Panama Canal

- Maps
- Major locks
  - Gatun locks and dam (near Colon)
  - Pedro Miguel
  - Miraflores (near Panama City)
- Culebra Cut
- Pacific Entrance
- Third set of locks for Post-Panamax vessels
Colon is the city at the north end of the Panama Canal and Panama City at the south end.
Panama has a mixed terrain—like much of Central America—the mountains east of the Canal receive high rainfall which provides much of the water for the Canal locks.
Outline view of Panama Canal—its route is almost north to south
Virtual Earth Image of the Canal

- Gatun Locks
- Madden Lake
- Gatun Dam
- Chagres River
- Gatun Lake
- Pedro Miguel Locks
- Miraflores Locks
Panama Canal Layout

Source: BBC
Panama Canal Limiting Dimensions
(source: PCA)
Panama Canal—Miscellaneous Facts

- Cargo through the Panama Canal is estimated to grow 3% per year for the next 20 years.
- The Canal is the primarily economic resource for the Republic of Panama.
- The PCA charges tolls based on vessel capacity—not the number of transits.
- Locks filled and emptied by gravity (no pumps).
Panama Canal—Miscellaneous Facts

• To transit one container through the Canal costs about $54 per 20 ft TEU (as of May 2007).

• Post-Panamax vessels
  – Typical dimensions: 1200’x160’x50’draft.
  – Suez Canal can accommodate Post-Panamax vessels now.
  – Third set of locks at the Canal will accommodate these vessels.
Miscellaneous Facts

• Costs as of 2009:
  – Cost per container now $72 per TEU.
  – Cruise liners pay $120 per berth.
  – Canal has revenues of $2 billion and costs of $600 million.

• Transit times:
  – US operation of canal (ended 1999): 27 to 28 hours
  – Currently about 24 hours
  – Annual transits about 14,000 per year.

Source: The Economist, Dec 5-11, 2009
Miscellaneous Facts

- In 2000, 85% of the world container fleet could pass through the PC.
- 2007: Only 57% can pass through the PC
- 2011: Projected that less than ½ could pass through the PC.

Source: The Economist, Dec 5-11, 2009
Miscellaneous Facts

• Shanghai to New York
  – Via Panama Canal 25 to 26 days.
  – Via Suez Canal 27 to 28 days.
  – Via Los Angeles then train 19 to 21 days (which costs about $600 per container more than the transit through the Panama Canal).

• Typical container ship operating costs $60,000 per day.

Source: The Economist, Dec 5-11, 2009
Panama Canal—Miscellaneous Facts

- Total excavation for the original construction of the Canal (1904-1914) was about 262 million yd$^3$.
- Culebra Cut required removal of 96 million yd$^3$.
- Balboa: 22 million yd$^3$ deposited there resulted in 676 acres reclaimed from the Pacific Ocean.
- Construction of the Canal required 61 million lb. of dynamite.
South Entrance to Canal

Breakwater

Isla Naos

Isla Perico

Isla Flamenco
Google Earth Image of Gatun Locks
Google Earth Image of Miraflores Locks
Gatun Locks
Gatun Locks

Source: Virtual Earth 3D
Gatun Locks—South Entrance
Ships waiting to enter Gatun Locks—Gatun Lake
Gatun Dam
Gatun Dam
Gatun Locks—North Entrance/Exit
Gatun Locks—North Entrance/Exit
Gatun Locks—three sets bring ships up (or down) 85 ft.
Crossing Gatun Lock—Atlantic level
All kinds of cargo transit the locks
Ship moving into lower lock from Limon Bay
Water from lower lock flowing into Limon Bay
Construction of Gatun Locks
1910

Source: Panama Canal History Museum
Miraflores Locks
Photograph of John F. Stevens who worked on the tunnel for the Great Northern railroad (Stevens Pass) prior to his work at the Panama Canal
David Du Bose Gaillard, in charge of the excavations in the Cut, led an army of men and machines in the greatest earth-moving operation the world had seen. Gaillard did not live to see his task completed. In 1915, two years after his death, Culebra Cut was officially renamed Gaillard Cut in his honor.

David Du Bose Gaillard, encargado de las excavaciones del Corte, dirigió un ejército de hombres y máquinas en la mayor operación de movimiento de tierra vista en el mundo. Gaillard no vivió para ver su obra terminada. En 1915, dos años después de su muerte, el Corte Culebra recibió el nombre de Corte Gaillard en su honor.
Miraflores—South view toward Balboa
Miraflores—North direction toward Colon
Clog rail for mules
Miraflores—ship underway to north
Construction of the Miraflores Locks
1912

Source: Panama Canal History Museum
Construction of Miraflores gates
1913

Source: Panama Canal History Museum
First flooding—Miraflores Locks
1913

Source: Panama Canal History Museum
Pedro Miguel Locks—view to South
Pedro Miguel Locks—1978

Hill to be removed for construction of the new locks.

Source: National Archives
Hill north of Pedro Miguel Locks to be removed for construction of third set of locks.

Contract awarded to CUSA for $40 million June 2007. Requires clearing of ordinance left by US forces and movement of 7.5 million m³ of material.
Construction of Pedro Miguel Locks
February 21, 1911

Source: Panama Canal History Museum
View of a portion of the Culebra Cut
SS Ancon in the Culebra Cut—first vessel to transit the Canal—1914

Source: Panama Canal History Museum
Culebra Cut Slide—1913

Source: Panama Canal History Museum
Road to head of Pacific side of Panama Canal (Calzada de Amador)
Port at Balboa
PCA Headquarters—located in the former Canal Zone and monument to Goethals (PCA—Autoridad del Canal de Panama)
Panama Canal Railway Company near Balboa
Third Set of Locks

- Construction start during 2007
- Completion 2014
- Estimated cost: $5.25 billion
Panama Canal is gaining Market Share

Panama Canal Market Share of the Container Segment on the Asia to the U.S. East Coast Route

<table>
<thead>
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<th>Year</th>
<th>U.S. Intermodal System</th>
<th>Panama Canal</th>
<th>Suez Canal</th>
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<tr>
<td>1999</td>
<td>86%</td>
<td>11%</td>
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<td>65%</td>
<td>34%</td>
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<tr>
<td>2004</td>
<td>61%</td>
<td>38%</td>
<td>1%</td>
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Source: ACP data base, PIERS, AAR
The types of container vessels are changing toward Post-Panamax.

Orders for the Construction of Container Vessels Until 2011 (Thousands of TEUs)

- **Post-Panamax**: 50% (2,067 TEUs** (674 Vessels))
- **Smaller than Panamax**: 23% (940 TEUs** (262 Vessels))
- **Panamax**: 27% (1,091 TEUs** (258 Vessels))

*Panamax of 4,000 - 4,999 TEUs
**Total capacity of new orders

Source: Prepared by the ACP from the Shipping Intelligence Network of Clarkson Research Services, February 1, 2006.
What is a Post-Panamax Vessel?

Comparison between Panamax and Post-Panamax Container Vessels

- Length of Post-Panamax Vessel: 366m
- Post-Panamax Draft: 15m
- Panamax Length: 294m
- Panamax Draft: 12m
- Post-Panamax Beam: 49m
- Panamax Beam: 32m

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<th>Capacity</th>
<th>Panamax</th>
<th>Post-Panamax</th>
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<td>Containers (TEUs)</td>
<td>4,500</td>
<td>12,000</td>
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<table>
<thead>
<tr>
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<tr>
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Post-Panamax Locks
(source: PCA)
Excavations were started in 1939 for the third set of locks but stopped in 1942 due to WW2. These excavations will be used for the new locks.
Third Locks for Post-Panamax Vessels

Cross Section of the New Locks Complex

- Water saving basins
- Valve
- Culvert
- Post-Panamax Vessel

Dimensions:
- 49m (160')
- 55m (180')
Third Locks for Post-Panamax Vessels

Partial View of New Locks and Gates

- Water saving basins
- Rolling gates
- Middle lock chamber
How the third set of locks will function
References

• PCA, “Proposal for the Expansion of the Panama Canal—Third Set of Locks Project,” Panama Canal Authority, April 24, 2006.