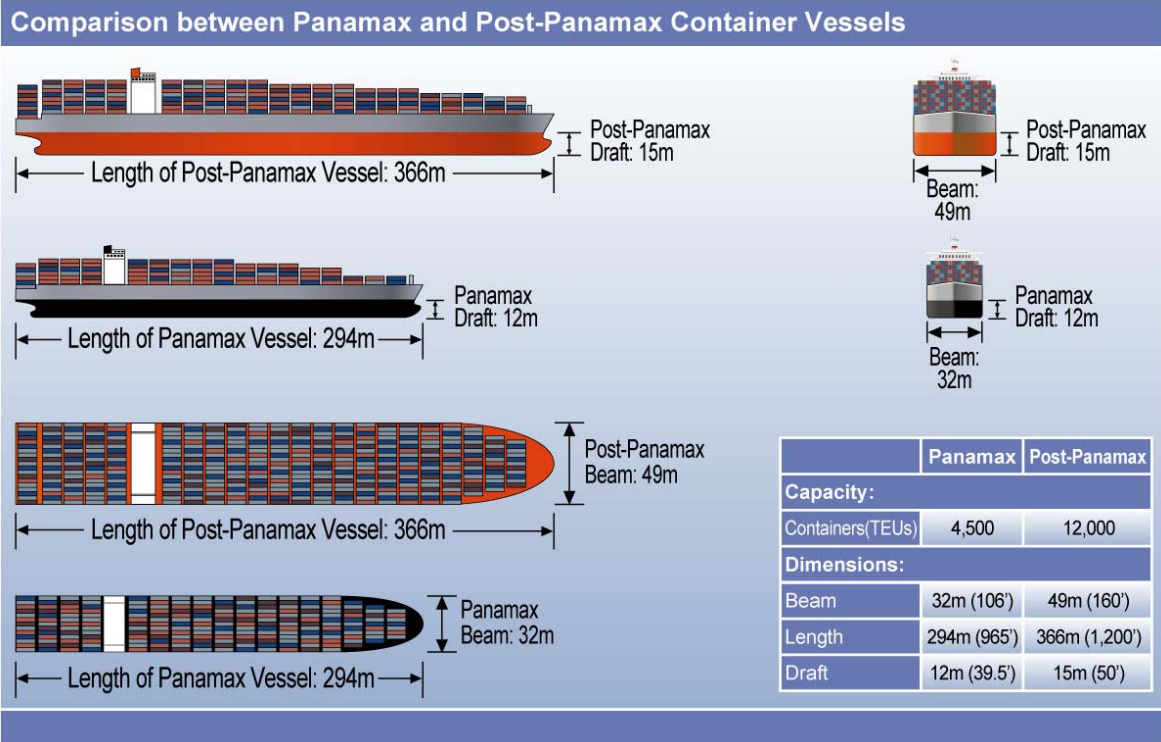
A post-Panamax containership of 366 m (1,200') length, 49 m (160') width and maximum 15-m (50') draft (TFW) was used as the reference for establishing the ideal lock chamber sizes. This vessel has been identified as the largest type of vessel that carriers in the routes with the greatest frequency, volume, and intensity would regularly deploy in transiting the Canal<sup>69</sup>. It accommodates up to 19 container rows through its width and has a nominal cargo capacity of up to 12,000 TEU<sup>70</sup> (see figures 29 and 30). The proposed lock dimensions will also allow handling of *Capesize* dry-bulk vessels and *Suezmax*<sup>71</sup> tankers displacing 150,000 to 170,000 tons. The proposed locks chambers will have the adequate dimensions to allow the transit of vessels that will become relevant for each of the segments and routes served by the Canal in the long run.

<sup>68</sup> Conceptual studies by Coyne-et-Bellier Tractebel and the U.S. Corps of Engineers.

<sup>69</sup> Studies by Mercer Management Consulting, SSPA Sweden AB, analyzed by and reviewed by Dr. Hans Payer de Germanischer Lloyd.

<sup>70</sup> In contrast, a Panamax vessel has up to 13 container rows along its width and a close to 4,500 TEU capacity.

<sup>71</sup> Typical Capesize and Suezmax vessels have a dead weight of 130,000 to 140,000 tons; with 270-280 m in length; and 40-45 m in width.



**Figure 30** Comparison between the largest Panamax container vessel that can transit the current Canal and a Post-Panamax size vessel with 12,000 TEUs container capacity. The larger vessel has 2.5 times the cargo carrying capacity of the Panamax vessel.

## 5.4 Rolling gates

All potential gate types<sup>72</sup> were studied and the conclusion was that rolling gates constitute the best option for the new locks. Just as the existing locks, the new locks will have two gates at each chamber end.

Around the world, all locks of the proposed size use rolling gates<sup>73</sup>. Rolling gates work from an attached recess that is perpendicular to the lock chamber (see figure 31). This configuration turns each recess into a dry dock that, in turn, allows performing maintenance work on site without the need to remove them and without significant interruption in lock operations. Therefore, during maintenance work the new locks may continue to operate with the backup gate. The investment required to build miter gates is similar to that required for rolling gates when the recess they require is included.

<sup>72</sup> Conceptual study by Coyne-et-Bellier Tractebel, which included an evaluation and comparison between sector gates, miter gates, and rolling gates, and their variations.

<sup>73</sup> Locks in Berendrecht and Zandvliet, Belgium; Ijmuiden, the Netherlands; and Le Havre, France; among others.



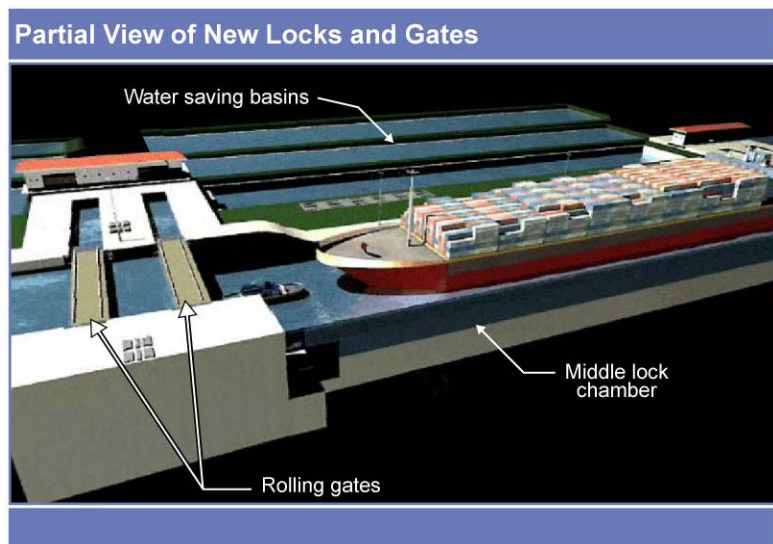


Miter gates like the ones in the current locks now require the chamber to be longer because they rest on the lock wall. And because they do not have a recess, they need to be removed from the lock and taken to a shop for maintenance. This operation forces the temporary interruption of lock operations. Inasmuch as maintaining the recommended rolling gates do not require interrupting lock operations, they increase lockage operations capacity and flexibility, offering shorter maintenance times and lower costs.

### 5.5 Positioning vessels in the locks using tugboats

Multiple lock chamber vessel positioning systems were evaluated and compared<sup>74</sup>. The conclusion was that there is no proven technology for positioning vessels with electromechanical systems, such as devices with electromagnets or vehicles with the capacity, safety and performance required to reliably handle the post-Panamax sizes and configurations that would be utilizing the locks.

It was determined that for the third set of locks a possible vessel positioning system assisted with vehicles – such as the towing locomotives used by the Canal at the moment – would be risky because of the number and capacity of the locomotives that would be required to maneuver post-Panamax vessels safely. For instance, at least 12 to 16 locomotives – larger than the existing ones – would be required in order to handle vessels with these dimensions and weights in the new locks. Consequently, the locomotive-assisted positioning system used now at the Canal would result in longer lockage times and higher operational and maintenance costs than those required by a tugboat-assisted vessel positioning system. Also, the use of locomotives would increase the locks’ construction costs and time to complete, since they require that lock walls be designed with the capacity to withstand the weights and forces required by the locomotives.



**Figure 31** The new locks will use rolling gates. Tugboats will be used to maneuver and assist vessels during the lockage process.

<sup>74</sup> Preliminary analysis of vessel positioning systems by Texas A&M University and conceptual studies by Coyne-et-Bellier / Tractebel.

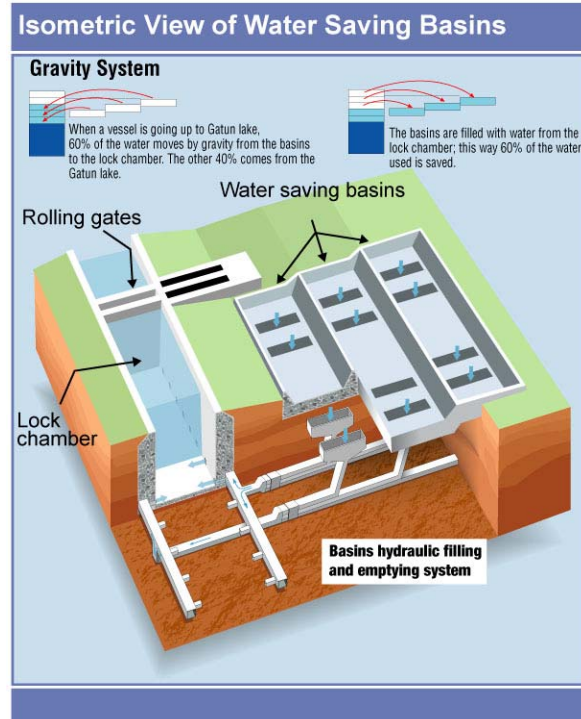


Vessel positioning systems that rely on electromagnets have never been used in the past and they present technological risks because there is much uncertainty regarding their performance, reliability, and operational viability. They also have high costs since there are multiple vessel types and hull shapes. Moreover, operating these systems requires great amounts of electricity. Finally, the possible adverse effect of electromagnetic forces on the health of the people involved in lockage operations, on marine life, vessel navigational systems, electronic cargo components, and Canal telemetric and communication systems, among other, is unknown. In synthesis, this system generates risks that result in costs and uncertainties that are unacceptable for the third set of locks project; hence, they have been discarded.

The use of tugboats to position vessels during lockages is the best alternative (see figure 31). Except for the Panama Canal, all locks of similar dimensions use tugboats to assist in vessel positioning. This vessel positioning system uses proven and commercially-accepted technology, with a large number of manufacturers, components and spares availability and also constitutes a natural extension of Canal tugboat fleet operations. In order to confirm its viability, the ACP has performed successful lockage tests with tugboats in the present locks and has verified the viability of similar operations in other locks<sup>75</sup>.

### 5.6 Water reutilization basins

The water reutilization pools or basins technology is the most effective system for reducing the water volumes utilized in the new locks. These basins are water storage structures, adjacent to the lock chambers and connected to them through valve-controlled culverts. At present, these basins are used successfully in locks found in Germany<sup>76</sup>.



**Figure 32** Isometric view of water saving basins. The new locks will have three basins per chamber that will use 60% less water than locks without basins.

<sup>75</sup> Operations personnel from ACP inspected the post-Panamax locks in Berendrecht and Zandvliet in the port of Antwerp, Belgium, to observe tugboat-assisted lockages and to verify their viability.

<sup>76</sup> For example, in Rothensee locks and Hohenwarthe locks, in the federal state of Sachsen-Anhalt, Germany.



The amount of basins built for each lock chamber determines the amount of water used for each lockage. Therefore, with more basins per chamber the amount of saved water will be greater. However, the water reutilization rate decreases as extra basins are added. For example, one basin will reduce utilization by 33%; two basins by 50%; three by 60%; four by 66%; five by 71%; and six by 75%. All basins have the same construction cost, but each additional basin yields significantly less savings than the previous one; as a result, the more basins per chamber the greater the required investment. Furthermore, lockages would become slower as the number of basins increases, because filling and emptying lock chambers would take more time, and thus diminishing their capacity.

The proposed three basins per chamber is the best option because they offer the highest water yield in relation to construction costs, and have a low impact on lockage times and locks capacity<sup>77</sup>. Studies performed by Delft Hydraulic determined that the use of three water reutilization basins per chamber will not affect Gatun Lake's water quality, that the lake will continue to be a living, stable fresh water ecosystem and that its water will continue to be perfectly suitable to be made potable for human consumption. The new locks, with three water reutilization basins, will utilize 7% less water per transit than the existing locks (see figure 32)<sup>78</sup>.

## 6 Environmental and social aspects of the third set of locks project

The third set of locks project is environmentally viable. It will be developed totally within ACP previously-intervened patrimonial areas. It has been found that all possible adverse environmental impacts can be mitigated through existing procedures and technology and no immitigable or permanent adverse impacts on the population or the environment are anticipated.

Pursuant to the Constitution, the ACP is responsible for administrating, maintaining, using, preserving and safeguarding the water resources of the Canal Watershed. To this end, the ACP has developed an environmental and socially-sustainable development strategy with programs aimed at protecting the environment and natural resources of the Canal Watershed, with the purpose of guaranteeing the avail-

<sup>77</sup> The amount of basins must be incorporated into the locks design. Basin levels and water flow conduits are different for locks designed to operate with one, two, three or more basins. Extra basins may not be added afterwards.

<sup>78</sup> The existing locks use 55 million gallons of water per transit and the new locks, even though larger, would use approximately 51 million gallons because 60% is reutilized by using lateral basins.



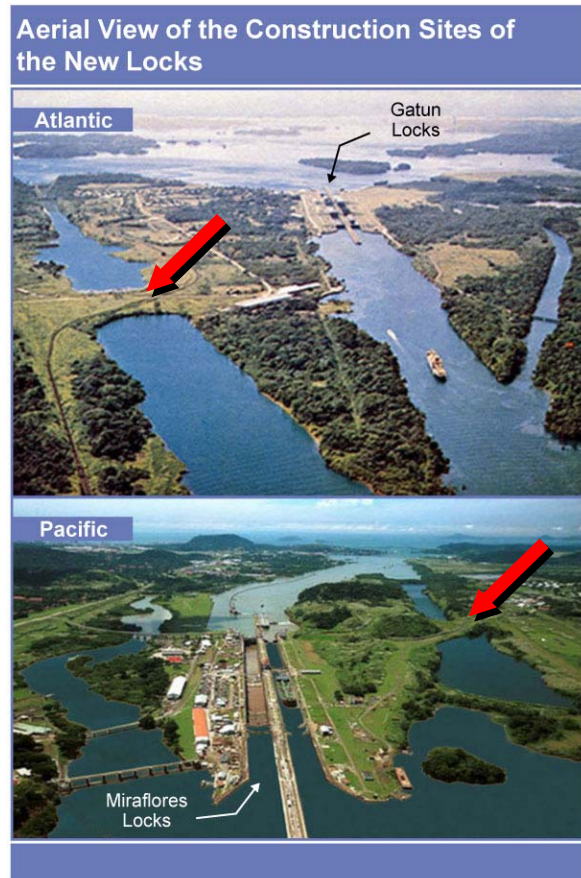


ability and quality of the water resource for the use of both the population and the Canal<sup>79</sup>.

In furtherance of its commitment to fulfill its corporate vision and mission, as well as its strategic objectives and guidelines, the ACP is a signatory of the United Nations Global Pact and became a member of the World Business Council for Sustainable Development (WBCSD)<sup>80</sup>. Additionally, the ACP follows the Ecuador Principles on issues related to standards for environmental impact studies and responsibly conducting the environmental monitoring of its projects. Consequently, the third set of locks project components are based on widely accepted environmental principles and standards of the highest level, and incorporate appropriate analysis, selection, consultation, mitigation and follow-up processes.

Like every engineering project with a broad domain and scope, the construction of the third set of locks implies diverse effects on the environment and the social surroundings. For formulating the third set of locks proposal, the ACP developed a variety of multidisciplinary environmental, scientific, social and technical studies at the inspection, diagnosis, survey, pre-feasibility and evaluation levels. The results of these investigations were used to evaluate and compare the different alternatives, determine each of their possible impacts and benefits, and to put together a balanced and environmentally responsible proposal.

This third set of locks project will be executed within Canal operational areas (see figure 33). There are no elements within the scope of the project that will compromise its environmental viability, such as communities, primary forests, national parks or forest reserves, relevant patrimonial or archaeological sites, agricultural or industrial production areas, or tourist or port areas,



**Figure 33** The third set of locks project will be built in the 1939 excavation site inside current Canal operation areas.

<sup>79</sup> The Canal Watershed comprises an area of 5527.61 km<sup>2</sup>. Approximately 37,727 people live in the western watershed region, while the eastern watershed region is populated by 144,042, who are mainly concentrated in communities that are close to the Panama – Colon corridor, and between Arraijan and Pacora.

<sup>80</sup> The *World Business Council for Sustainable Development* (WBCSD) is a coalition of 175 international companies that share a commitment to sustainable development through economic growth, ecological balance and social progress.





and the project will not cause permanent or irreversible impacts on water or air quality. The proposed water supply program fulfills the objectives of maximizing the use of Gatun and Alhajuela lakes' water capacity and applying the most efficient water utilization technology at the locks, so that that no new reservoirs will be required.

In general, the project will be developed in areas that have already been impacted by a number of Canal projects and activities<sup>81</sup>. The most relevant environmental impacts will be those that are common to every construction project, such as noise, construction equipment emissions, and suspended dust. All possible adverse environmental impacts can be mitigated with existing procedures and technology and good environmental management practices, and no immitigable or permanent adverse impacts on the population or the ecosystem are foreseen.

The third set of locks project estimated costs include sufficient resources for reforestation, cleaning and restoration of excavated material deposit sites and work areas as well as for socio-environmental management and follow-up. Debris management, runoff control, wild life precautionary measures, rescue and relocation, ecological compensation, water and air quality follow-up, erosion control, precautionary measures and rescue of archaeological, cultural or scientific interest findings (if any), and the replacement of the infrastructure of and served waters treatment, are among the most relevant prevention and mitigation actions.

The operation of the third set of locks will be governed by environmental principles and regulations applicable to ACP operations. Therefore, it is not anticipated that it will generate environmental impacts or affect either the population or the ecosystem. The various evaluated components are specified below.

## 6.1 Flora and fauna

The areas where the new locks, navigational channels, and excavated material deposit sites will be located have been impacted by human activity on multiple occasions since the construction of the Canal. These sites have a plant cover mainly consisting of grassland, weeds, and secondary forests in different developmental stages. There are very few fauna or flora species of special interest living in construction areas or excavated material deposits<sup>82</sup>. Most of the species that

<sup>81</sup> All locks construction proposed sites, channels and excavated material deposits, were subject to fillings, deforestation and work during the original Canal construction; afterwards, some were used again for the excavation of the third set of locks initiated by the U.S. in 1939 and after that for additional Canal works.

<sup>82</sup> Study by the Louis Berger Group, 2004.



could be affected have ample population and distribution in nearby sectors, as well as in the rest of the national territory.

Building the third set of locks will not affect primary forests, protected areas, national parks or forest reserves. Neither will it destroy or endanger the existence of any species, and, at any rate, all measures and actions required to mitigate the possible impacts of the construction on the fauna and flora will be undertaken. The ACP, in coordination with the National Environmental Authority, will rescue and relocate in adequate ecosystems any affected species before construction works start, will protect the flora and fauna during the construction and will follow-up on and provide sustainability to the species after the project completion.

## 6.2 Water quality

Even when operating at maximum capacity<sup>83</sup>, the third set of locks, equipped with water reutilization basins, will not affect the water quality of Gatun and Alhajuela lakes or that of their tributaries. These lakes will keep their tropical fresh water quality with stable ecosystems, and the water will be kept to well within appropriate quality levels and standards in order that they can be made potable and used by the population. The ACP will continue its measurement, testing and follow-up program to preserve the nature and quality of the fresh water of Gatun and Alhajuela lakes. All the correct actions to maintain water quality during project construction operations will be taken as part of the environmental management plan resulting from the project's environmental impact study.

## 6.3 Populated areas and infrastructures

The operation of the third set of locks will not require additional reservoirs. Consequently, it will not be necessary to relocate communities. The entire area directly affected by the project is located within ACP operational and administrative areas.

As a result of the project to increase Gatun Lake's maximum operational level by approximately 45 centimeters, at the end of each rainy season, when the lake achieves its maximum level, some structures on the lake's banks, which are situated under the 30.48 m (100') PLD elevation level<sup>84</sup> and within land that is the property of the ACP, might be affected. This affectation is predicted to occur once a year and during a short period. Many of these structures are ACP property and will be modified as required. The project includes re-

<sup>83</sup> Study performed by Delft Hydraulics in 2004.

<sup>84</sup> Established in Panama Canal Authority Agreement No. 16 of June 17, 1999, by which the limits of Gatun Lake were established.



sources to modify or relocate such structures that might be affected, and will adequately indemnify the owners of the limited number of structures that may be affected.

### 6.4 Cultural and historical resources

Archaeological and paleontological surveys have been carried out at the new locks and channels locations, and it has been determined that the uncovering of important archaeological, cultural or scientific findings is not probable. Required measures to protect and safeguard all cultural, patrimonial and historical resources that may be discovered will be undertaken prior and during construction, in coordination with the competent authorities.

### 6.5 Paleontological resources

There are areas in the Pacific side sites where there may be some fossils of scientific relevance. Both the La Boca and Culebra geological formations are of marine origin, and bivalve, coral and plant fossils are frequently found in them. Miocene land organisms may be found in the Cucaracha geological formation, including mammals and reptiles. Also, on the Atlantic side, the Gatun formation may contain marine invertebrate fossils. Consequently, permanent monitoring will be maintained during the construction in all areas that may contain fossils, so as to detect and rescue those of scientific interest.

### 6.6 Excavated material disposition

The ACP studied 29 possible excavated material deposit sites (see figure 34). Most of them have been and are still utilized by the Canal, since its construction, to deposit such material. Several new sites were evaluated for their potential to produce usable land or to gain land from the sea through marine or land fillings.

There is the intent to deposit excavated material in locations that are close to excavation and dredging sites because it would

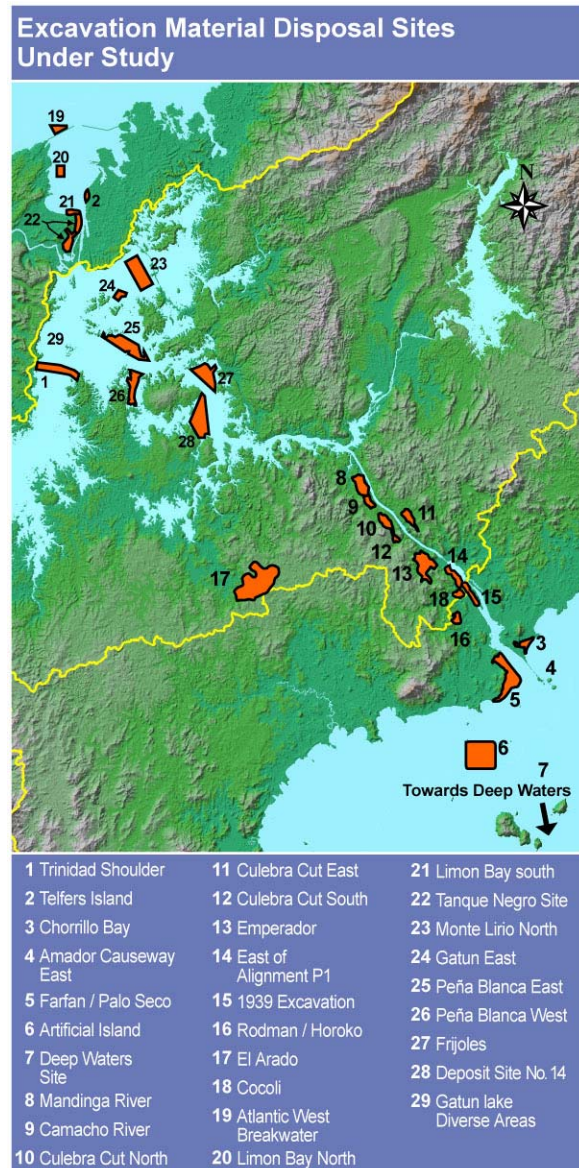


Figure 34 Location of sites studied for material disposal.



imply lower transportation costs and lessen the environmental impact. All recommended excavated material sites are within ACP operational areas, and it has been determined that no relevant, permanent or irreversible environmental impacts on waste material deposit sites will be generated.

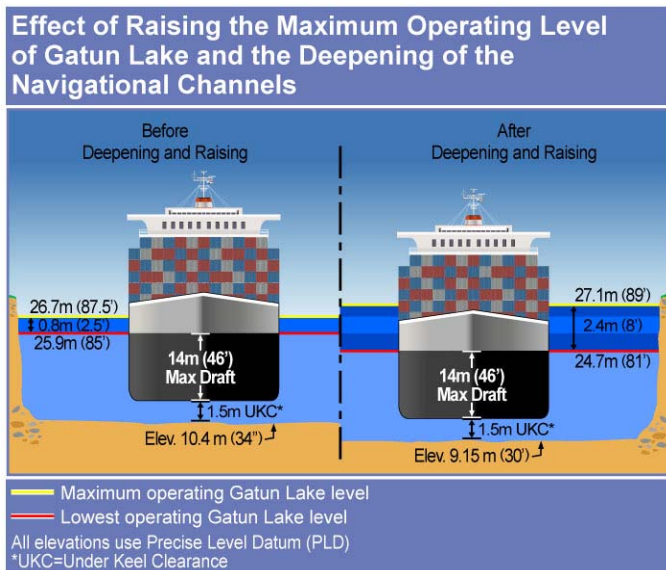
The ACP develops and maintains up-to-date environmental evaluations of the environmental plans for each of the sites it uses to deposit excavated material. Once each project stage is completed, all sites where excavated material may have been deposited will be reforested and rehabilitated, and the ACP will follow up on their environmental recovery and sustainability. Furthermore, before and during the construction, the ACP will continue evaluating opportunities to obtain economic benefits from the excavated materials.

## 7 Water supply

Water requirements for the population and Canal use will be satisfied by building water reutilization basins, deepening Gatun Lake's and Gaillard Cut's channels, and elevating Gatun Lake's maximum operational level. The proposal to expand the Canal through a third set of locks does not require new reservoirs.

When analyzing the water supply options for the Canal with a third set of locks, the ACP followed three basic principles: (1) the water supply for population use and other human activities must be guaranteed; (2) the system has to be environmentally responsible and make use of the most efficient technology for water utilization; and, (3) the water yield of the Canal's eastern watershed must be used, so that no new reservoirs are built.

In 2005 the water used by the population and other human activities in the metropolitan areas of Panama and Colon amounted to approximately 250 million gallons (1,000 million liters) per day. For comparison purposes, this amount of water would be enough to carry out



**Figure 35** Raising the maximum Canal operation level and deepening of the Gatun lake navigation channels will increase the usable water volume of Gatun Lake and the water reserve of the eastern region of the Canal Watershed.





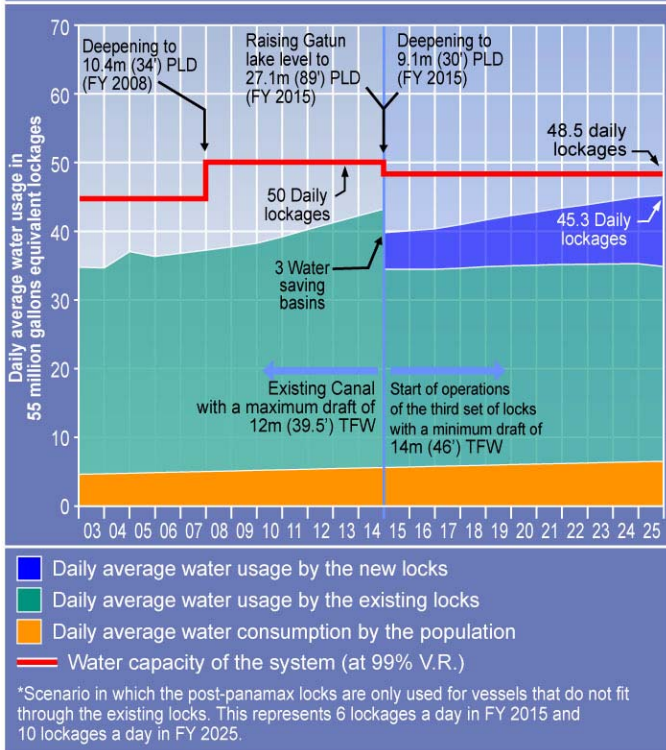
4.5 lockages<sup>85</sup>. Projections indicate that by 2025, this water usage will go up to 340 million gallons (1,300 million liters) per day, which is equivalent to the water required to perform 6 lockages per day<sup>86</sup>.

The ACP analyzed over 30 options to meet its water requirements for both for human use and Canal operations with the third set of locks. Among the most relevant options that were discarded are using the Trinidad, Alto Chagres, Toabre, Caño Sucio, Cocle del Norte and Indio watersheds, as well as water pumping recycling systems.

All of these options were evaluated and then discarded during the analysis process. The Trinidad project presents significant technical and construction challenges, mainly because it requires sub-aquatic construction on an unstable bottom and is prone to unpredictable sinking<sup>87</sup>. The Trinidad option was discarded by reason of its high cost when compared to the other alternatives, long development times and high construction and technological risks, as well as because it presents a significant socio-environmental impact by entailing forest area loss and population affectations<sup>88</sup>. The Alto Chagres option was discarded because of its high socio-environmental impact and low water yield. The Cocle del Norte, Toabre and Caño Sucio options were discarded due to their environmental impact and reliance on other projects that needed to be executed previously. The Rio Indio alternative presents adverse socio-environmental impacts, such as the relocation of up to 1,600 persons and the flooding of secondary forest areas,

**Water Capacity of the Eastern Region of the Canal Watershed with an Expanded Canal**

- Raising the maximum Gatun Lake level to 27.1m (89') PLD
- Deepening of the navigational channel to 9.1m (30') PLD
- Three water saving basins per lock chamber



**Figure 36** The implementation of the proposed water projects will provide water equivalent to 48.5 lockages per day. This will meet the water requirements for the expanded Canal and the general population beyond fiscal year 2025.

<sup>85</sup> One equivalent lockage refers to the water required to transit a vessels from one ocean to the other through the present Canal, or approximately 55 million gallons per transit.

<sup>86</sup> Long-term forecast for municipal and industrial water demand and raw water consumption, by Montgomery Watson Harza, February 2001.

<sup>87</sup> Based on the Managerial Recommendations for the Lower Trinidad Project report by Parsons Brinkerhoff and Montgomery Watson Harza, of March 2003.

<sup>88</sup> Based on the results of the study performed by the US Army Corps of Engineers, in August 2002, later reviewed by the Geotechnical Board advising ACP.



reasons for which it was also discarded. The water recycling system<sup>89</sup> was ruled out because it would have a significant adverse impact on Gatun Lake's water quality and for its high power requirements and operational risk.

In order to have the necessary water to satisfy human consumption and other human activities and at the same time guarantee Canal operations once it is expanded with the third set of locks, the ACP proposes the following measures: (1) to build, as previously explained, three water reutilization basins per chamber in each new lock<sup>90</sup>, that is to say, nine for each lock facility, for a total of 18 basins; (2) to deepen Gatun Lake's navigational channels from a 10.4m (34') PLD to a 9.1 m (30') PLD level; and, (3) to raise Gatun Lake's maximum operational level by approximately 0.45 m (1.5'), or from a 26.7 m (87.5') PLD level to level 27.1 m (89') PLD (see figure 35).

The water reutilization basins will reduce the amount of water used for each lockage by 60%, as compared to the amount that would be utilized if the basins were not built. This means that the new locks will use 7% less water per transit than the existing locks<sup>91</sup>. Also, the deepening of Gatun Lake's and Gaillard Cut's navigational channels will allow for the use of a greater part of the lake storage capacity, and thus increase the water capacity of the system by 385 million gallons (1,540 million liters) per day, or enough water to perform seven additional lockages. Finally, raising Gatun Lake's maximum operational level will further increase its storage capacity, adding approximately 165 million gallons (660 million liters) of water per day, enough to carry out three extra lockages.

The combination of these three components will provide the Canal's water system with capacity to supply an average 2,670 million gallons (10,680 million liters) of water per day, which would suffice for an average of 48.5 equivalent lockages per day (see figure 36). Additionally, these three components will allow the Canal to offer an appropriate and competitive draft in Gatun Lake's navigational channels, with a high degree of reliability.

This program guarantees the water volumes required to satisfy both the demand from the population and human activities that are served by Gatun and Alhajuela Lakes and as well as for Canal operations

<sup>89</sup> *Conceptual Design to Recycle Water in Post Panamax Locks*, by the Post Panamax Consortium, April 2004

<sup>90</sup> The possibility of adding three water reutilization basins to existing locks was evaluated and discarded for it entailed a high technological and construction risk by requiring the total shutdown of the lock for many months.

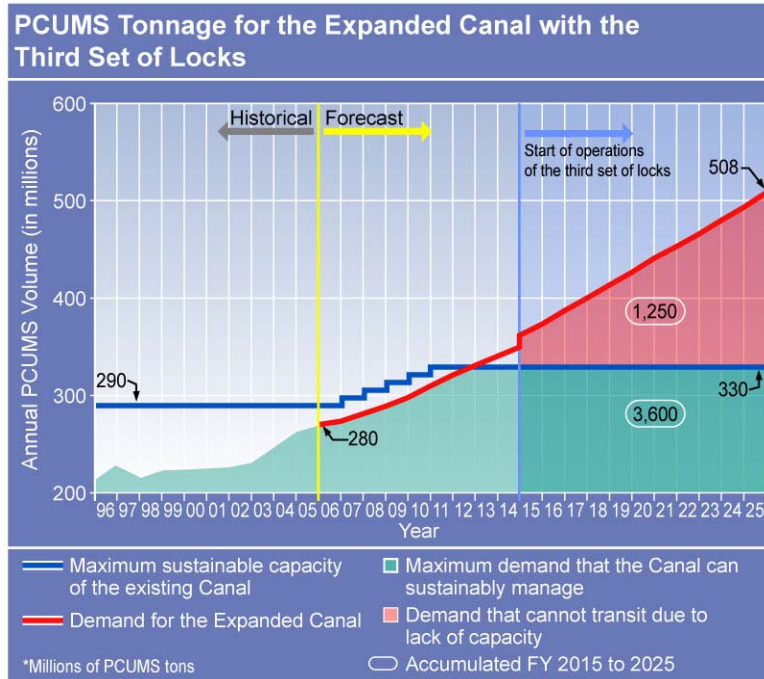
<sup>91</sup> Each transit using the new locks with three water reutilization basins per chamber will use 7% less water than transits in the current locks. In terms of PCUMS tonnage, the new locks will be able to handle vessels with approximately two and a half times the cargo capacity, using less than half the water per PCUMS ton than the current locks.



once it is expanded with a third set of locks, even when it reaches its maximum sustainable capacity beyond 2025. Thus, the Canal’s eastern watershed’s yield is fully used and the Canal, expanded with the third set of locks, will reach its full operational capacity and will function reliably at that level without the need for an additional water sources. For that reason, it will not be necessary to build additional reservoirs in the future.

## 8 Profitability and benefits of the third set of locks project

The third set of locks, aside from being technically viable and environmentally responsible, is financially profitable. Based on the most probable demand forecast and cost estimate including contingencies, the third set of locks project yields a 12% internal rate of return. The investment will duplicate the Canal’s maximum sustainable capacity and improve its productivity and efficiency.



**Figure 37** An expanded Canal with the third set of locks will be able to capture a total cumulative additional tonnage exceeding 1,250 million PCUMS tons between fiscal year 2015 and 2025.

### 8.1 Canal revenues

The main purpose of Canal expansion program is to increase Panama’s ability to benefit from the growing traffic demand. This growing demand is manifested both in cargo volume increases as well as in an increase in vessel sizes that will use the Panama route. In this sense, the Canal with a third set of locks will be able to manage the traffic demand forecast beyond 2025, and total revenues for that year, adjusted for inflation, will amount to over \$6,200 million.

Expanding the Canal will also double the waterway’s capacity and strengthen the Canal’s market share, particularly in the containerized cargo route between Northeast Asia and the U.S. East Coast. The third set of locks will also allow the Canal attain a more than 50% share of that market by 2025, which represents an increase of more than 10% over its present market share, and equals more than 2.8



million additional TEUs over what transited in 2005. Moreover, it opens the possibility of new markets, adding value to the Panama route.

From 2015 to 2025, the expanded Canal will handle a total of over 4,850 million PCUMS tons; while if not expanded, it will only be able to manage approximately 3,600 million tons during that same period<sup>92</sup>. Therefore, during its first eleven years of operation, the third set of locks will allow the Canal to handle an additional traffic volume of over 1,250 million PCUMS tons, which it would not be able to serve if it were not expanded. This equals a 35% increase in cargo volumes during that period (see figure 37).

The traffic volume increase will represent, during that same period, additional tolls revenues on the order of \$10,000 million, and \$2,650 million in additional revenues for other maritime services which would not be realized if the Canal were not expanded<sup>93</sup>. In total, during the 2015-2025 period, the expanded Canal will surpass the revenues of a Canal without the third set of locks by about \$12,650 million<sup>94</sup>.

Given the above, it is anticipated that Canal revenues for the first eleven years of operation with the third set of locks will exceed those of a non-expanded Canal by an average of \$1,150 million per year. Should the comparison period be expanded, the difference would be even more dramatic.

The ACP will implement a price policy aimed at capturing the value that the Canal adds to each segment served. This policy will be subject to the following economic criteria:

- Tolls will be established so that they reflect the value provided by the Canal to its users.
- Tolls will be set so that their relative value is maintained over time and will be periodically adjusted to consider inflation.
- Tolls will be established at appropriate levels to maintain the competitiveness of the Panama route at all times and to reach a profitability level in accordance with the risk levels, investment amounts and the value added by the Canal to its users, so that the

<sup>92</sup> Panama Canal Operational Capacity Study, ACP, March 2006, performed with a simulation model developed by Rockwell International and Paragon Consulting.

<sup>93</sup> Canal expansion program financial profitability analysis, ACP 2004-2006.

<sup>94</sup> Canal expansion program financial profitability analysis, ACP 2004-2006.





payments to the National Treasury and the benefits to Panama are increased in a sustainable manner.

- Tolls will be set at levels that allow the short-term recovery of the investment required to build the third set of locks.
- Tolls will be applied in the same unbiased manner to all transits regardless of the lock used, since the locks will be used by all kinds of vessels, pursuant to Canal operational requirements.

In this sense, the ACP will raise tolls between 2007 and 2025 so as to maintain or increase its market share in each of the above mentioned segments, with the goal that the Canal remain competitive when compared to other alternatives, such as the Suez Canal and intermodal systems. The time and amount in which the tolls increase is applied will be determined by the project's financing requirements and disbursements program. Execution of this pricing policy will be subject to the consultation process established by the Organic Law as well as ACP regulations, and in the same way that it has been carried out to date .

## 8.2 Canal efficiency and productivity improvements

The third set of locks will allow the Canal to increase its efficiency and productivity. Economies of scale brought about by the use of larger vessels together with the additional capacity of the expanded Canal will allow for the transit of a larger amount of PCUMS tons, with relatively less vessels. For example, in the year 2025 the expanded Canal will handle a vessel mix with an average size of 33,800 PCUMS tons per transit. This represents a more than 50% increase over the average vessel size in 2005, which was about 22,000 PCUMS tons. Additionally, it is anticipated that by 2025 more than 50% of PCUMS tonnage will transit in post-Panamax vessels<sup>95</sup>.

It is precisely these economies of scale that will allow the expanded Canal to substantially improve its productivity, as measured through net profit per PCUMS ton. Projections indicate that by 2025 the third set of locks will permit the Canal to obtain net profits per PCUMS ton of over four times that of the year 2005.

<sup>95</sup> Projection developed based on market and fleet composition research conducted by ACP and analyzed through the demand models developed by Mercer Management Consulting.



### 8.3 Canal profits and contributions to the National Treasury

During the execution of the third set of locks program the Canal will continue to make growing contributions to the National Treasury. This is because the Canal will continue, as always, to make payments according to the net tonnage of vessels transiting the Canal<sup>96</sup>. In addition, during the construction of the third set of locks, the ACP will transfer operational surpluses to the National Treasury in an amount that will never be less than the surplus of 2005. After the construction, the contributions to the National Treasury will increase at the same rate that Canal revenues grow. The expansion program will allow the Canal to recover its investments and generate an adequate return on them. The third set of locks will increase Canal capacity, which represents additional traffic, and, as a result, higher revenues than those the Canal would receive without the investment.

With the third set of locks, Canal net income will grow up to \$4,310 million in 2025, equivalent to an average annual growth of over 11.6% (see figure 38)<sup>97</sup>.

In 2025, the expanded Canal will be able to generate total contributions of up to \$4,190 million to the National Treasury, which will consist of \$670 million in net tonnage fees and public services fees, and up to \$3,520 million in surplus after reserves for investments are made (see figure 39). In cumulative terms, during the first 11 years of operation of the third set of locks, the expanded Canal will be able to generate contributions to the National Treasury of \$8,500 million more than it would if it were not expanded, an amount which, by itself, exceeds the amount that will be invested on the third set of locks.

### 8.4 Profitability and internal return rate of the third set of locks project

For the purposes of determining the profitability of the investment, the difference in Canal cash flows under scenarios both with the expansion and without the expansion have been considered, so that the difference in net cash flows may be ascribed to the third set of locks investment. In this sense, the project presents a typical financial profile for an infrastructure project of this type, with investments during the first years, and benefits that are perceived later, after the facility begins operation. Based on the most probable demand projections,

<sup>96</sup> ACP pays to the State 75 cents per PCUMS ton transiting the Canal.

<sup>97</sup> Expansion program financial profitability analysis, ACP 2004-2006.



the third set of locks investment generates an internal rate of return in the order of 12%<sup>98</sup>. This rate of return is excellent for an infrastructure investment such as the one proposed, considering its moderate risk and the type of mature and established industry in which the Canal operates. Therefore, from the financial standpoint, this is a profitable and attractive investment.

This profitability has been estimated based on a \$5,250 million investment program, which is to be executed in approximately eight years beginning with the final design in FY2007 and ending when operations start in FY2015. The cost of the investment program is described in figure 8, which, as previously explained, includes all of the project’s components as well more than suitable provisions for contingencies and unforeseen events, based on a strict analysis of risks and their possible impacts.

The profitability analysis took into account the stated pricing<sup>99</sup> policy, and pursuant to the most severe and strict financial parameters, applied equal pricing methodologies to both the with and without expansion scenarios. Notwithstanding this, the ACP’s ability to establish tolls will depend on the added value as well as the quality of service and reliability that the Canal offers its clients,. Without the investments required to increase Canal capacity so that it may handle the growing demand and continue to offer a fast, reliable and safe service –which has been the hallmark of the Panamanian administration of the Canal–tolls increases will be harder to justify.

In addition, the profitability analysis conducted for the third set of locks project presupposes that the Canal, in the unexpanded scenario, will have sufficient demand to continue operating at its maximum capacity in a sustainable manner, without interruption and for the

Financial Results <sup>1</sup>	Year 2005	Year 2025	Annual average growth rate
PCUMS Tons <sup>2</sup>	279	508	3.0%
Transit Revenue	1,117	6,101	8.9%
Other Revenues	92	125	1.5%
<b>Total Revenues</b>	<b>1,209</b>	<b>6,227</b>	<b>8.5%</b>
Operating Costs	444	1,016	4.2%
Fee per Net Ton <sup>3</sup>	218	668	6.5%
Public Services Fees <sup>3</sup>	2	2	0.0%
Depreciation	61	231	6.8%
<b>Net Income</b>	<b>484</b>	<b>4,310</b>	<b>11.6%</b>

<sup>1</sup>Numbers in millions of dollars, including a general inflation of 2%, unless indicated otherwise  
<sup>2</sup>Millions of PCUMS tons  
<sup>3</sup>In order to facilitate comparison, the payments of right per net ton and rate for public services of FY 2005 were adjusted to reflect the change in calculation that applies to FY 2006

**Figure 38** An expanded Canal with the third set of locks will reach B/. 6,227 millions in revenues in fiscal year 2025, with income in the order of B/.4,310 millions.

<sup>98</sup> The third set of locks project generates an internal return rate in the order of 12%, considering cash flows prior to inflation effects, in 2005 dollars. Considering a possible 2% average annual inflation, the expansion program generates a 14% internal return rate. Financial analysis conducted by ACP.

<sup>99</sup> Canal price policy, section 8.1 hereof.



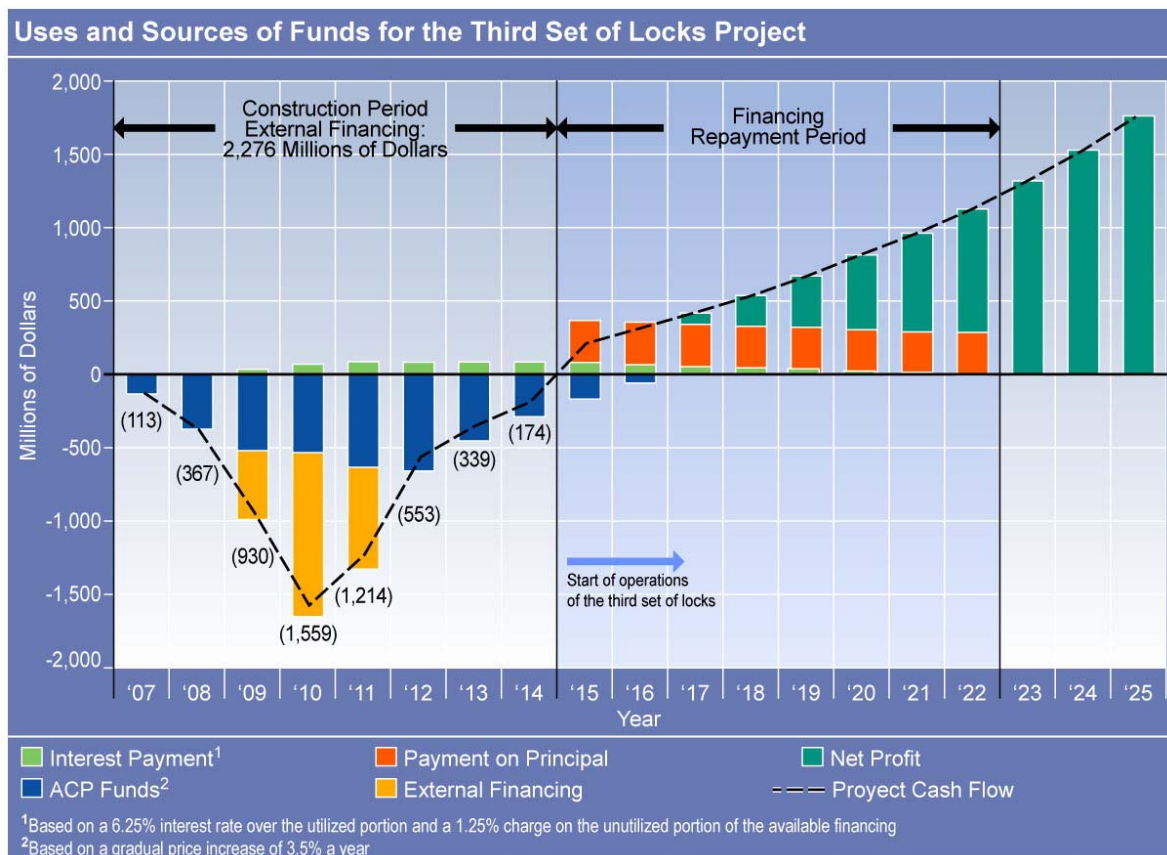
long term. Nevertheless, it is very improbable that this will happen, due to the appearance of new competitors and to the strengthening of existing competitors due to the Canal's lack of capacity. Should the Canal not be expanded, it will face a deterioration of its competitive position, which surely will cause a demand reduction in the long term.

### 8.5 Financing issues of the third set of locks project

The expansion program is self-financing, and will not burden the country because its financing will not be part of the State's sovereign debt. Funds for building the third set of locks will be obtained through tolls increases. Tolls are the source of all funds to be used for the payment of all investments related to the third set of locks and for the repayment of all financing related thereto.

The State will not guarantee or endorse any ACP financings.

Possible financing requirements will be dictated by the three follow-



**Figure 39** The financing of the third set of locks will come from a combination of ACP's funds, resulting from toll increases, and external financial sources to cover peaks during construction. Revenues from the third set of locks will repay external financing in 8 years or less.





ing factors:

- Investment amounts required for the project and the need to execute the construction as expeditiously as is technically and economically viable, with the purpose of achieving profit generation as soon as possible and the recovery of the investment.
- Canal revenues resulting from Canal traffic volumes and from the pricing policy implemented by ACP, in accordance with the stated pricing policies.
- The need to obtain, in a timely manner, external resources in order to cover peak construction periods.

To illustrate the above, in 2005 the Canal executed a \$150 million investment program entirely financed by ACP internal resources; this level of investment will be maintained, at a minimum, throughout the implementation of the third set of locks project. The new locks project investment program will require average investments in the amount of \$650 million per year. Therefore, the Canal will require approximately \$500 million per year in additional funding to cover program requirements.

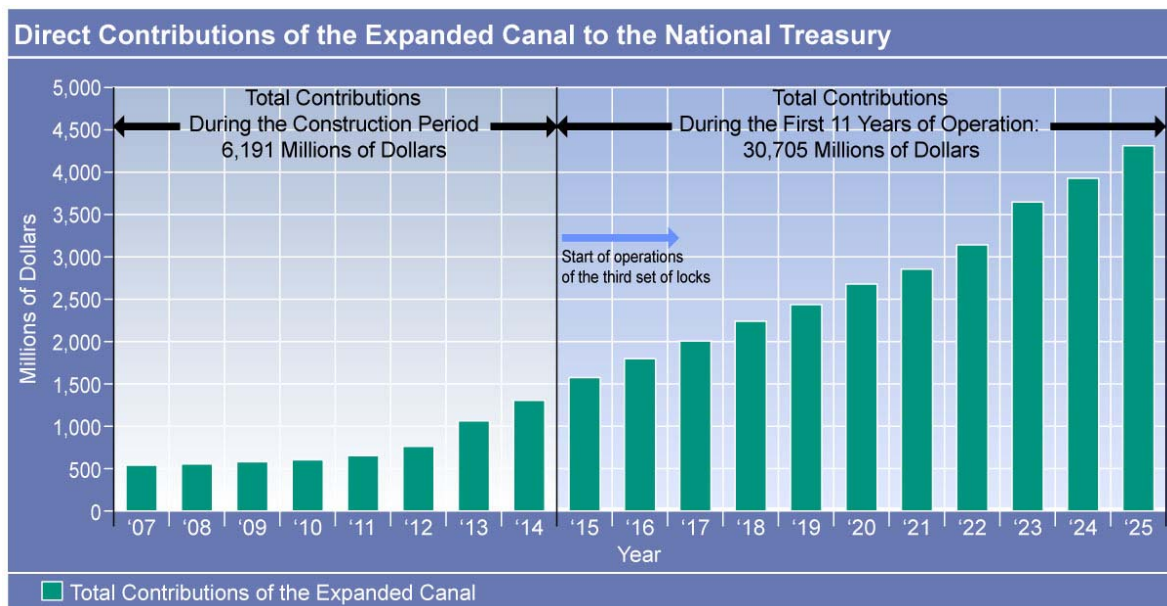
Where will this additional \$500 million per year come from? From a combination of additional revenues from the tolls increase derived from the pricing policy described earlier and from credit and financial sources that ACP may obtain in the financial markets. In this respect, ACP plans to increase tolls beginning in 2007 so it that may rely upon a portion of the resources required for the third set of locks project, while maintaining the competitiveness of the Panama maritime route in all of its segments. As a complement to the tolls increase, and in order to defray costs during the critical project construction peak in the 2009-2011 period, the ACP will need to contract temporary external financing that will be repaid, in the short term, with tolls revenues after the commissioning of the third set of locks.

The combination of additional financing from tolls increases and external financing will take into account the maritime transport market conditions on one hand, and prevailing financial market conditions, such as interest rates, periods and terms, as well as all relevant financing costs. The greater the capacity of the Canal to increase tolls, the lesser will be the need for external financing; conversely, to the extent the ability to generate additional revenues through tolls decreases, the need for external financing would increase. In this sense, in accordance with the most conservative policy for increasing tolls



of 3.5% per year, the amount of external financing required to cover the project’s peak construction period will not exceed \$2,300 million (see figure 39).

Under this conservative scenario, the contributions of the Canal to the National Treasury during the construction period will total close to \$6,191 million, and during the first 11 years of operation of the third set of locks they will be \$30,705 million, as shown in figure 40.



**Figure 40** During construction of the third set of locks Canal contributions to the National Treasury will increase.

If a less conservative tolls policy is implemented, for example, an increase of 8% per year during the first 5 years of the project, the need for external bridge financing to cover the peak construction period would be of approximately \$1,500 million.

The beginning of operations of the third set of locks will increase the operational capacity of the Canal, and as a result, the PCUMS tonnage passing through it. Therefore, Canal revenues will increase significantly and this will allow repayment of any temporary financing in a period of 8 years or less, and recovery of the investment before 2025. In any case, and even with external financing, the Canal’s increasing contributions to the National Treasury would be maintained.

The approval processes for ACP financing requires the authorization of the Cabinet and the definition of a financing policy in line with the following economic criteria:

- **Legal framework of ACP finances.** The Panama Canal belongs to the Panamanian State. Nevertheless, by virtue of Constitu-



tional Title that created ACP and the organic law<sup>100</sup> that develops it, ACP finances are managed independently from those of the rest of the Government. This independence will allow ACP to obtain financing terms under the best possible conditions.

- **No guarantee or endorsement by the Government will be used.** None of the Canal's financing will bear the sovereign guarantee of the State. Consequently, the Canal's financing contracts will not be consolidated with the sovereign debt. In other words, just as Canal finances do not form part of the public sector's finances, the financing for building the third set of locks would not form part of the State's public debt.
- **Canal contributions to the National Treasury will increase.** With the construction of the third set of locks, Canal contributions to the Treasury will increase and be greater than the contributions made during fiscal years 2005 and 2006<sup>101</sup>. During the construction of the third set of locks the Canal's contributions to the National Treasury will be, on average, more than \$750 million per year and in 2015 could be more than three times those made in 2005. It is estimated that in 2025 the total contributions by the Canal to the Treasury could be more than eight times those of 2005.
- **Alternative financing sources will be used.** Given the project's nature and risk, the ACP will make use of financial markets other than those used by the State to finance its investments programs.

The ACP will be able to obtain favorable financing terms, given that the Canal's income is external, and its financing capability and conditions are dictated by the quality of the Canal users, the route utilization levels, the fact that Canal services are paid in advance or handled through first class bank guarantees with a 48-hour collection cycle and that it is a going concern with a proven market. These facts allow for financing costs and conditions more favorable than those offered for public debt generally. For this reason, the Panama Canal Authority intends to enhance its financial independence by obtaining a risk classification better than the State's.

To date, the ACP has financed all of its capital investments with its own resources, with the approval of the Executive and Legislative branches. Given the magnitude of the third set of locks project, it is

<sup>100</sup> Title XIV of the Political Constitution of the Republic of Panama and Organic Law 19 of June 11, 1997.

<sup>101</sup> In accordance with the audited financial statements of the ACP, Canal payments to the National Treasury during FY 2005 amounted to \$489 million, which include \$191 million in net tonnage payments, \$29 million in public service fees and \$269 million in surplus payments.



only prudent for the ACP to have external financing resources, so as assure project execution within the proposed schedule. This bridge financing for the construction period, as well as for the construction of other projects, will be paid with the additional revenues that justify the project's profitability.

Financing for the third set of locks will be composed of a reasonable tolls increase, to be implemented immediately upon approval of the project, and external financing sources to cover peak funding requirements during the construction period. By virtue of the separation between the ACP and the State's finances, the investment repayment source will consist of tolls revenues to be received by the Panama Canal.

## 9 Employment generation and economic benefit for Panama as a result of the third set of locks

Expanding the Canal will provide benefits beyond those directly derived from its operation. This is because the Canal is the driving force of a conglomerate of services and interrelated activities that generate a variety of contributions to the national economy (see figure 41). This economic system includes ports, the railroad, shipping agencies, fuel sales, a great portion of Colon Duty Free Zone economic activity, tourist operators, the land and intermodal transportation services, the shipyard, the airport and merchant marine activities, legal and financial services, insurance services, telecommunications and the City of Knowledge, among others. All these economic activities complement each other, and together, enjoy Panama's main competitive advantage: its geographical position.

On a primary level, there are Canal conglomerate activities that interconnect with the global economy. Activities such as those of the

Components of the Services Clusters and the Canal Economic System			
Canal Related Services Clusters			
Canal Economic System			Parallel
Direct	Indirect	Induced	
Canal Operations	Shipping lines Shipping agencies Bunkering services Services to vessels in transit Repair and maintenance of vessels Launch services and dredging pilotage	Ports 80% Colon Free Zone (CFZ) 20% Canal tourism operators Logistics systems Railroad Export Processing Zones (EPZ) Intermodal service Cruise tourism Repair and maintenance of containers Ground transportation	Ports 20% Colon Free Zone (CFZ) 80% Air Hub Merchant Marine Telecommunications City of Knowledge Legal services Certifying and classifying of vessels Maritime Court Public Services Financial services Insurance Education and Training

Source: Intracorp Estrategias Empresariales, S.A.

**Figure 41** The Panama Canal economic system is a cluster of services and activities that contribute to the growth of the national economy.



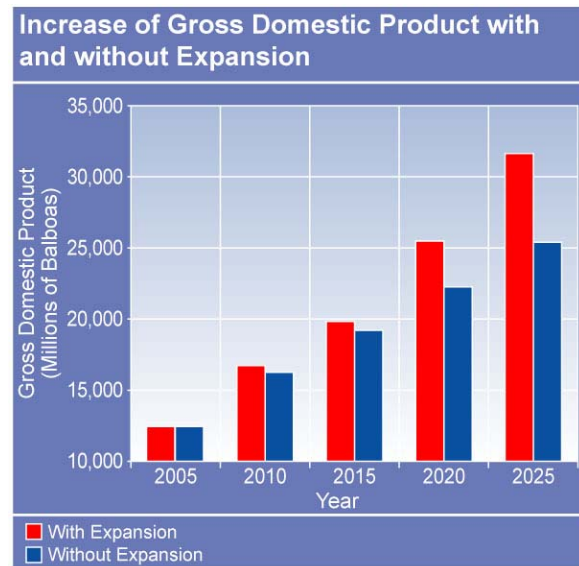


Canal, the Colon Duty Free Zone, the ports, the merchant marine, vessel registration activities, the air cargo center, cruise-ship tourism, and the trans-isthmian pipeline, among others, respond to international markets demands. On a secondary level, there are other activities such as those of shipping agencies, fuel supply, vessel repairs and maintenance, railroad, and other financial services (mainly banking and insurance services), which respond to service demands generated by primary activities. Consequently, there is an international demand for some of the conglomerate's activities that, at the same time, generates a local demand for additional complementary services which are produced by other conglomerate elements. It is precisely that internal synergy between complementary economic activities that comprises the primary characteristic of a conglomerate.

This means that the benefits of the Canal expansion will not only come from direct income generated by the waterway, but also from the entire conglomerate's economic activity level. It is estimated that the Canal expansion will allow the Canal economic system exports to be tripled by the year 2025. Additionally, the Canal expansion will stimulate a 40% increase in the rest of the conglomerate's investments, which will rise to \$1,100 million per year<sup>102</sup> by 2025. The Canal expansion will allow Panama to attain a gross domestic product of \$31,700 million by 2025 in 2005 dollars. This represents almost 2.5 times the gross domestic product of the country in 2005, and equals an average annual growth rate of over 5% for the next 20 years (see figure 42).

The Canal expansion's impact on employment will first be observed in the jobs directly generated by the economic boom that will be experienced during the years of the construction. In that respect, 35,000 to 40,000 new jobs will be created during the construction of the third set of locks. These include 6,500 to 7,000 additional jobs that will be directly related to the works during the construction's peak years.

However, the most important impact on employment will be medium and long term, and will come from the economic growth brought



**Figure 42** With the expansion of the Canal Panama's GDP will experience an average annual growth of 5% over the next 20 years until reaching over B/.30,000 million in 2025.

<sup>102</sup> Economic Impact of the Canal on the National Ambit, study performed by IntraCorp, March 2006.



about by the extra income that will be generated by the expanded Canal and the economic activities produced by the increase in Canal cargo and vessel transits, all of these contributing to fully leverage the advantages of Panama's geographical position.

Studies related to the proposed expansion indicate that annual economic growth in the case of an expanded Canal will average 1.2 additional percentage points in comparison with a Panamanian economy without the expansion alternative. When we apply the relation between economic growth and employment for the last two decades, it is estimated that the economic boom will generate a 0.5% to 0.75% annual employment growth over that without the construction of the third set of locks. Thus, 10 to 15% more jobs will be generated in the expanded Canal scenario than in the non-expanded Canal scenario. For example, if we estimate that without the expansion there would be 1.5 million employed people by 2025, an additional 150,000 to 250,000 people would have a job thanks to the expansion<sup>103</sup> (see figure 43). Therefore, this higher medium to long-term employment generation will be a result of the growth in Panama's economic activities by reason of the increased business in the service conglomerate, which will directly benefit from the economic movement brought about by greater cargo and vessel traffic in the Panama route.

Given the nature of the expansion of the Canal, a high proportion of formal employment will be created. This wage-based employment will reverse the dynamics observed in the labor market during the last decade. New job opportunities will reduce existing unemployment until reaching what is called a "natural unemployment rate." In addition, some of those inactive or underemployed will also be absorbed. Part of the population involved today in subsistence activities will enter this labor market, and there will be better opportunities for women and more first-time employment. Hence, the great importance of training, instruction and education programs to prepare Panamanians so that they may benefit from the opportunities that will be created both in the ACP as well as in the rest of the economy.

The labor required for the project will include artisans, technicians, specialists, heavy-duty equipment operators, and professionals of disciplines such as project management, building supervision, design, inspection, surveying, finance, accounting, purchasing, logistics, security, maintenance, drawing, and computing, among the most

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<sup>103</sup>The Economic Impact of the Canal on the National Ambit study developed by Intracorp determined that by sometime between 2015 and 2025, the third set of locks project will generate approximately 250,000 new jobs over the amount of jobs that would exist in the unexpanded Canal scenario.



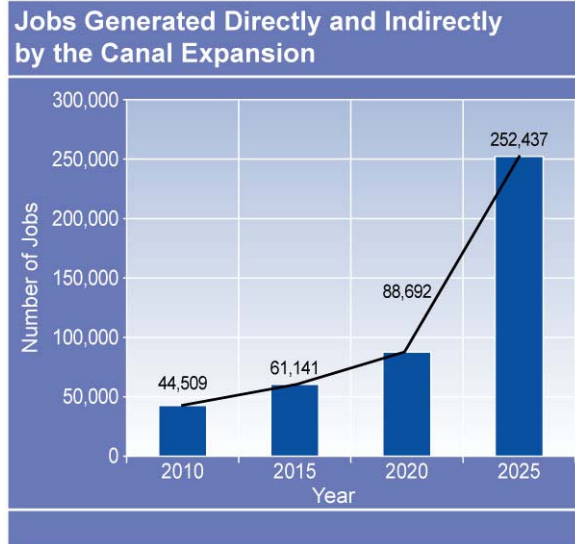
relevant. The labor force that will be working in the construction of the third set of locks will, in its vast majority, be Panamanian. In order to ensure Panamanian labor availability necessary for the third set of locks project and its connected activities, the ACP and the competent public and private authorities will work jointly to train the required workforce with sufficient lead time, so that it has the necessary competencies, capabilities and certifications. The amounts necessary to carryout these training programs are included in the cost estimates of the project.

The third set of locks is estimated to have a social profitability of between 11 and 14%. With these percentages one may say that the third set of locks project will enhance the country's economic welfare. When studying the effect of the Canal expansion on Panama's poverty levels, it is estimated that the number of people at or below the poverty level will decrease by over one hundred thousand in 2025 in the project execution scenario versus the non-execution scenario<sup>104</sup>.

These results indicate that the third set of locks will generate benefits to the economy that are higher than the cost of the resources to be used for the expansion and its complementary activities.

## 10 CONCLUSIONS

What yesterday was the consolidation of our territorial integrity with the transfer of the Canal to Panama, tomorrow will be the strengthening and development of the country by way of better utilization of its resources, and in particular that of its geographical position. The Panama Canal represents the cornerstone that supports a large part of the country's economy and from which the latter's development and growth is driven. It is therefore convenient that the Canal continue to be useful and attractive to its users, from whom the benefits generated by the Canal for all Panamanians come. It is because of this, through a clear strategic vision, that the Canal must respond to changes in world trade patterns, anticipating its requirements and



**Figure 43** The third locks Project will contribute to the creation of approximately 250,000 new jobs between 2015 and 2025 as a result of the growth of economic activity of the Canal related services cluster.

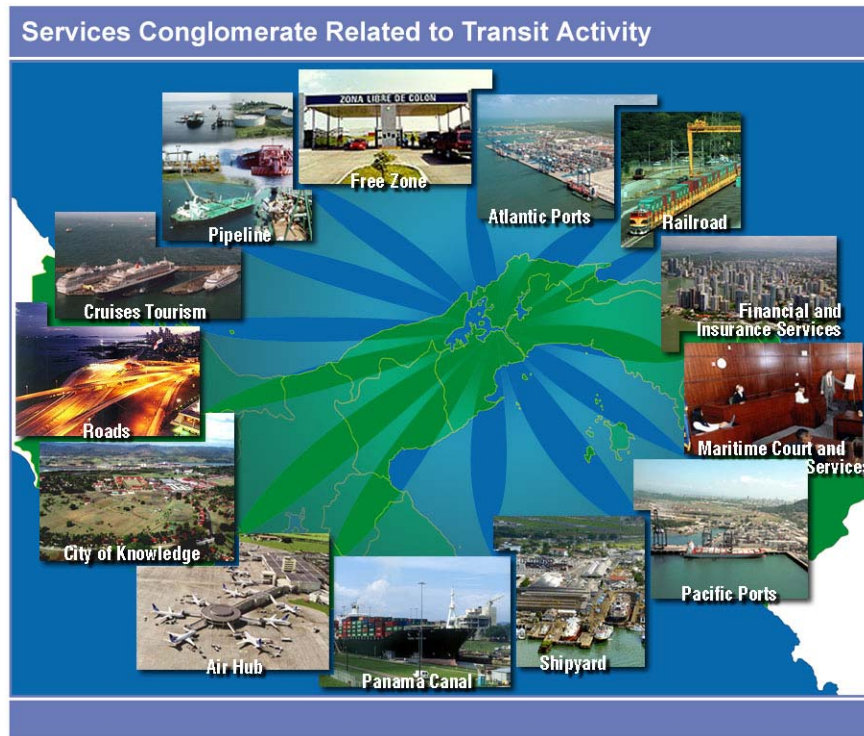
<sup>104</sup>Socio-Economic Evaluation of the Canal Capacity Expansion Program (Third Set of Locks Project), study developed by INDESA, April 2006.



thereby succeeding in facing the challenge of maintaining its role as the motor of economic growth of Panama (see figure 44).

In order to guarantee and increase the benefits brought by the Canal to all Panamanians and maintain the long term sustainability of the level of its contributions to the National Treasury, it is imperative for Panama to secure the Canal's competitiveness and strategic participation as a key route in world trade. Therefore, by the end of the first century of Canal operations, a thorough diagnostic of the waterway's past and present performance was carried out and a long-term prospective developed, with the purpose of establishing the direction that the Canal must follow in order to continue to be competitive and profitable, for the benefit of the Panamanian people. Had this diagnosis not been done and the prospective not been developed, the ACP would have failed in its institutional tasks, and as a result, in its responsibility to further the best interests of the country.

The Canal is about to reach its maximum capacity and faces the dilemma of becoming stagnant or investing in order to grow. Research conducted by the ACP indicates that the Canal has the opportunity to benefit from a growing commercial and transit demand, which is projected to be predictable and profitable. Once the Canal reaches its maximum sustainable capacity, it will not be able to capture any additional demand, which will reduce its competitiveness and market share in the main routes that it serves and which will encourage other competitors to enter the business. In addition, this will set the conditions for new trade and transport patterns to be defined in the medium and long terms. This situation will cause the Canal to gradually lose its position as a key maritime route in world trade. Should the decision not to expand the Ca-



**Figure 44** The expansion of the Canal through the third set of locks will ensure the continuous development and growth of the dynamic Canal related services cluster giving Panama the opportunity to fully realize the benefits of its geographic position.

Should the decision not to expand the Ca-





nal be made, others will develop new alternatives in order to benefit from the demand that the Canal will not be able to handle. It will be very difficult to capture this demand with a belated expansion in the future, since once these alternatives are developed, trade patterns will experience fundamental and irreversible changes.

In order to enhance the capacity and eliminate the restrictions imposed on the maritime industry by the Canal, take advantage of the ever-increasing forecasted demand of cargo and commerce, maintain a competitive and growing Canal and add value to the Panama route, the ACP proposes the above investments program, designed to increase Canal capacity by incorporating a third set of post-Panamax locks. The necessity to expand the Canal responds to the projected growth in the maritime commerce in the Panama route and represents, in addition, an opportunity – by attracting larger vessels – to make the Canal more efficient, more competitive and more profitable. As mentioned above, the statements made in this proposal are extensively detailed in the 2005-2025 Canal Master Plan, and are fully supported by the over 120 studies conducted by the ACP to that effect.



# Annex

## Master Plan Study List





## List of Studies

### Environmental and social

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  - Estudio sociocultural de la Región Occidental de la Cuenca del Canal de Panamá – Cuenca del río Indio, ABT Associates, March 2004
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Web address: [www.pancanal.com](http://www.pancanal.com)  
E-mail address: [ampliacion@pancanal.com](mailto:ampliacion@pancanal.com)