



# **Panama Canal**

## **July 2007 with updates**

**Prepared by J. Mahoney**



# 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



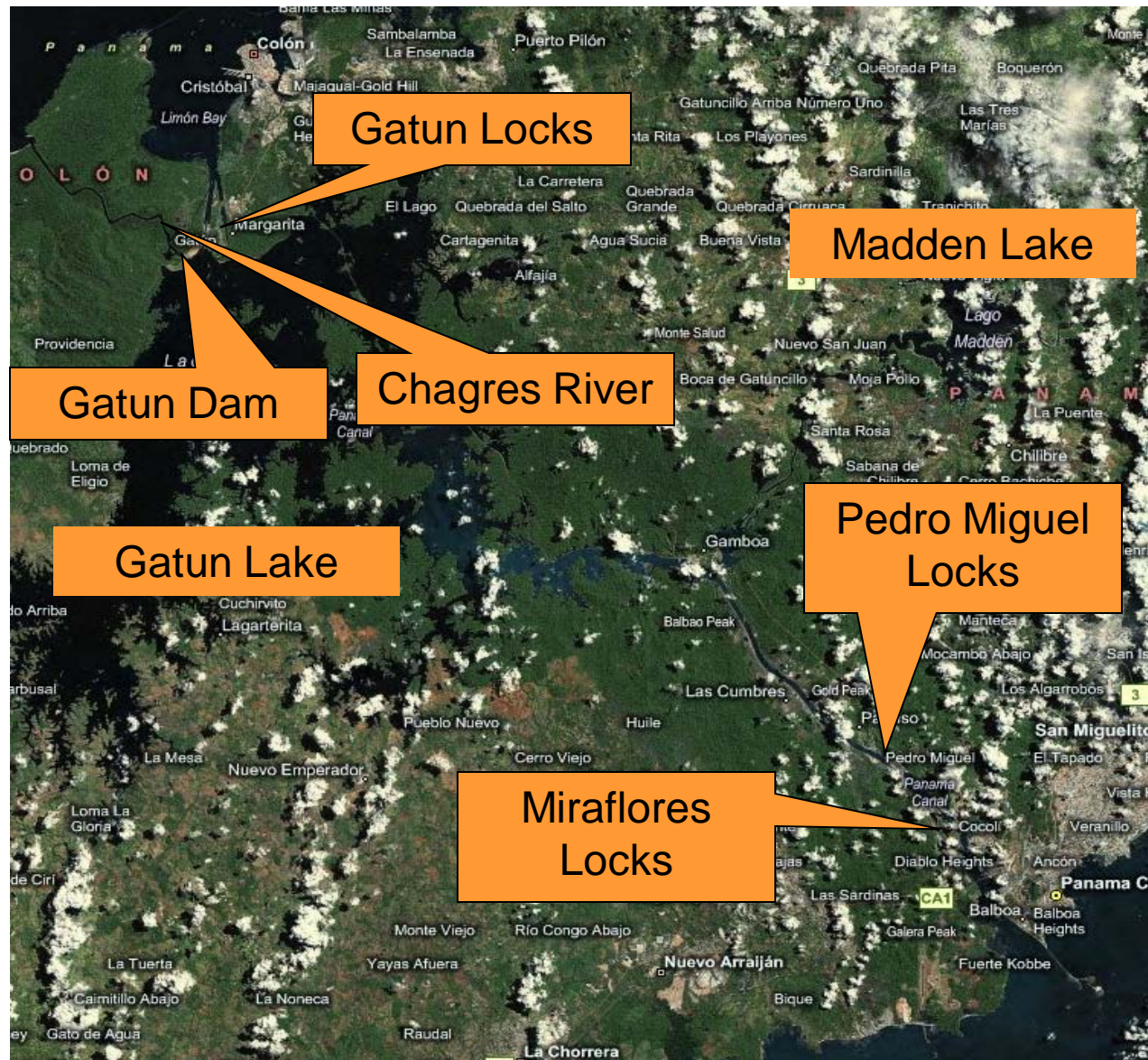
Panama has a mixed terrain—like much of Central America—the mountains east of the Canal receive high rainfall which provides much of the water for the Canal locks



# Outline view of Panama Canal—its route is almost north to south



# Virtual Earth Image of the Canal



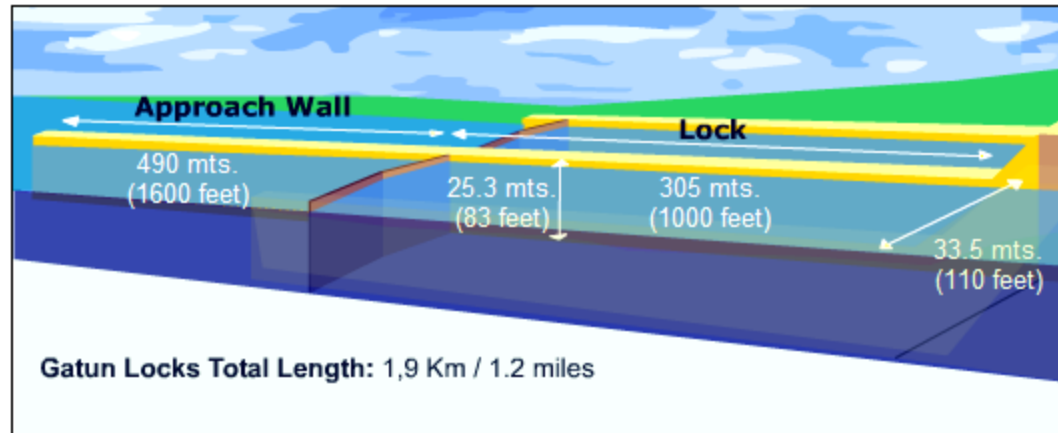
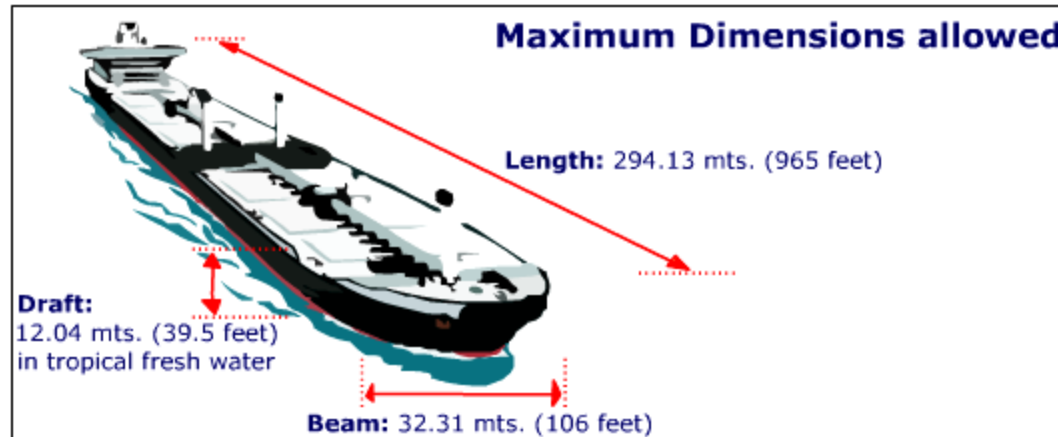
# Panama Canal Layout



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.

# 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  $\frac{1}{2}$  could pass through the PC.

# 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.

# Panama Canal—Miscellaneous Facts

- Total excavation for the original construction of the Canal (1904-1914) was about 262 million yd<sup>3</sup>.
- Culebra Cut required removal of 96 million yd<sup>3</sup>.
- Balboa: 22 million yd<sup>3</sup> 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



# Google Earth Image of Gatun Locks





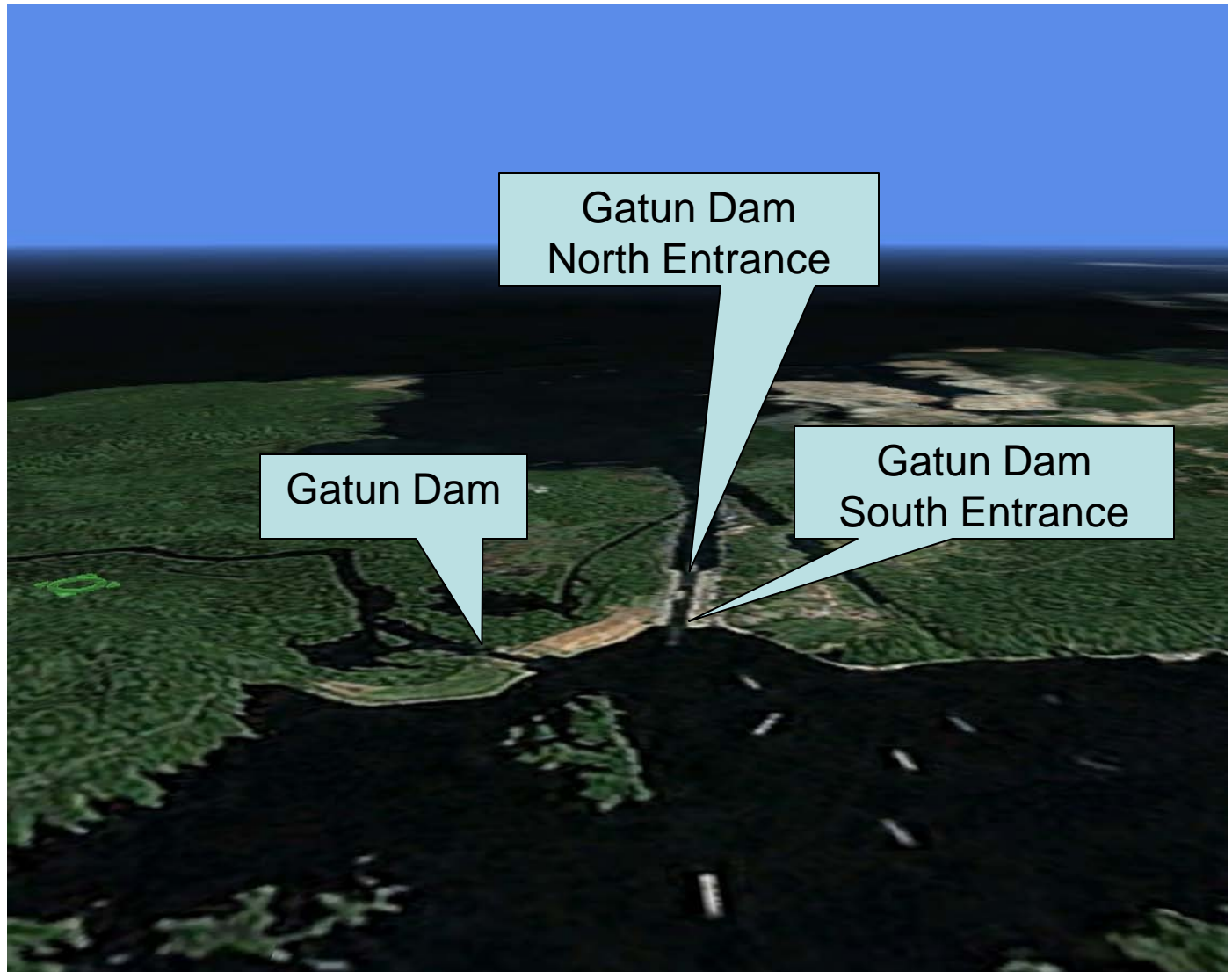
# Google Earth Image of Miraflores Locks



# 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

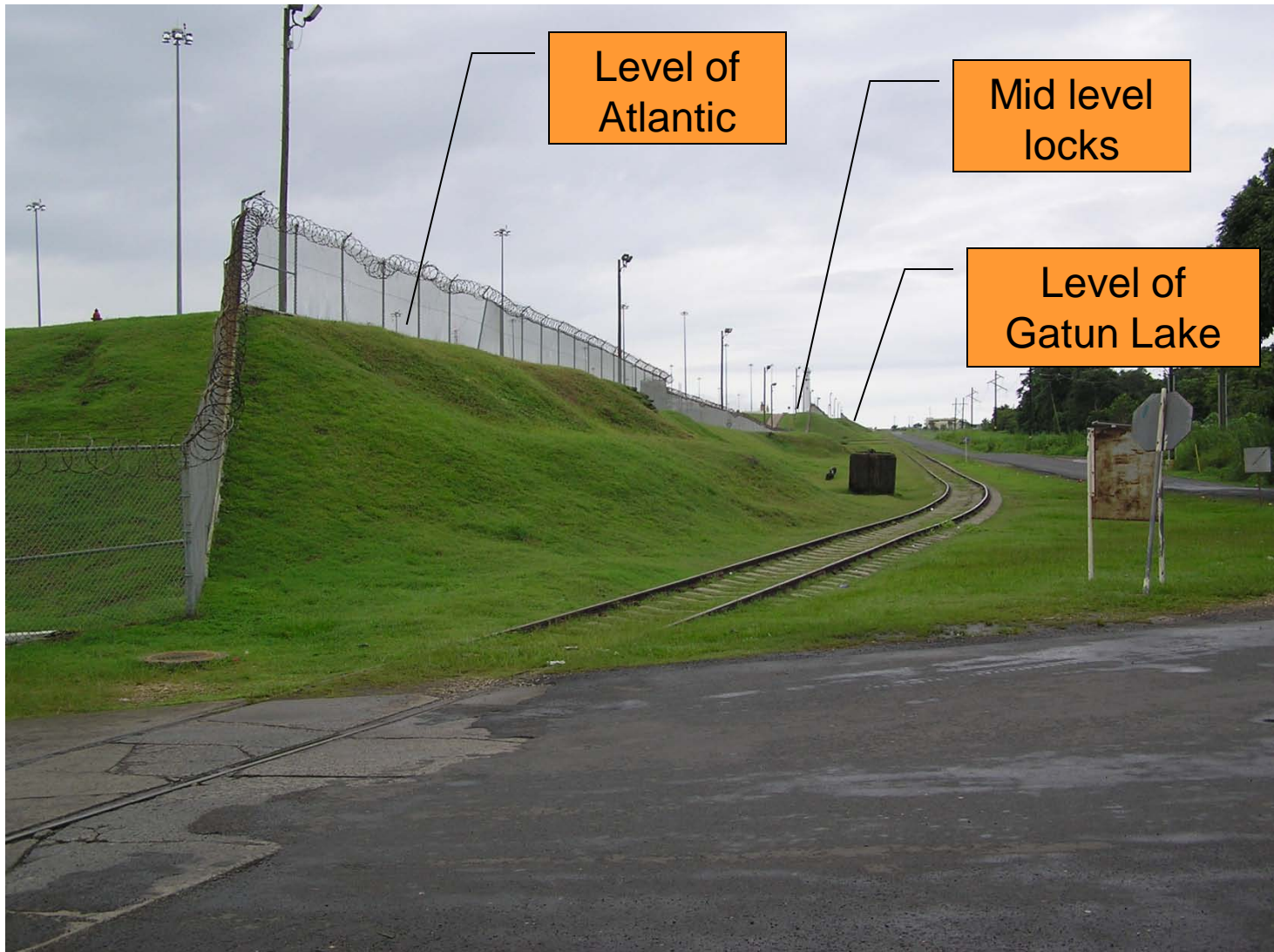






Gatun Locks—North Entrance/Exit

# Gatun Locks—three sets bring ships up (or down) 85 ft.



# Crossing Gatun Lock—Atlantic level



All kinds of  
cargo transit  
the locks



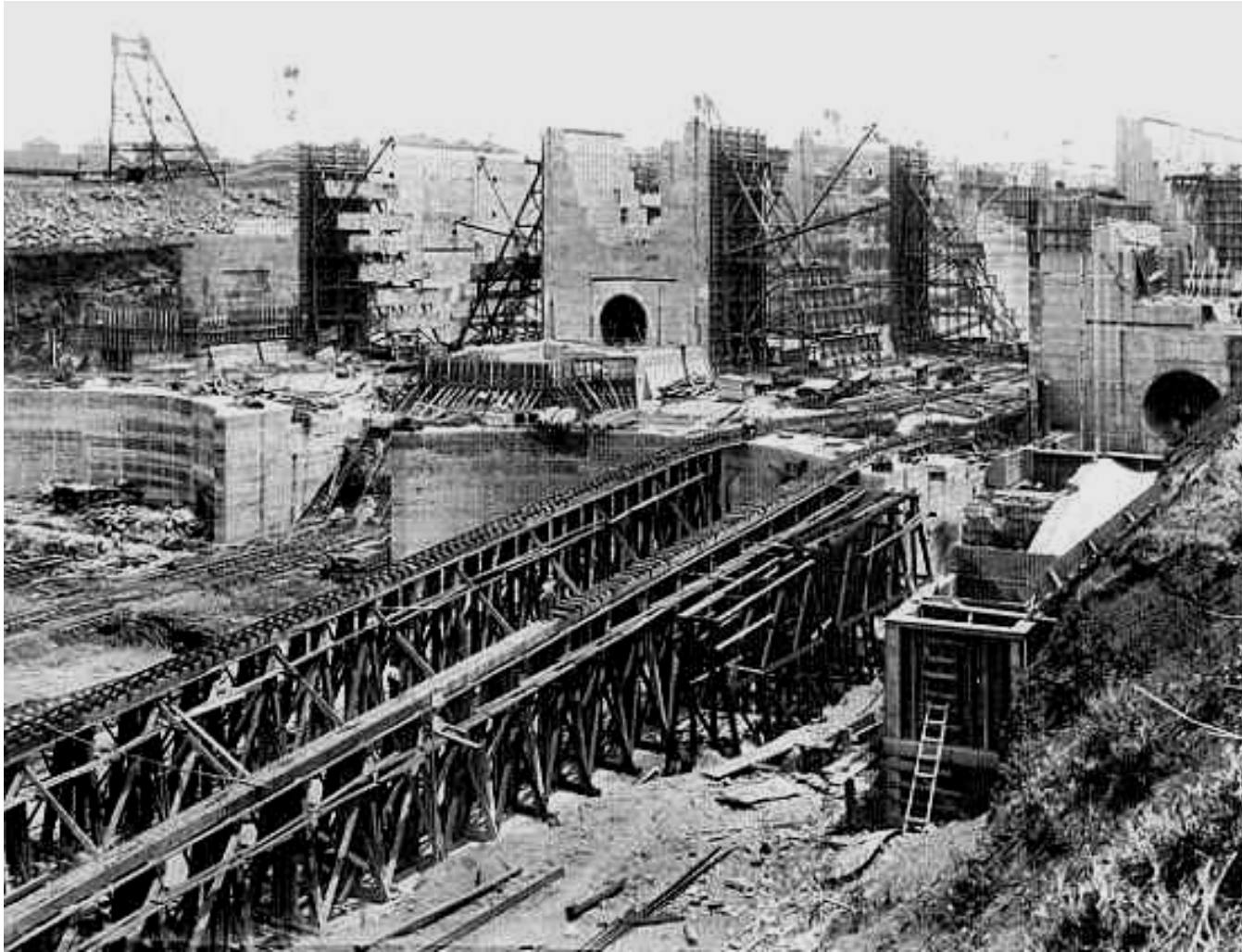
Ship moving into lower lock from Limon Bay



Water from  
lower lock  
flowing into  
Limon Bay



# Construction of Gatun Locks 1910



Source: Panama Canal History Museum

# Miraflores Locks







...ciones del Corte,  
...yor operación de  
...ó vivió para ver  
... muerte, el Corte  
...onor.

... the Cut, led an army  
...ration the world had  
...n 1915, two years  
...rd Cut in his honor.

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

*Como ingeniero jefe de la Comisión del Canal Istmico (1905-1907), John Frank Stevens promovió la utilización del ferrocarril y de nuevas maquinarias para las excavaciones.*

*As chief engineer of the Isthmian Canal Commission (1905-1907), John Frank Stevens sought to use the railroad and new machineries for the excavations.*



# David Gaillard

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.

*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.*

# Miraflores—South view toward Balboa



# Miraflores—North direction toward Colon





MIRAFLORES LOCKS  
PANAMA CANAL  
1913

1000 504

“Mule”



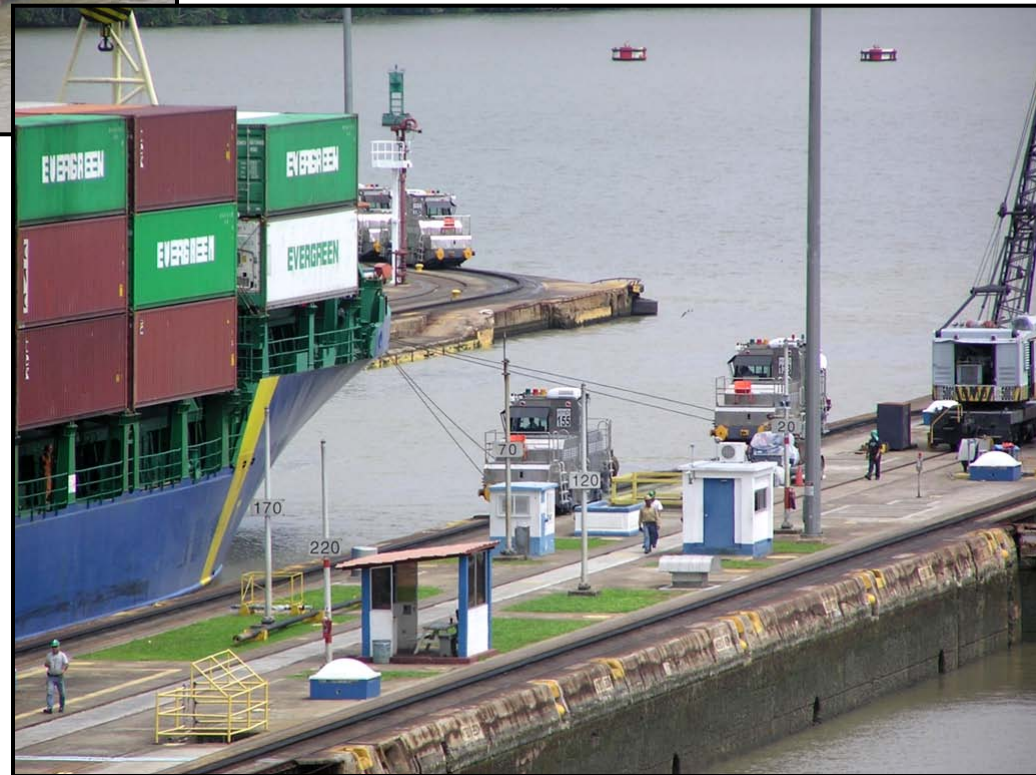
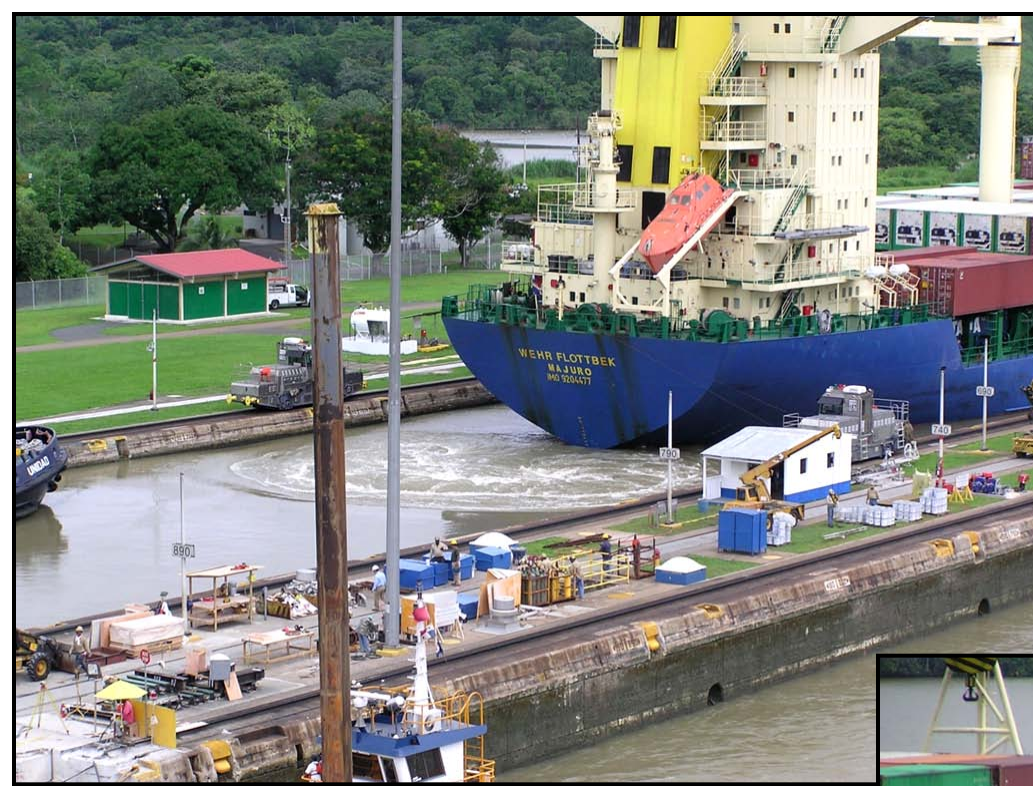
Clog rail for mules

←00001

09→



Miraflores—ship  
underway to  
north



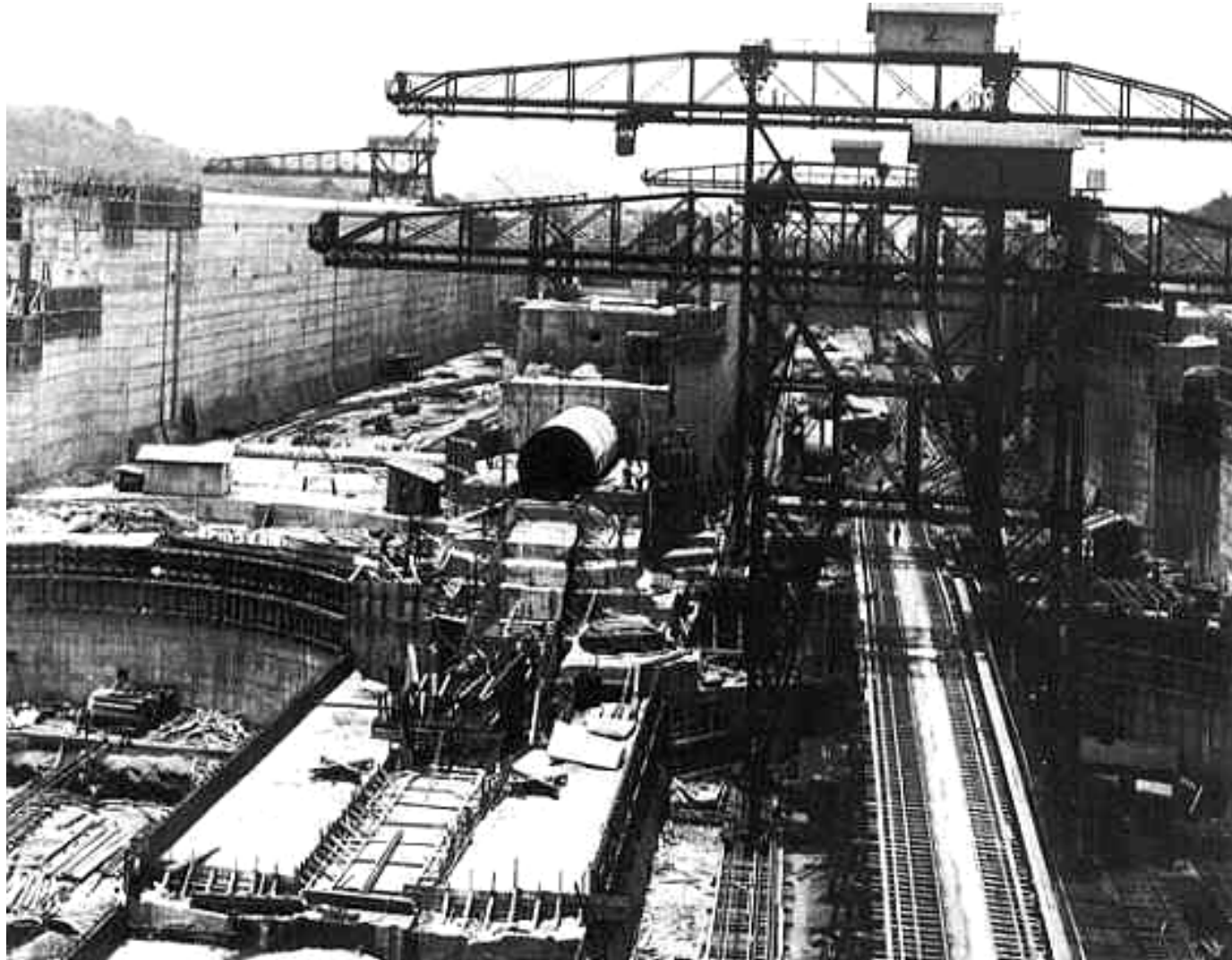


# Construction of the Miraflores Locks November 11, 1910



30-A.<sup>2</sup> - Miraflores Upper Locks. General View, looking North. - November 11, 1910.

# Construction of the Miraflores Locks 1912



Source: Panama Canal History Museum

# Construction of Miraflores gates 1913



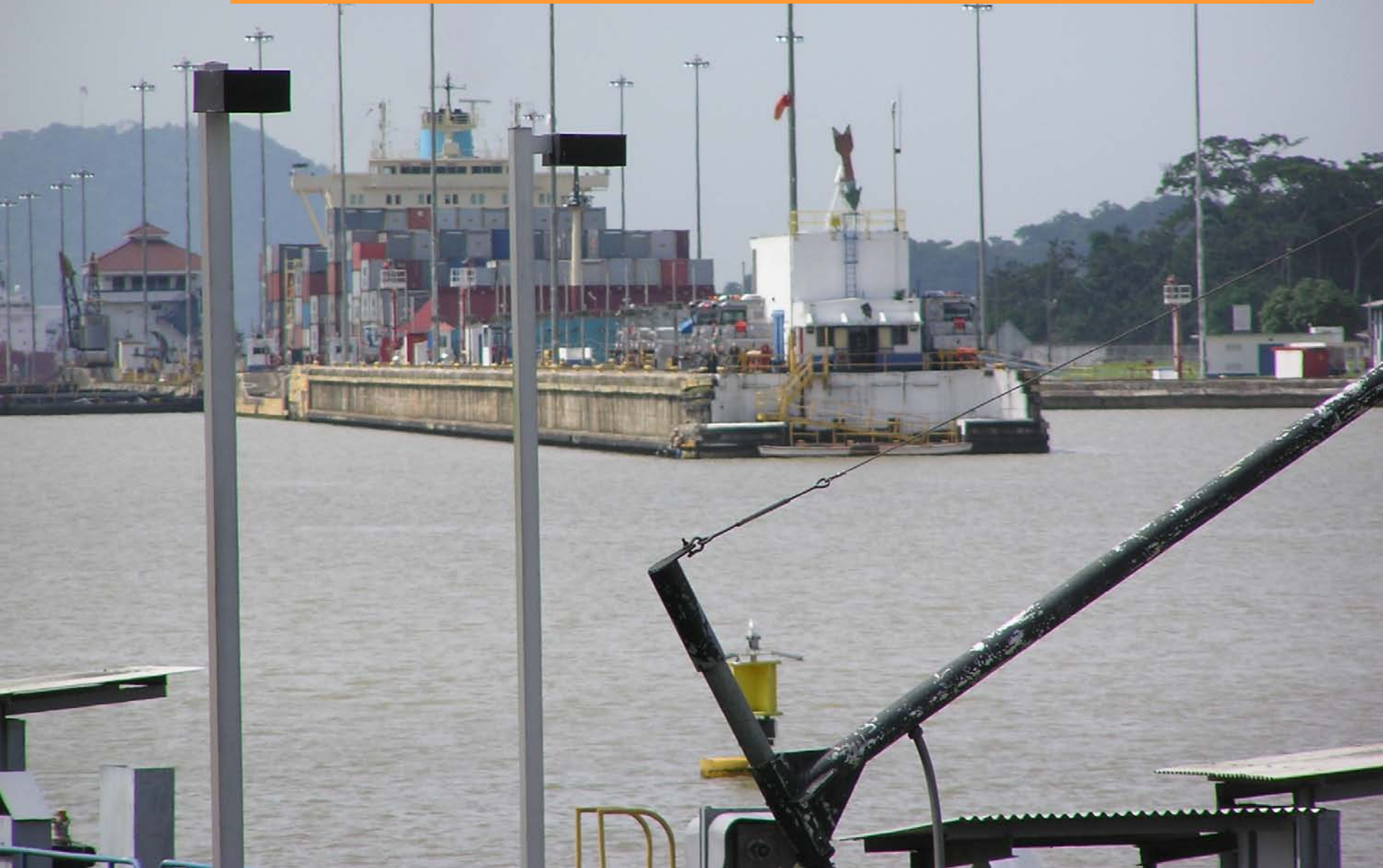
Source: Panama Canal History Museum

# First flooding—Miraflores Locks 1913



Source: Panama Canal History Museum

# Pedro Miguel Locks—view to South



# Pedro Miguel Locks—1978



Source: National Archives



Hill north of Pedro Miguel Locks to be removed for construction of third set of locks.

Existing Canal



Contract awarded to CUSA for \$40 million June 2007. Requires clearing of ordinance left by US forces and movement of 7.5 million m<sup>3</sup> of material.



# Construction of Pedro Miguel Locks February 21, 1911



*JJ-P.<sup>6</sup> - Pedro Miguel Locks. General View, Looking South from Forebay. - February 21, 1911.*



# 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

# Culebra Cut Slide—December 3, 1913



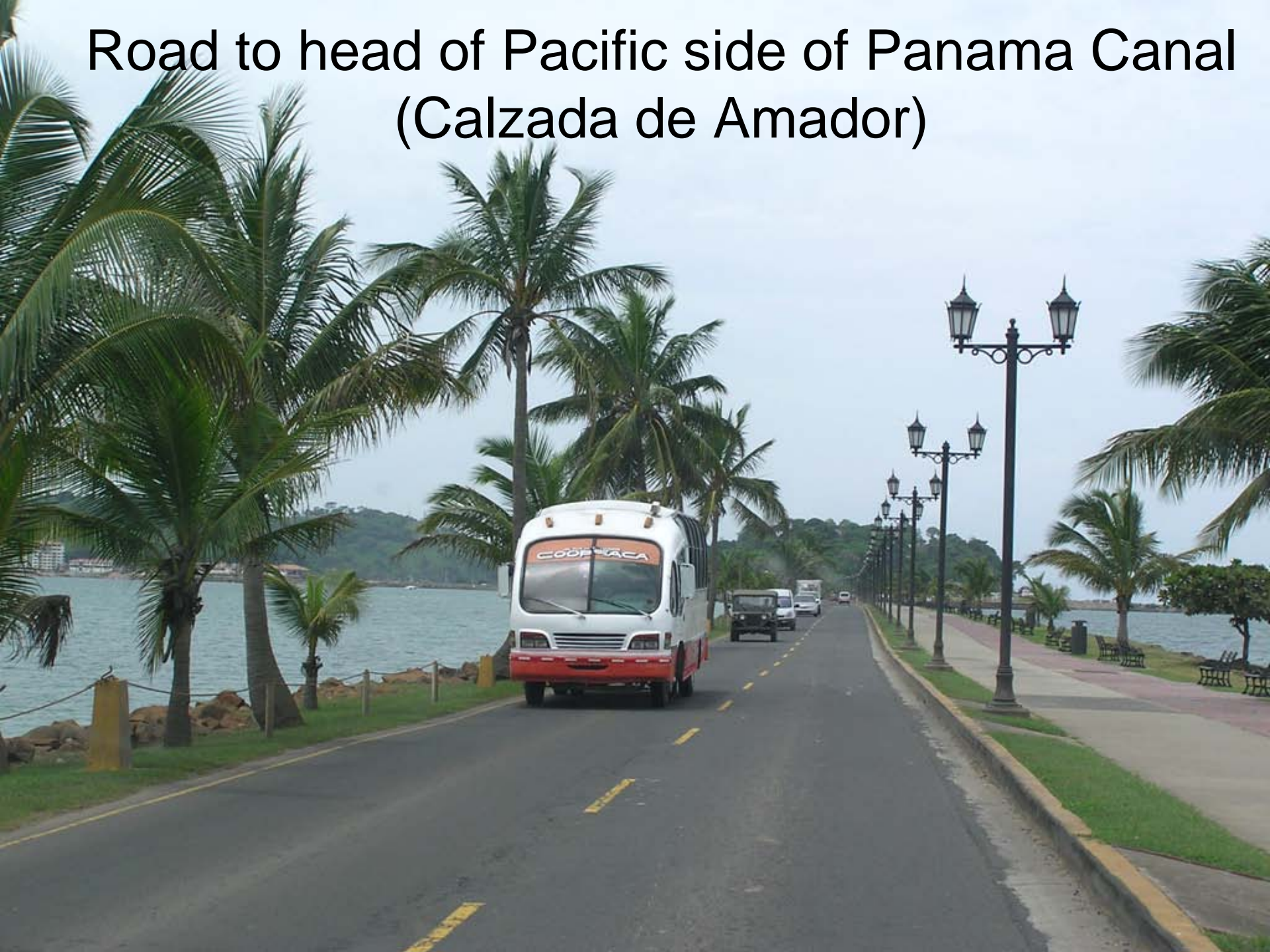
Source: Panama Canal History Museum

# Culebra Cut—January 16, 1915



38-X<sup>27</sup>. Culebra Cut. Looking North From Contractor's Hill. S.S. Baren Driesen (Russian) passing Gold Hill slide. Jan. 16, 1915.

# 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

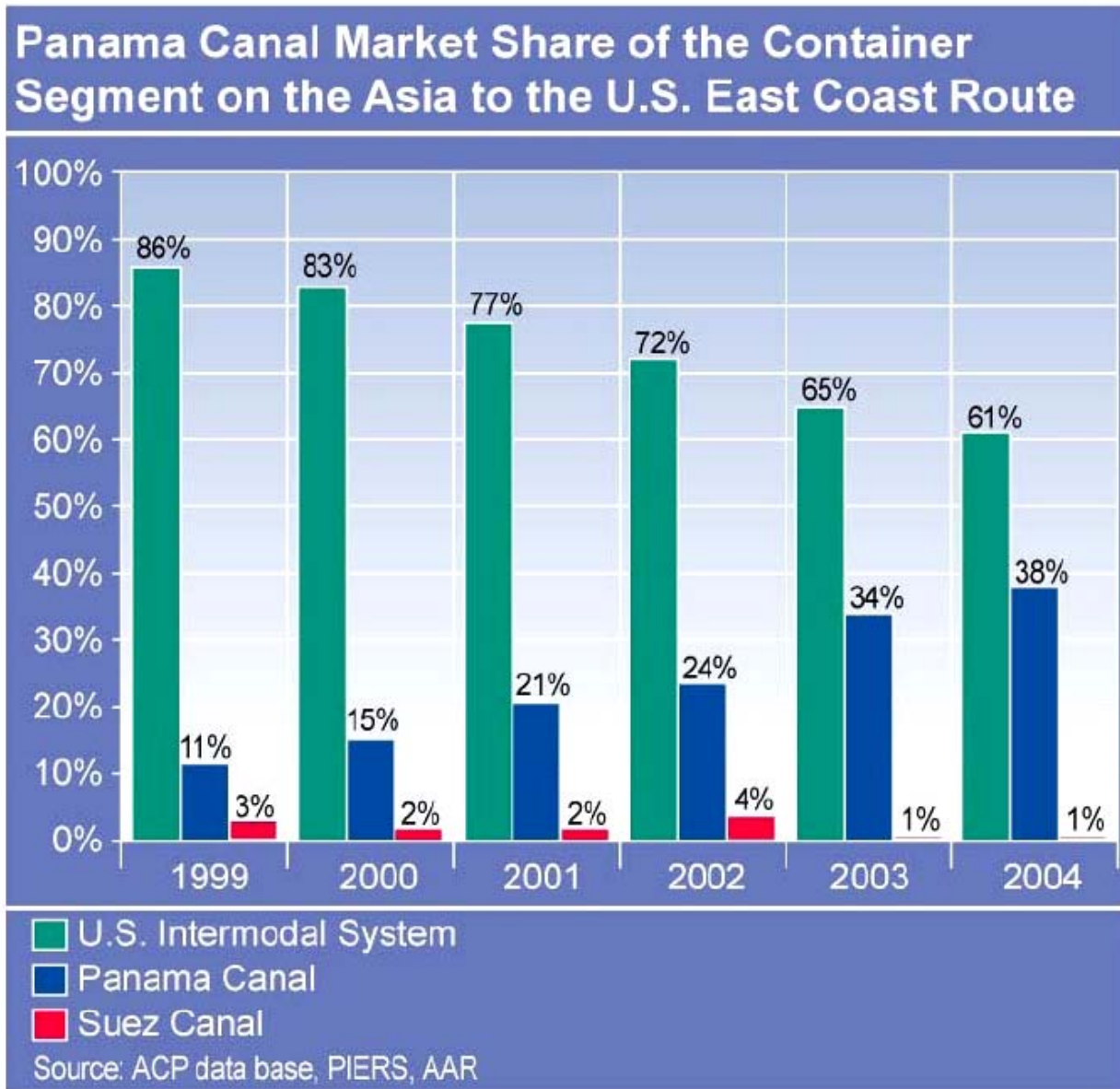


# Third Set of Locks

- Construction start during 2007
- Completion 2014
- Estimated cost: \$5.25 billion

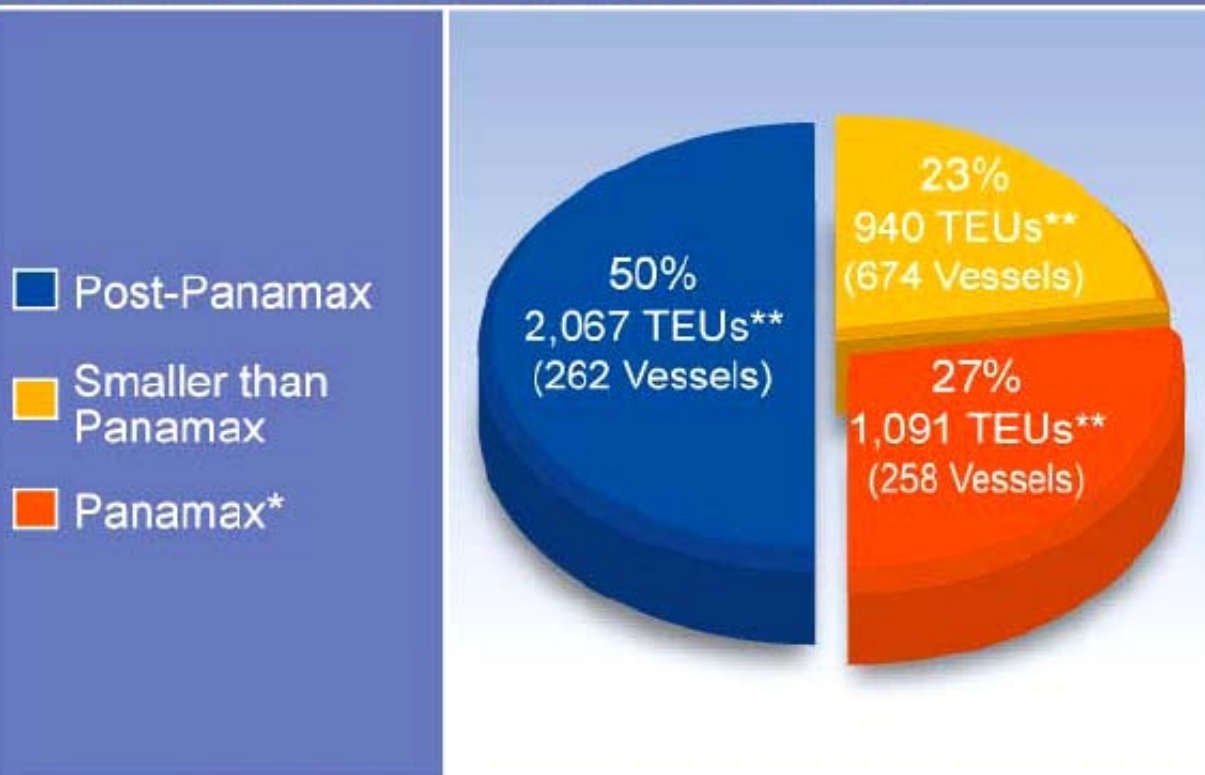


# Panama Canal is gaining Market Share



# The types of container vessels are changing toward Post-Panamax

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



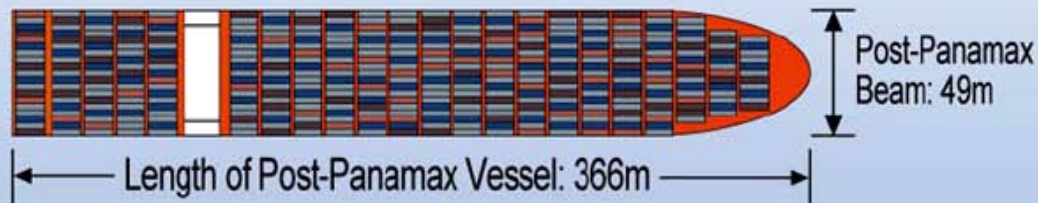
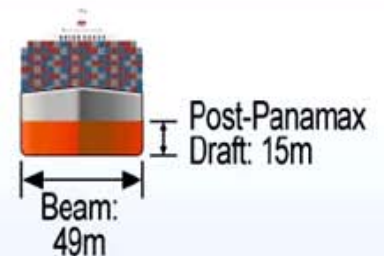
\*Panamax of 4,000 - 4,999 TEUs

\*\*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

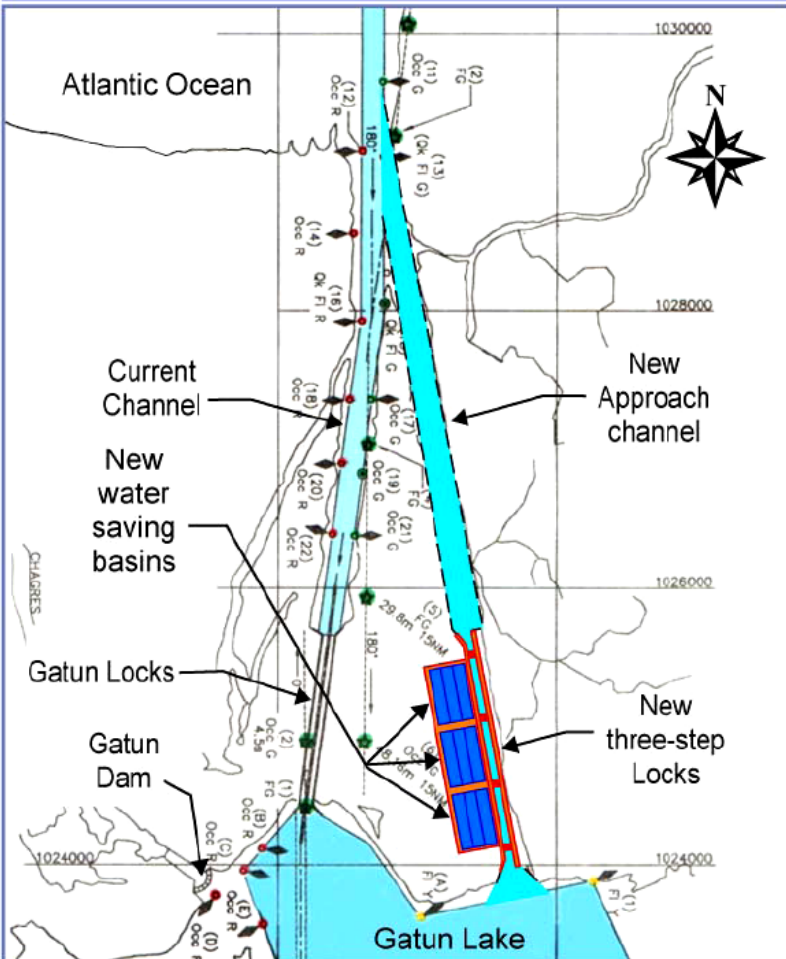


	Panamax	Post-Panamax
<b>Capacity:</b>		
Containers(TEUs)	4,500	12,000
<b>Dimensions:</b>		
Beam	32m (106')	49m (160')
Length	294m (965')	366m (1,200')
Draft	12m (39.5')	15m (50')

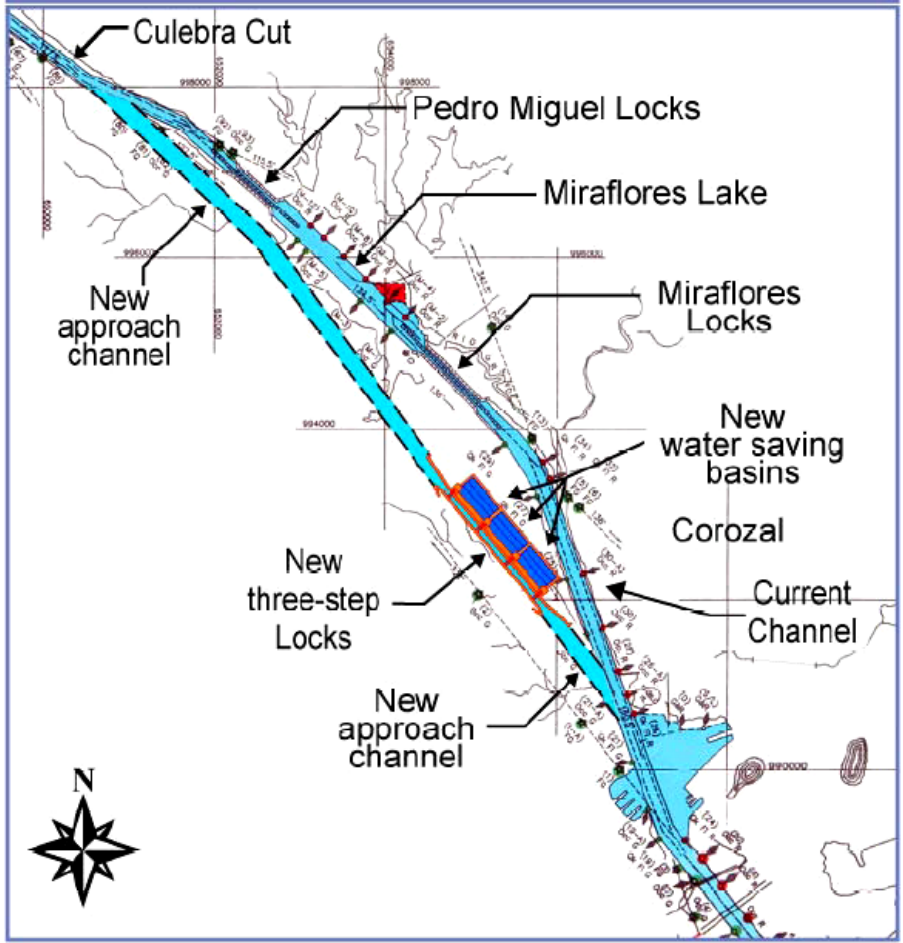
# Post-Panamax Locks

(source: PCA)

## Conceptual Location of the New Atlantic Locks

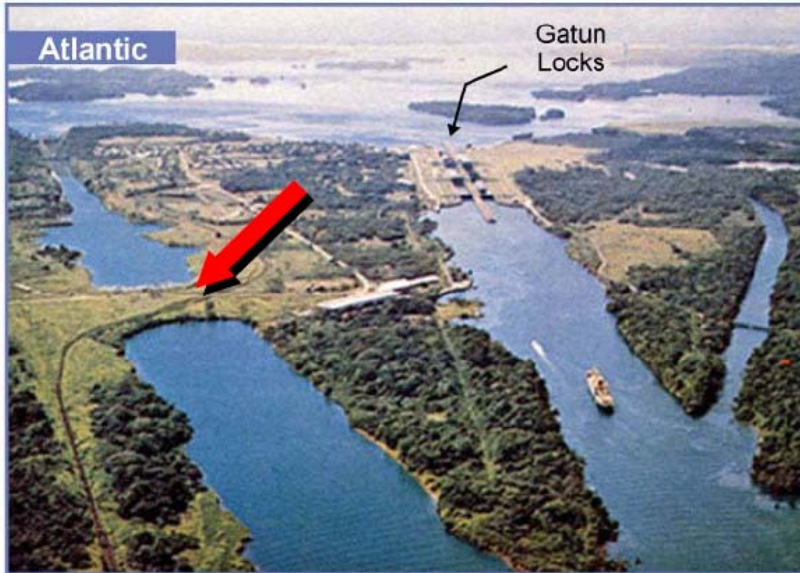


## Conceptual Location of the New Pacific Locks



# Third Locks for Post-Panamax Vessels

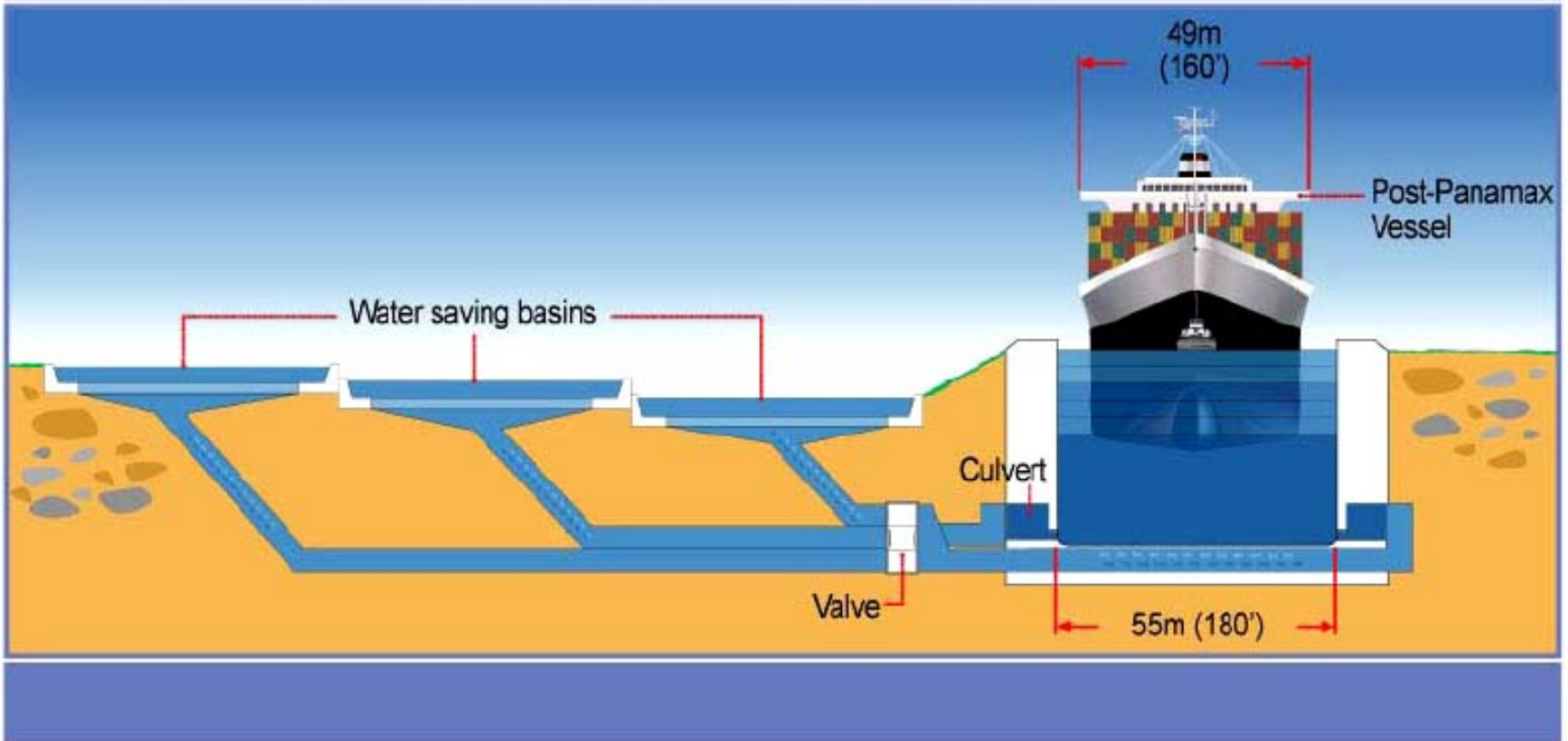
Aerial View of the Construction Sites of the New Locks



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.

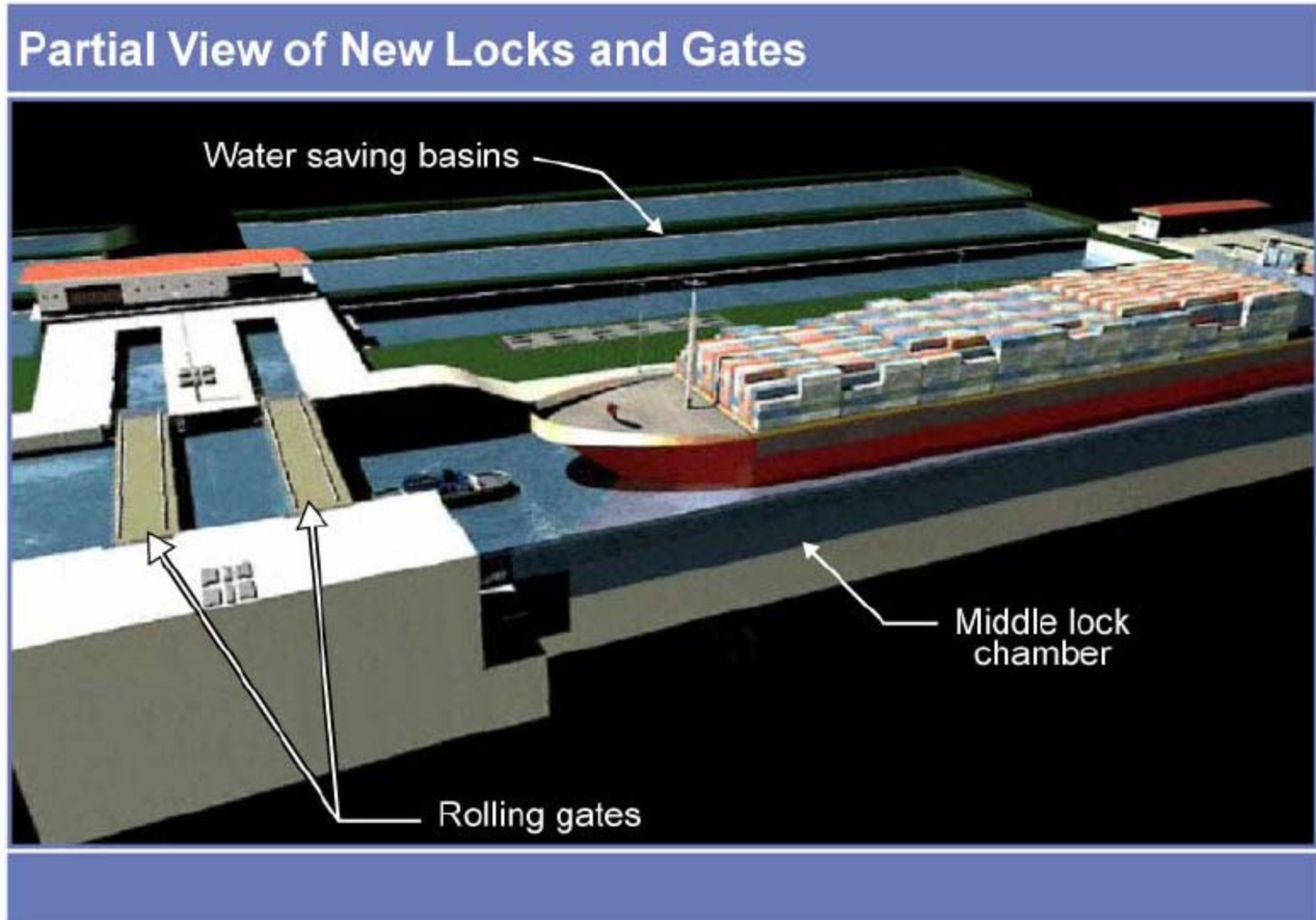
# Third Locks for Post-Panamax Vessels

Cross Section of the New Locks Complex

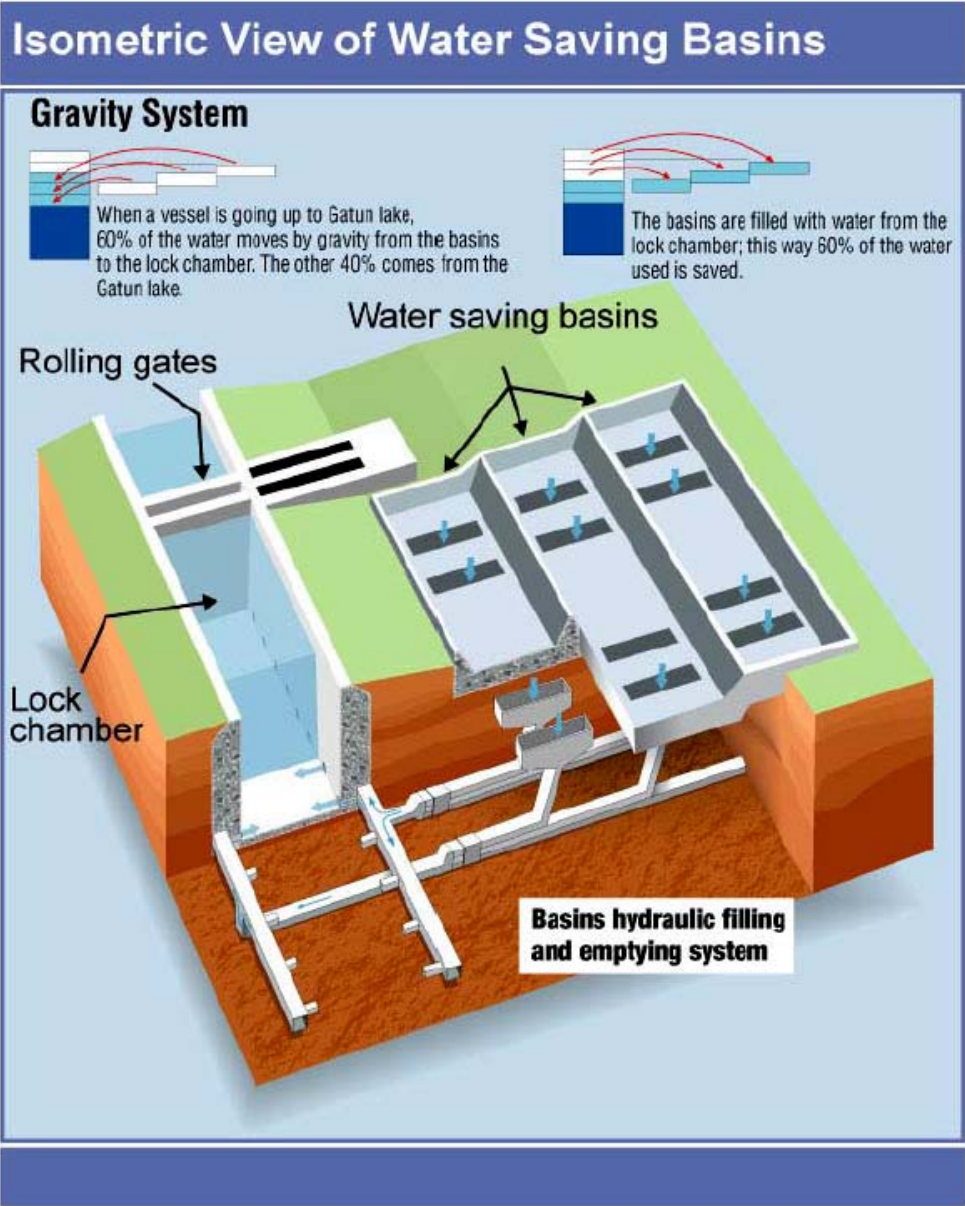




# Third Locks for Post-Panamax Vessels



# 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.
- McCullough, David (1977), “The Path Between the Seas—The Creation of the Panama Canal 1870-1914,” Simon and Schuster Paperbacks.