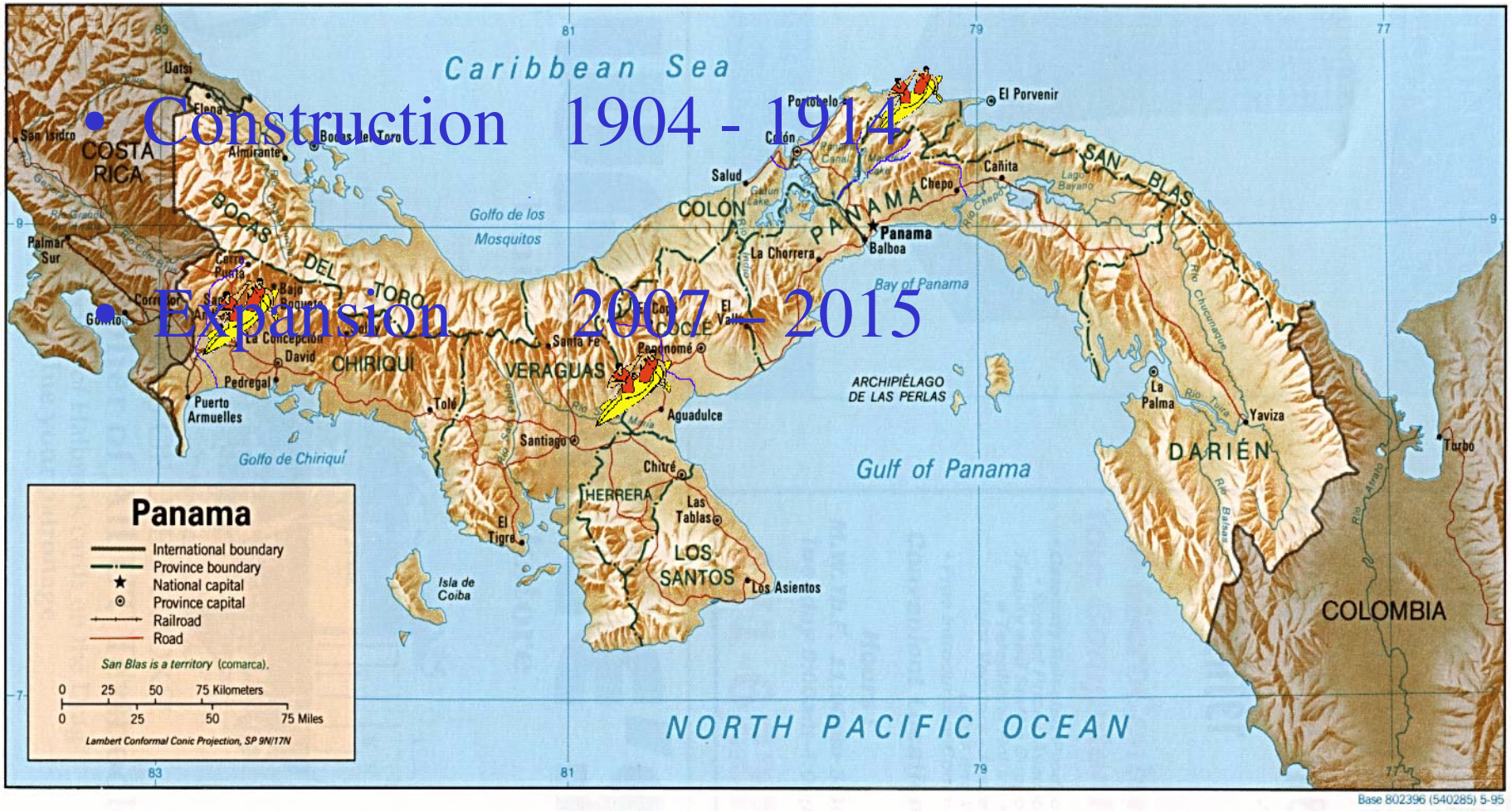
Panama Canal: Old Dig & New Dig

- Geo Virginia 2012
- Williamsburg, Va

- Frank Townsend
- May 2, 2012

Panama Canal

- Construction 1904 - 1914
- Expansion 2007 – 2015

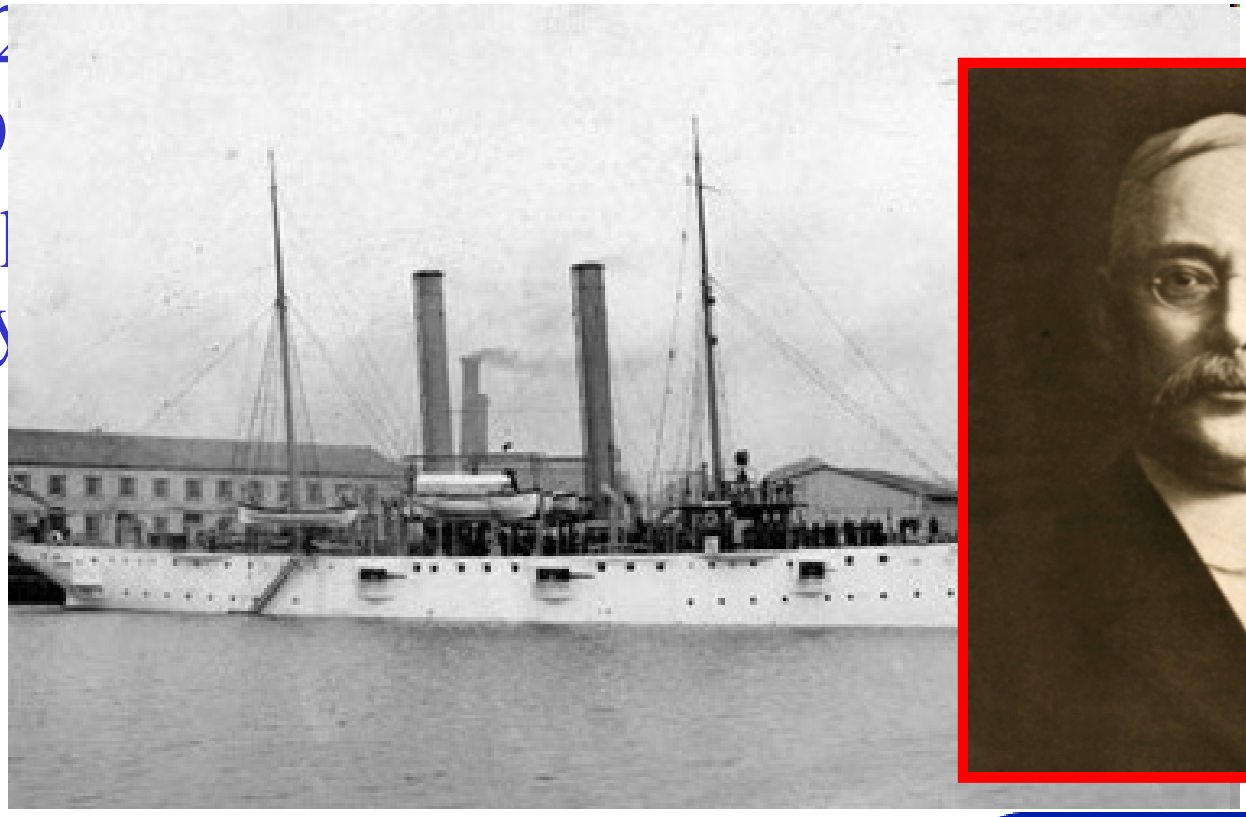


Prior to John F Stevens Arrival 1905

- 1879 DeLesseps (
  Canal Comp
  Raises $60
  Proposes 7
  Canal 72’
- 1889 Bankrupt 20

Prior to John F Stevens Arrival 1905

- 1903 Colombia rejects US $10million /$2
- 19
- Jo
  1 y



1905 John F S

- Resists Congress
  Dirt Fly”
- Builds Infrastruc
- Gives Gorgas Fr
  Fever/Malaria
- Recreation
- 1906 Convinces

Lock Canal –Three Geotechnical

1907 Stevens Resigns !

- Exhausted on verge of “Breakdown”
- Yellow Fever –eradicated
- Railroad System in Place

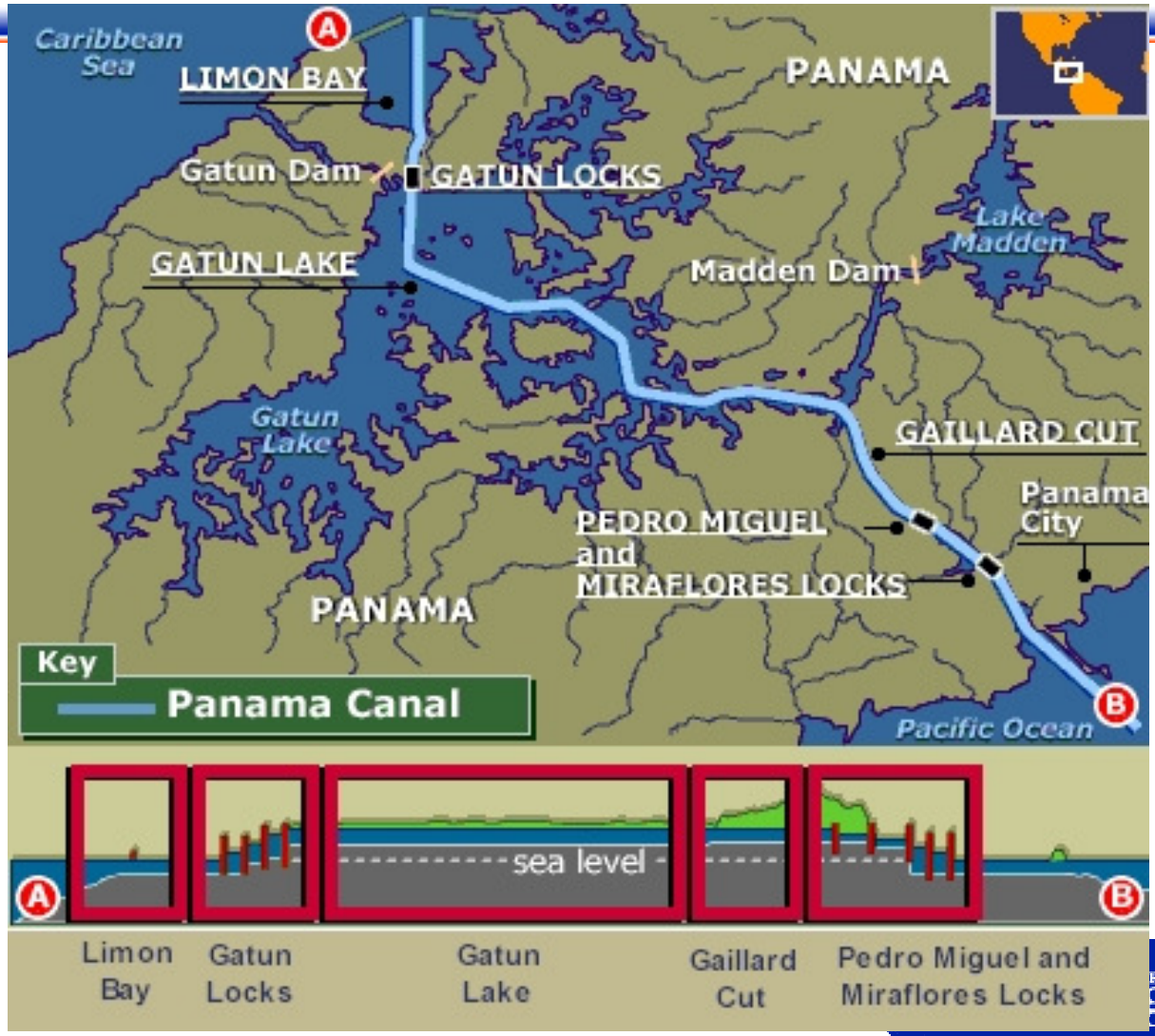
Roosevelt appoints Goethals

George Washington Goethals

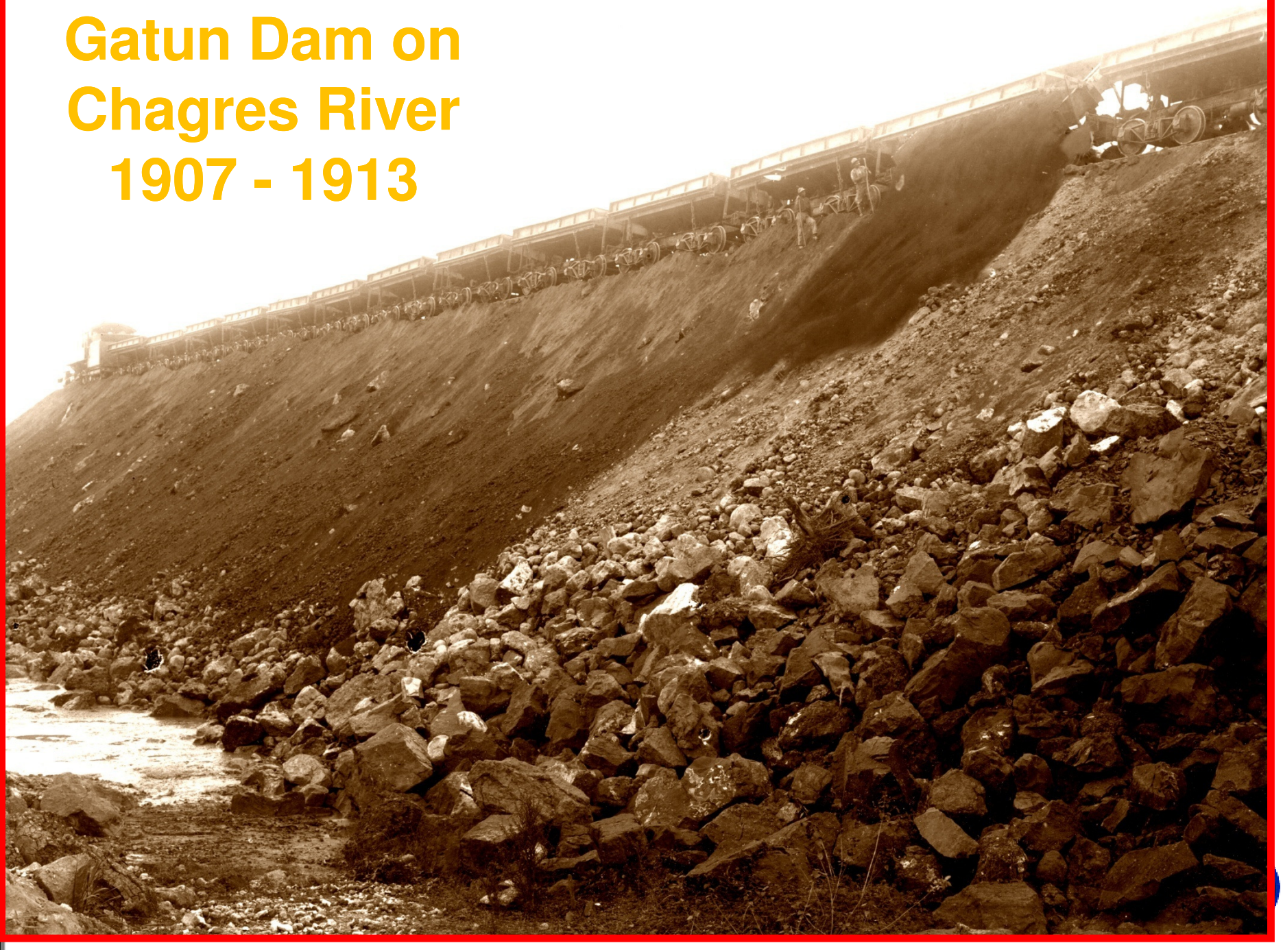
3rd Chief Engineer

1858-1928

- The completion of the Canal.
- The damming of the powerful Chagres River with the Gatun Dam that created Gatun Lake.
- Digging “Culebra Cut”
- The building of the huge concrete locks with steel gates.


Caribbean Sea
A
LIMON BAY
PANAMA
Gatun Dam
GATUN LOCKS
Lake Madden
GATUN LAKE
Madden Dam
Gatun Lake
GAILLARD CUT
Panama City
PEDRO MIGUEL and MIRAFLORES LOCKS
PANAMA
Key
Panama Canal
B
Pacific Ocean
sea level
A
B
Limon Bay
Gatun Locks
Gatun Lake
Gaillard Cut
Pedro Miguel and Miraflores Locks

Gatun Dam on Chagres River 1907 - 1913



Gatun Dam

- 

Will the Gatun Dam Stand?

Report of the Board of Engineers Analyzed and Discussed—Some of the Engineers Who Say Yes, Said the Same of the Similar Dams at San Corozal and La Boca, Which it Has Been Found Necessary to Abandon.

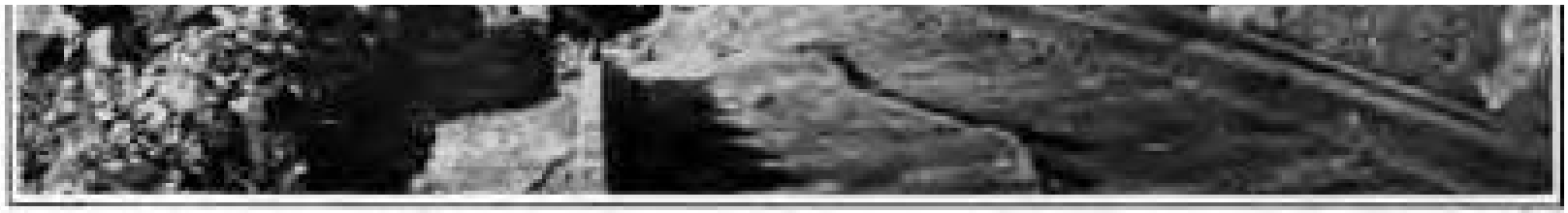


FIG. 14.—SLIDES INTO WET FILL, GATUN DAM.

Gatun Dam - Landslides

- Original Slopes
  - Upstream 3H : 1V
  - Downstream 25H : 1V

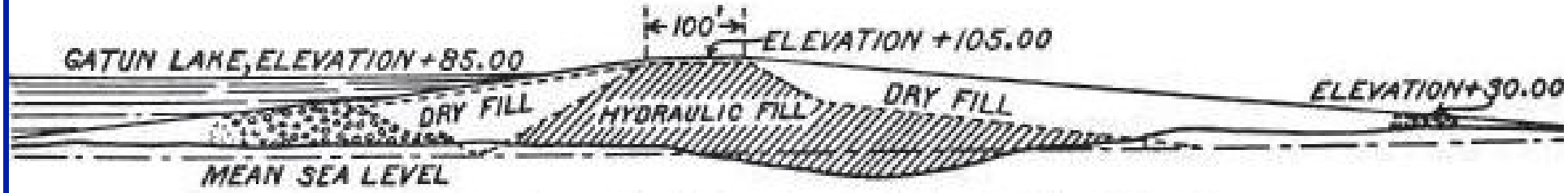
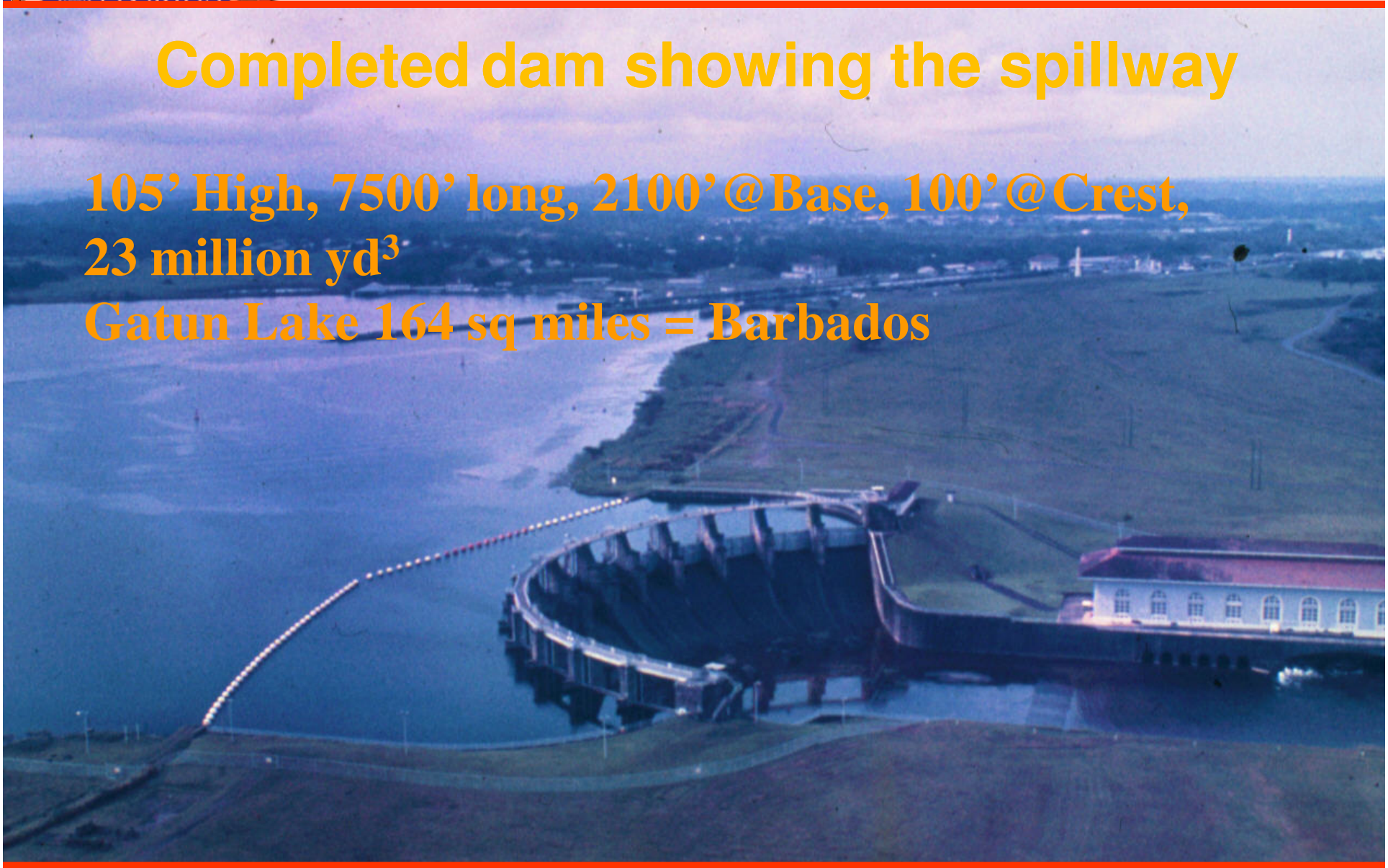


FIGURE 5.—Cross section of Gatun Dam showing dry fill and hydraulic fill.

  - Downstream 16H : 1 V (30 to 60 ft) 8:1 (60 to 90)
- Shallow Cutoff
  - 20 ft wide x 10 ft deep trench backfilled with sand/clay

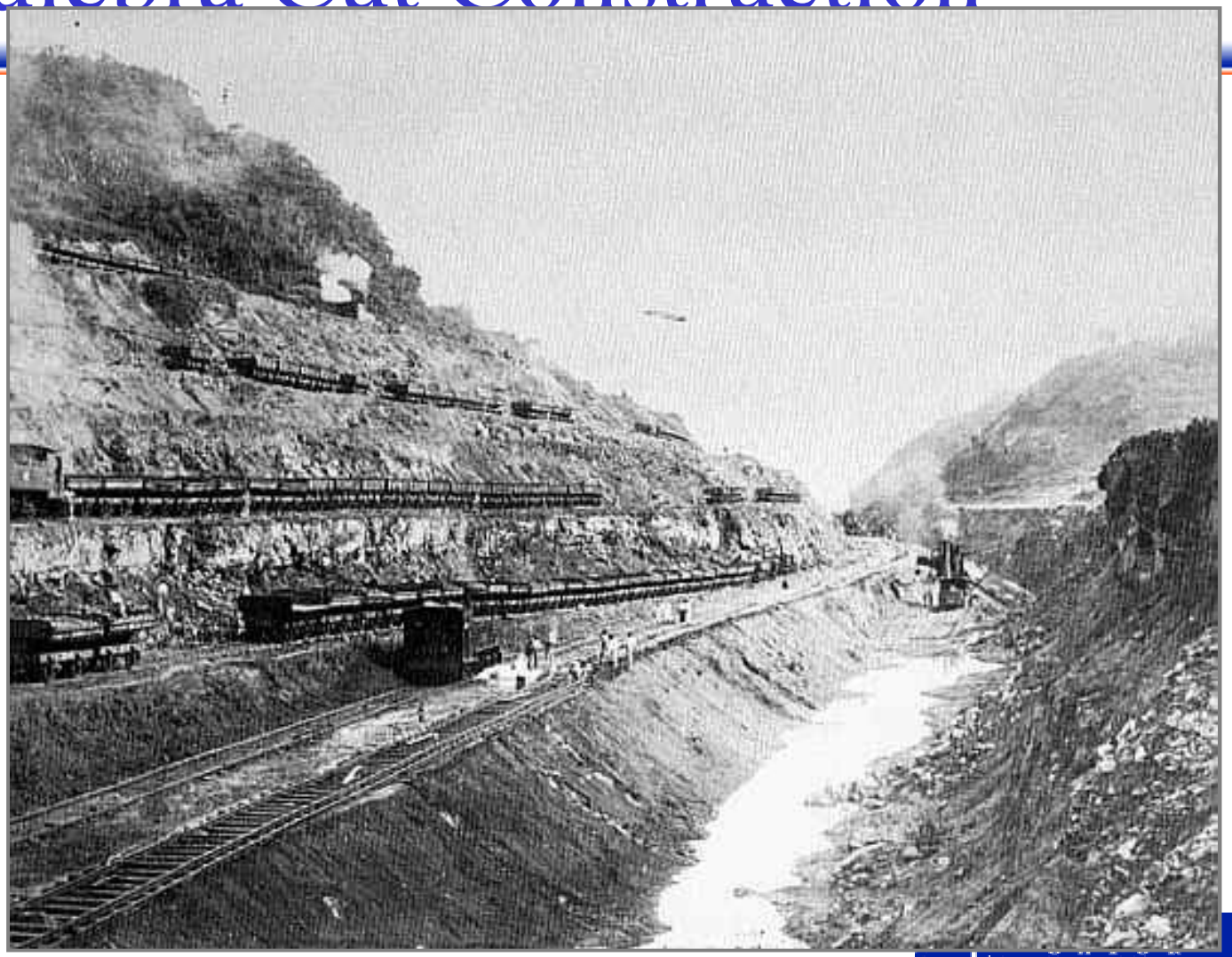
Completed dam showing the spillway



105' High, 7500' long, 2100'@Base, 100'@Crest, 23 million yd^3

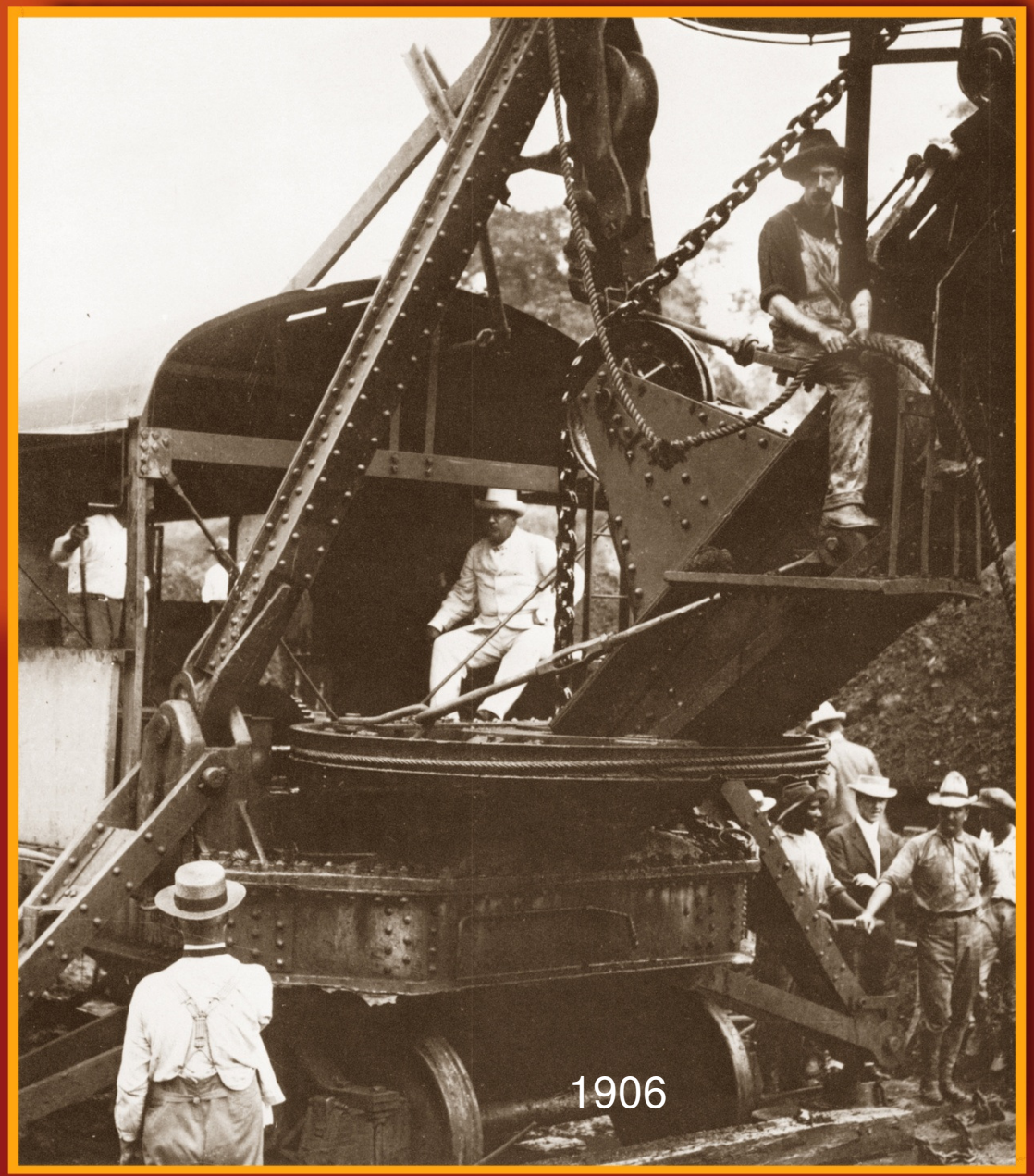
Gatun Lake 164 sq miles = Barbados

Culebra Cut Construction

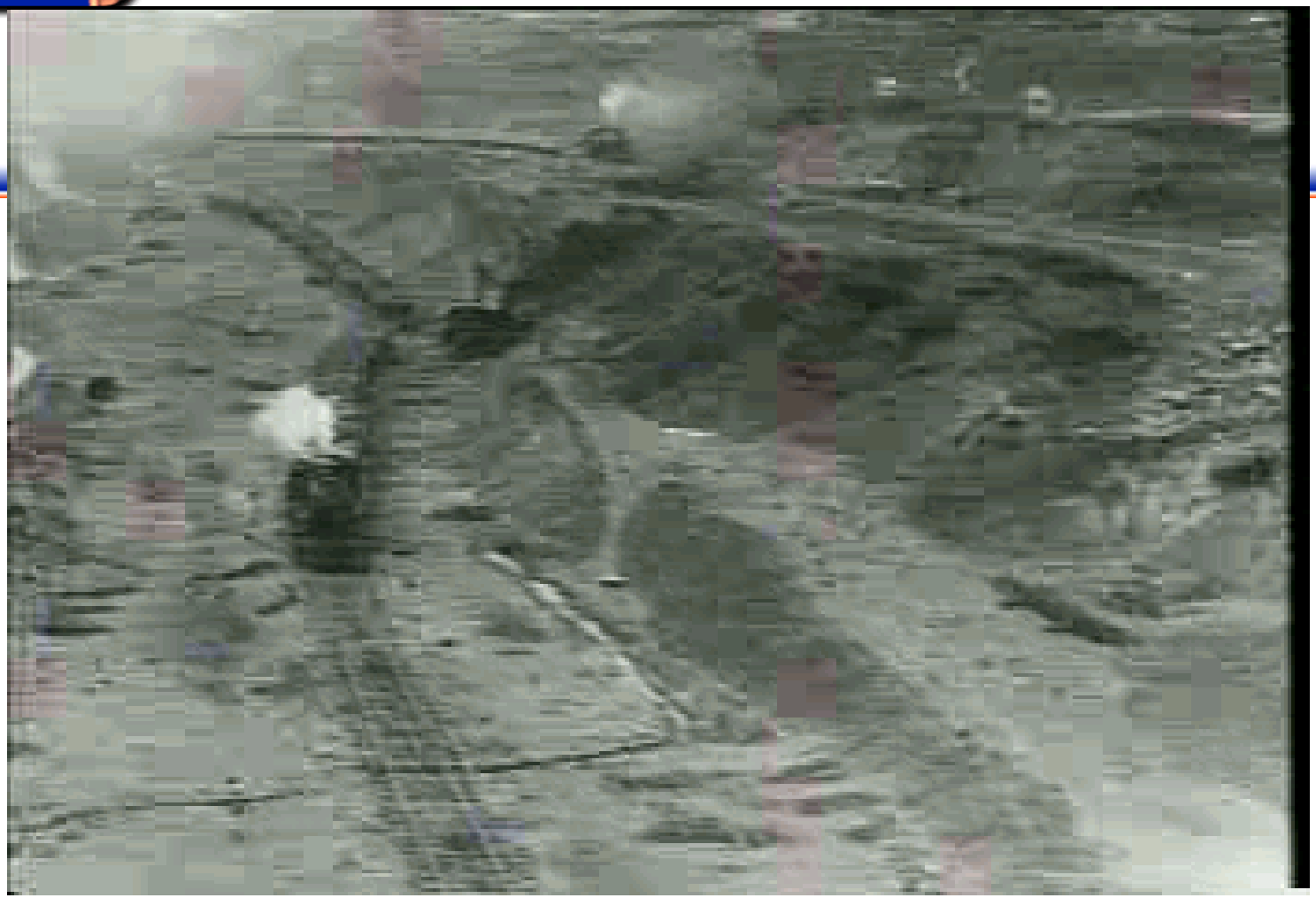


(canalmuseum.com, 2001)

Bucyrus Steam Shovel



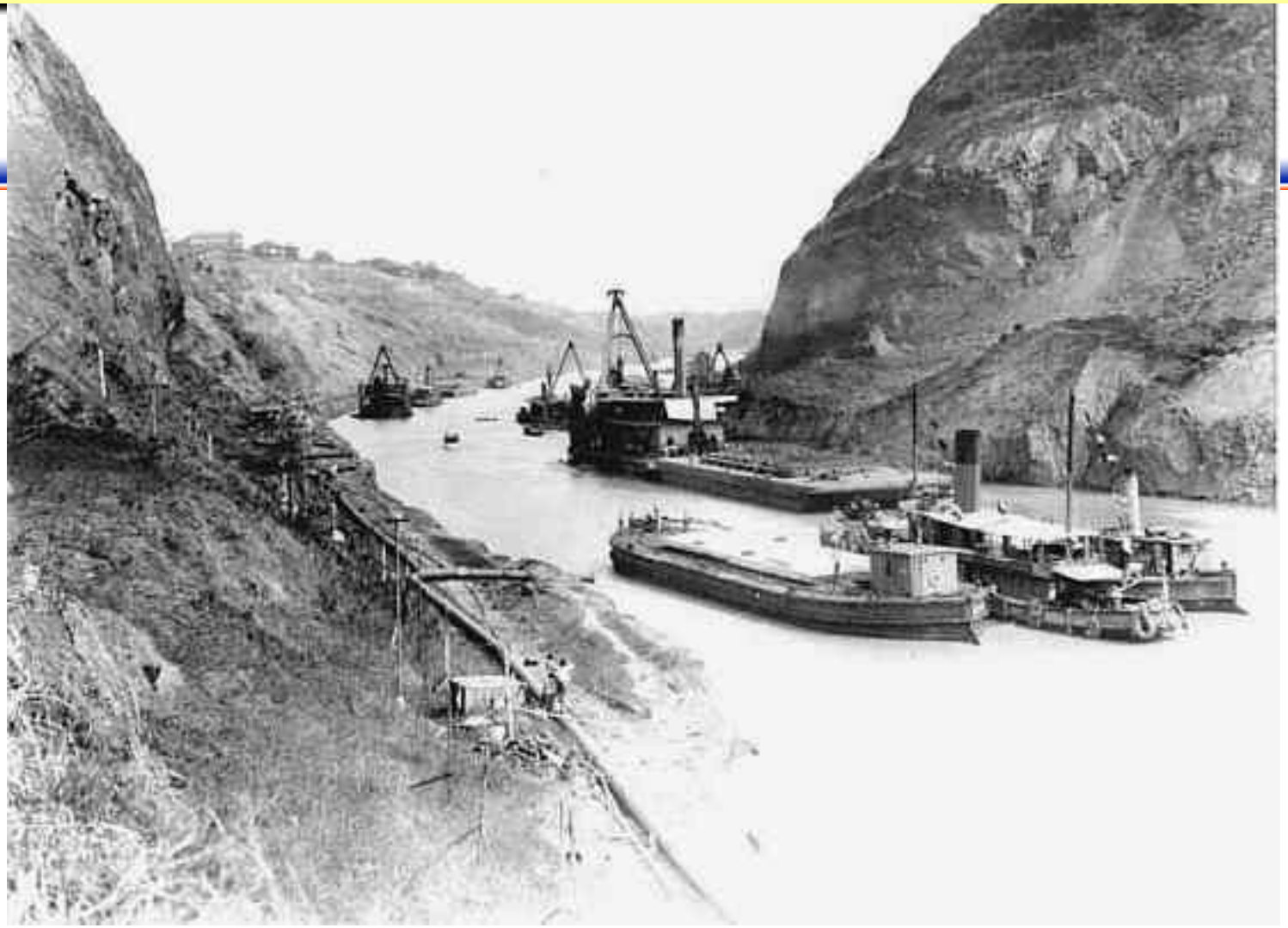
Culebra Cut 1910



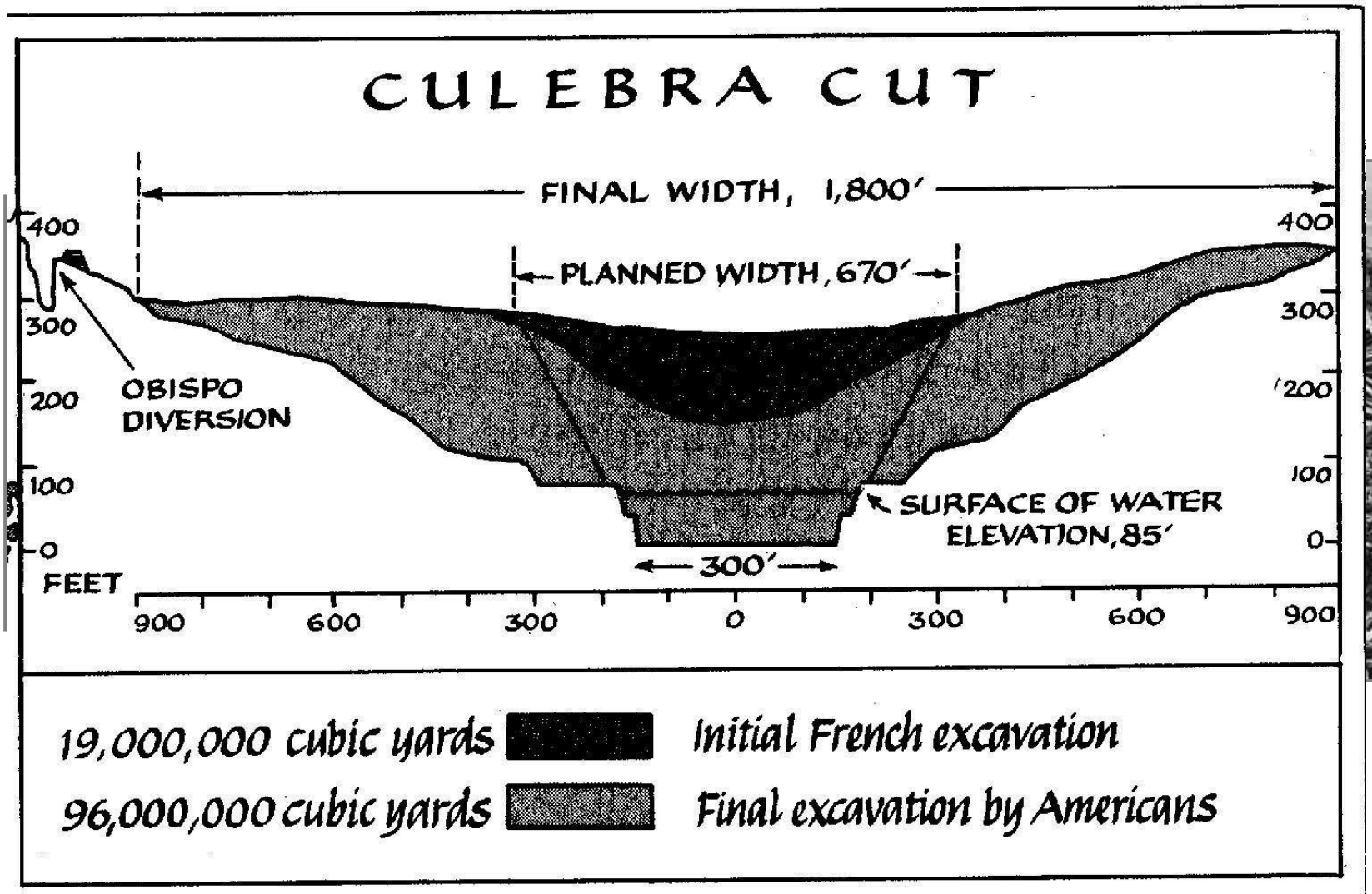
Excavating the Culebra Cut

Excavating the Culebra Cut and the Gatun Dam

Engineering



Culebra Cut 1913

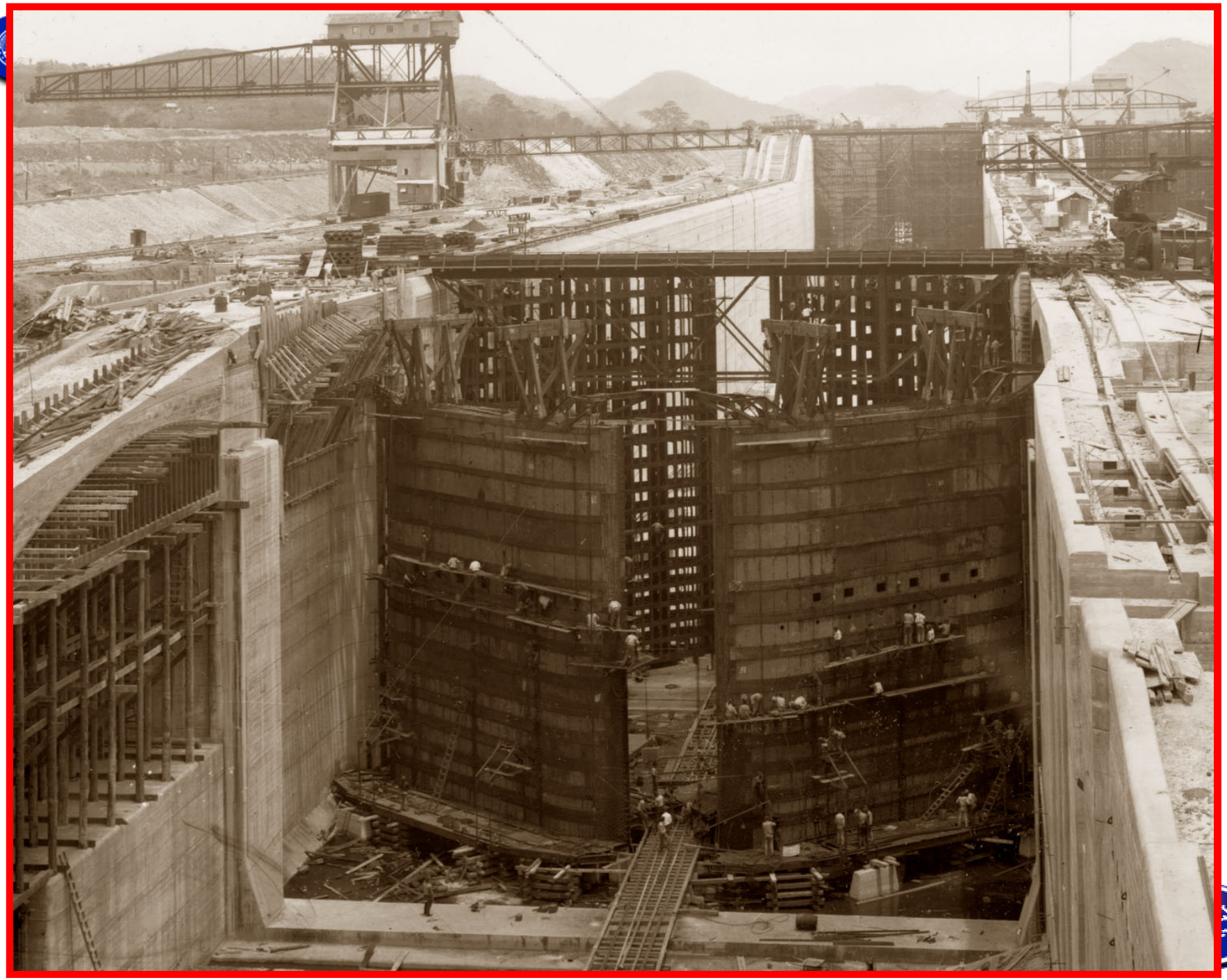


* 25% of total spoil removed

(canalmuseum.com, 2001)

En[illegible]uantities

- USA e[illegible]million yds^3 + 30 millio[illegible]of 262 million yds.
- Frenc[illegible]million yds^3, of which[illegible]e useful to US
- Post-C[illegible]s about 91.5 million yds^3
- Canal[illegible]



Filling Gatun locks for the first time. 1909 -1913

Engineering Quantities- Locks

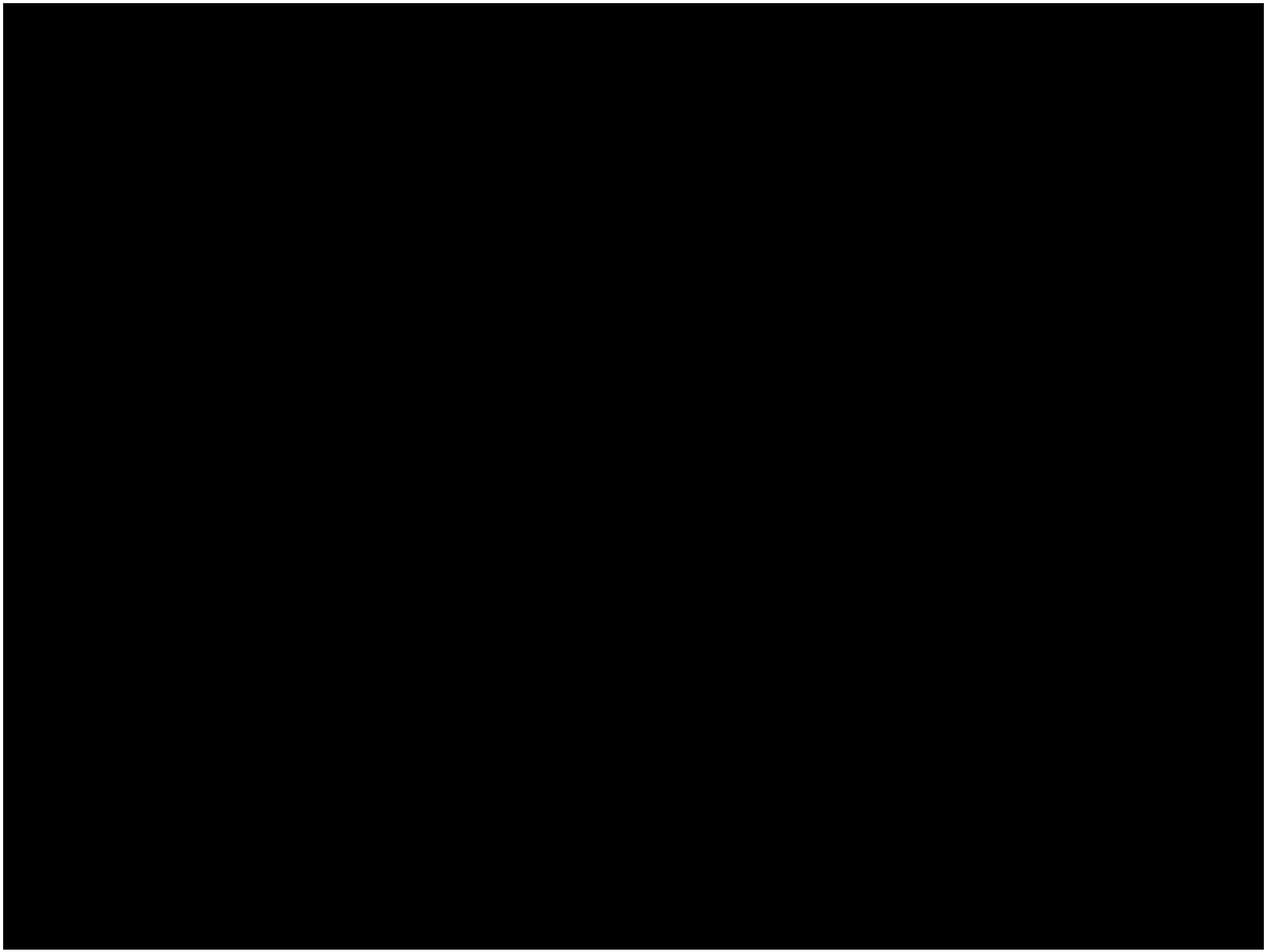
- Building the Canal
  - Construction of the locks
    - Engineering the locks of the Panama Canal was among the greatest challenges designers faced. All lock chambers have the same dimensions, 110 feet by 1,000 feet. Construction took four years after the first concrete was laid at Gatun on August 24, 1909.
    - 4.5 Million yd^3 concrete

Chart of Expenditures

Total French contribution	$287,000,000
U.S. buys all property rights to canal from the French	$40,000,000
U.S. Cost for equipment and materials	$312,000,000
U.S. contribution to finish canal	$352,000,000 = $7.8 B. (2011)
Total cost to build canal	**$639,000,000**

Note: U.S. came in $23,000,000 under budget.

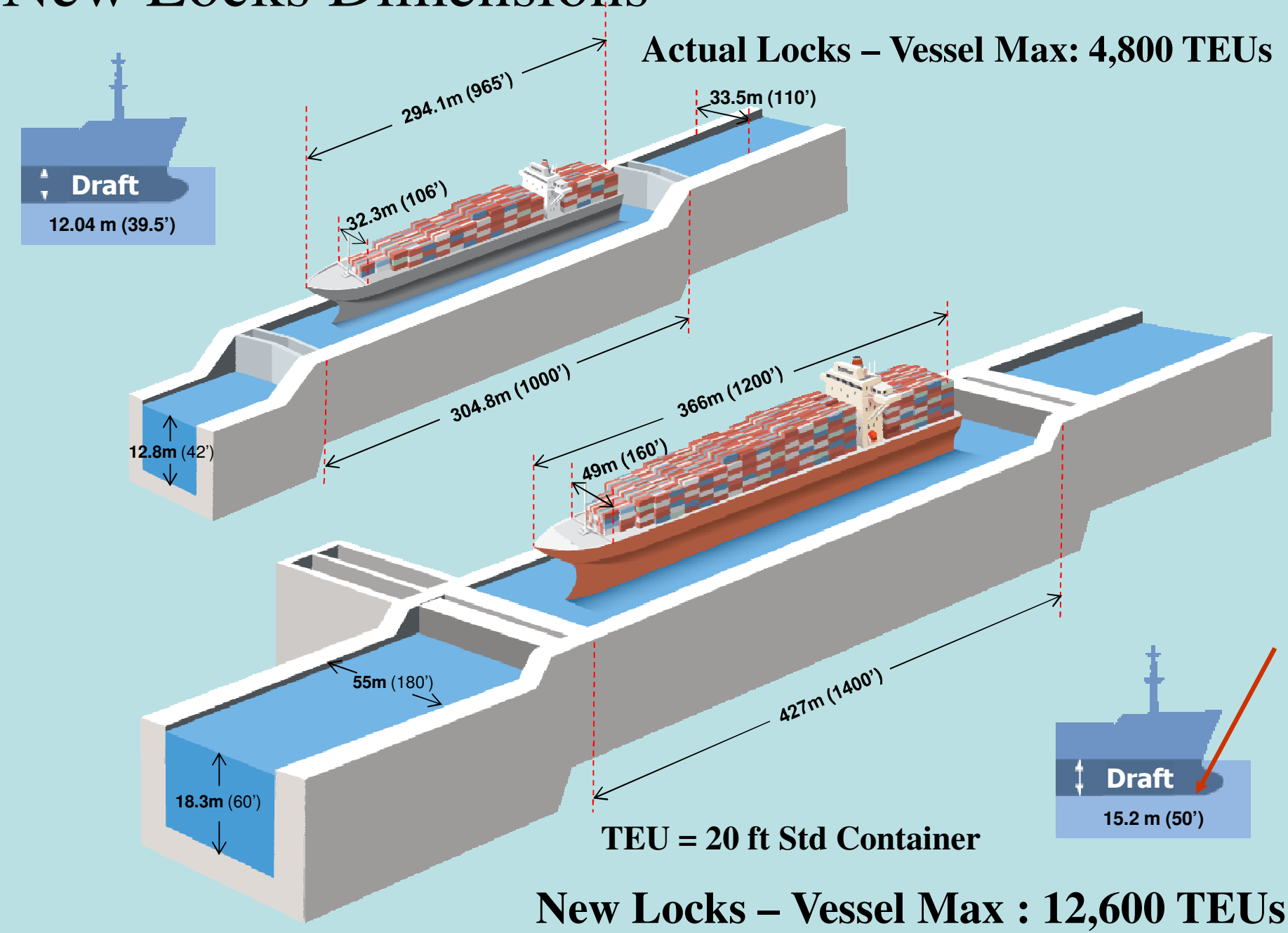
(canalmuseum.com, 2001)



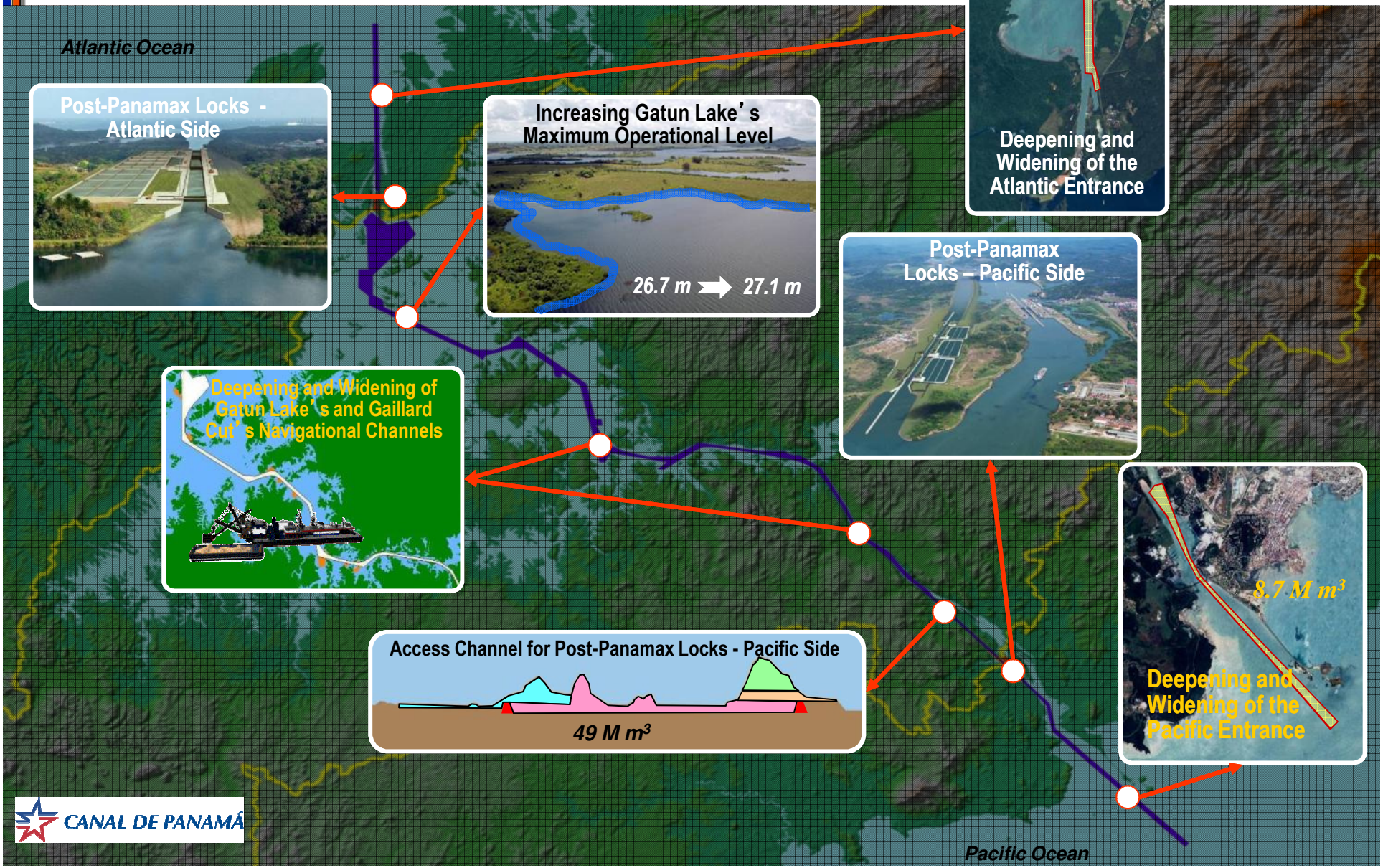
Update on the Panama Canal Expansion Program

$5.25 Billion completion 2015

New Locks Dimensions

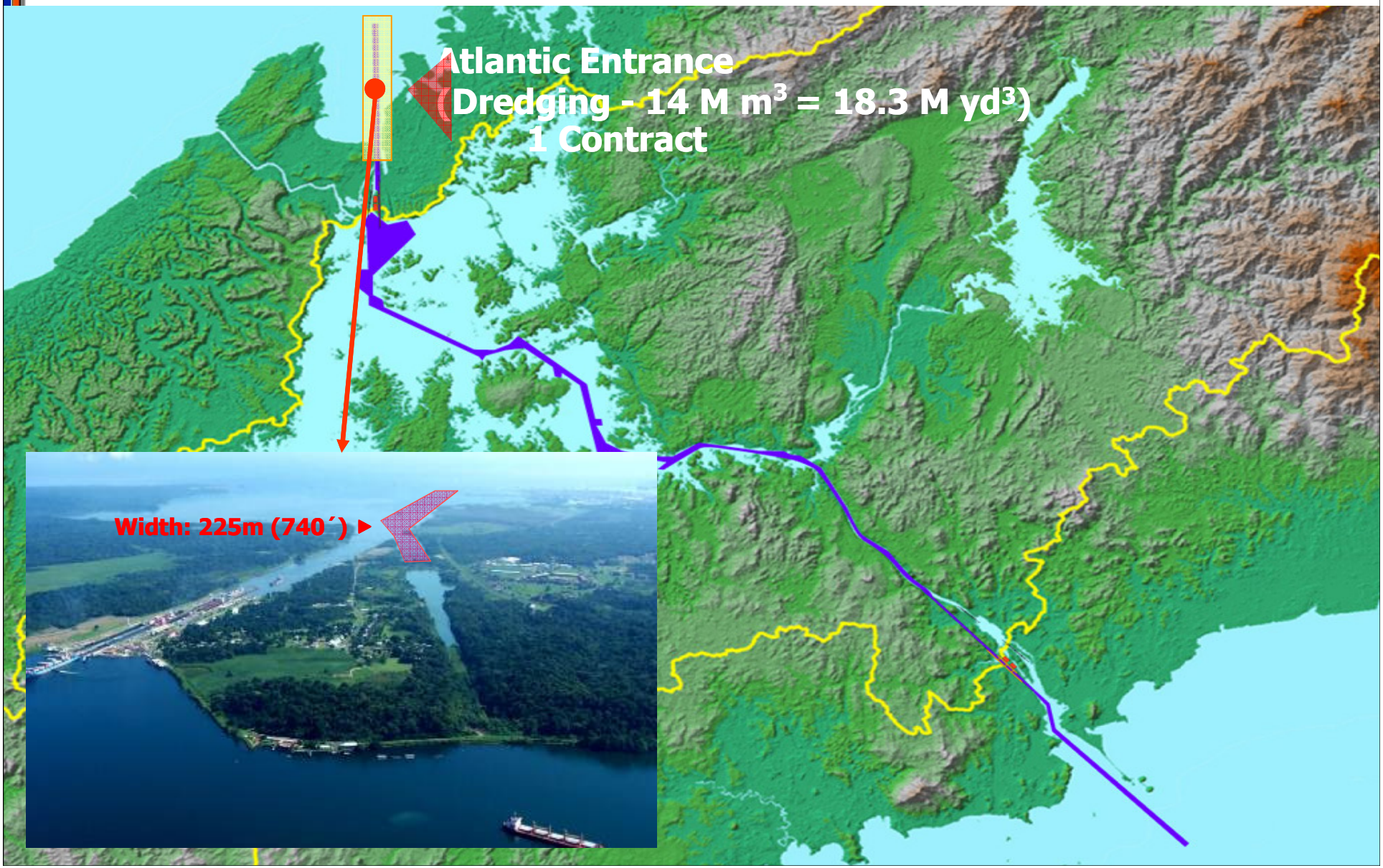


Program Components



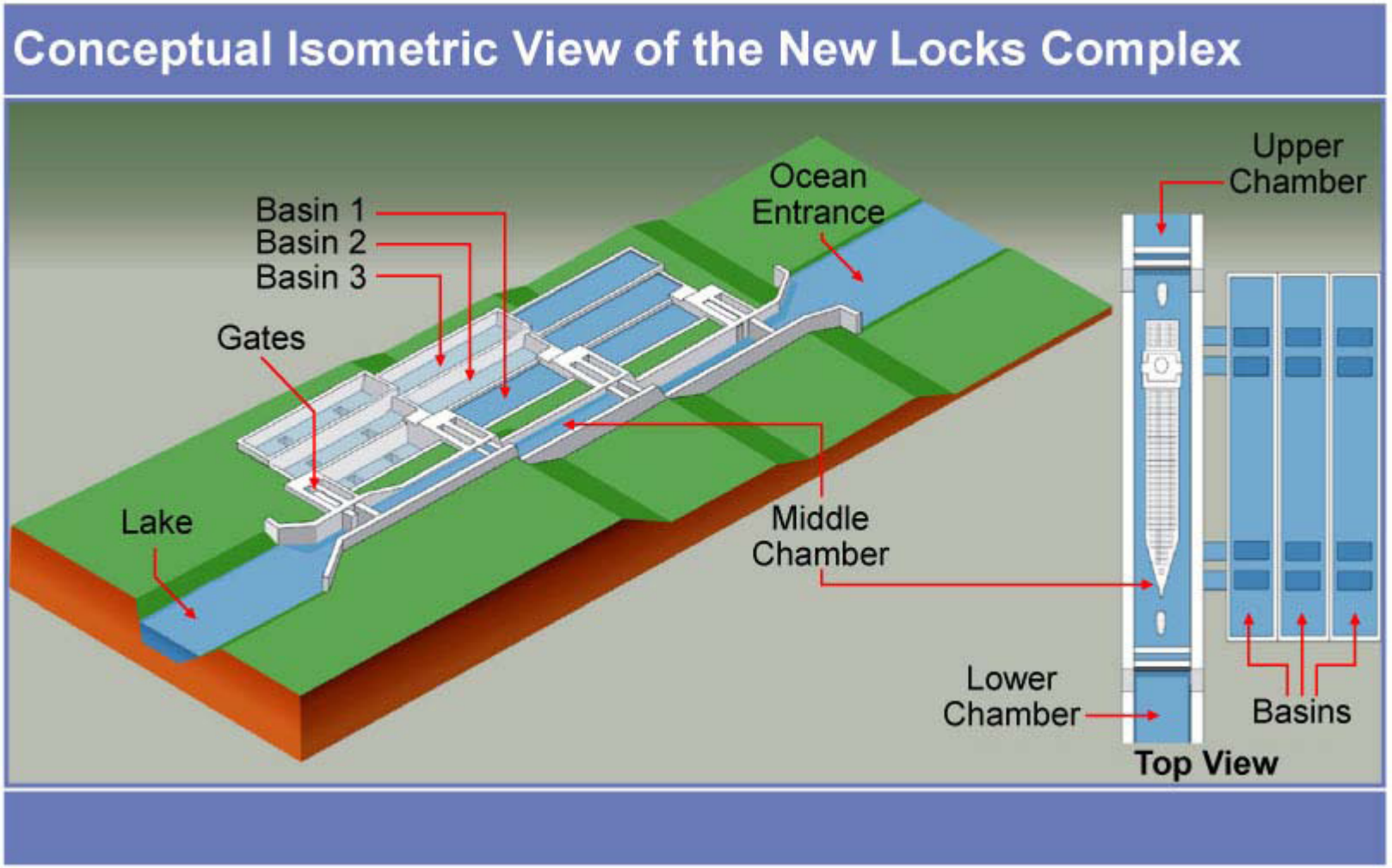
Atlantic Locks

Atlantic Entrance Deepening and Widening



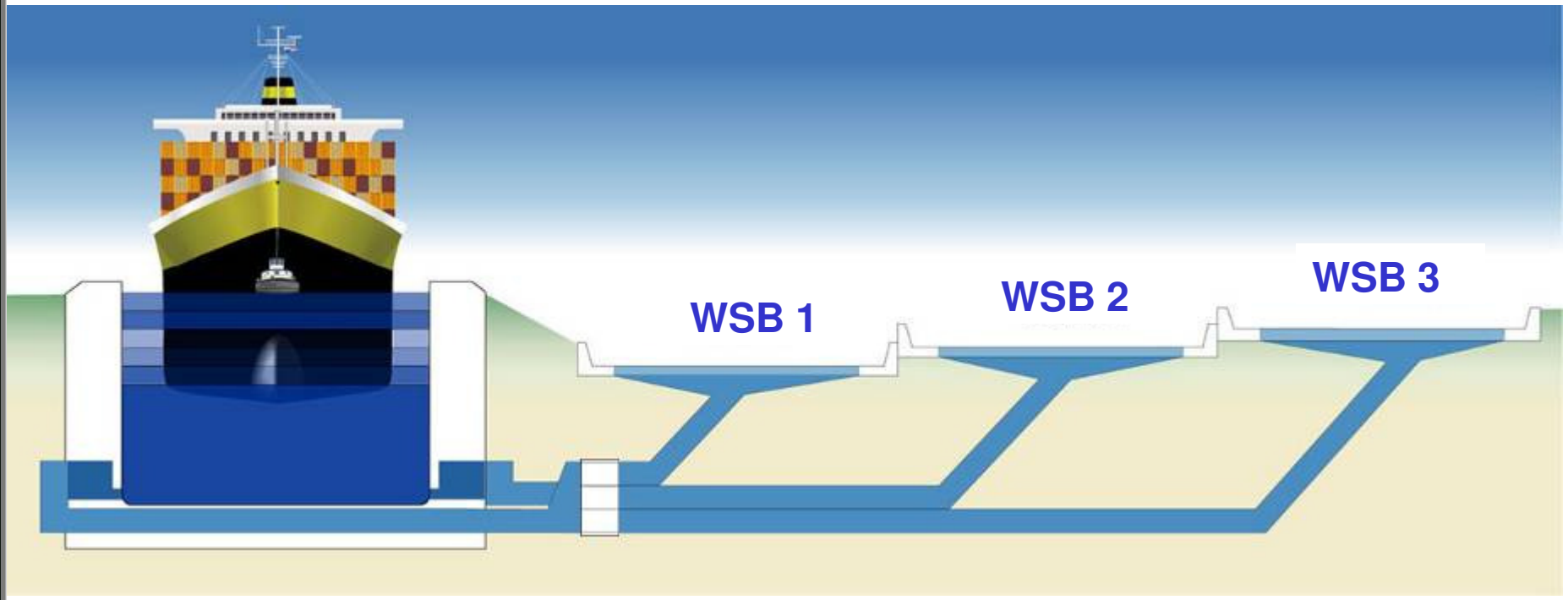
Post Panamax Locks

Atlantic and Pacific Locks
(30 M m³ = 39.2 M yd³ Dry Excavati
1 Contract



Three Lock Chambers both Atlantic & Pacific

Operation of Water Saving Basins



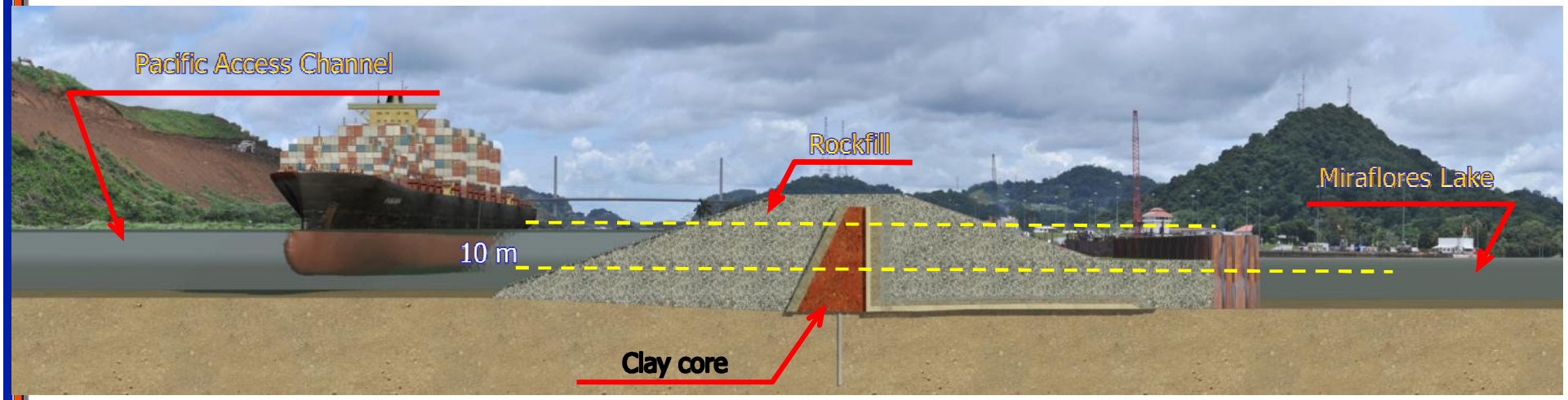
7% less

Pacific Locks

Post Panamax Locks

Atlantic and Pacific Locks
(30 M m3 Dry Excavation)
1 Contract

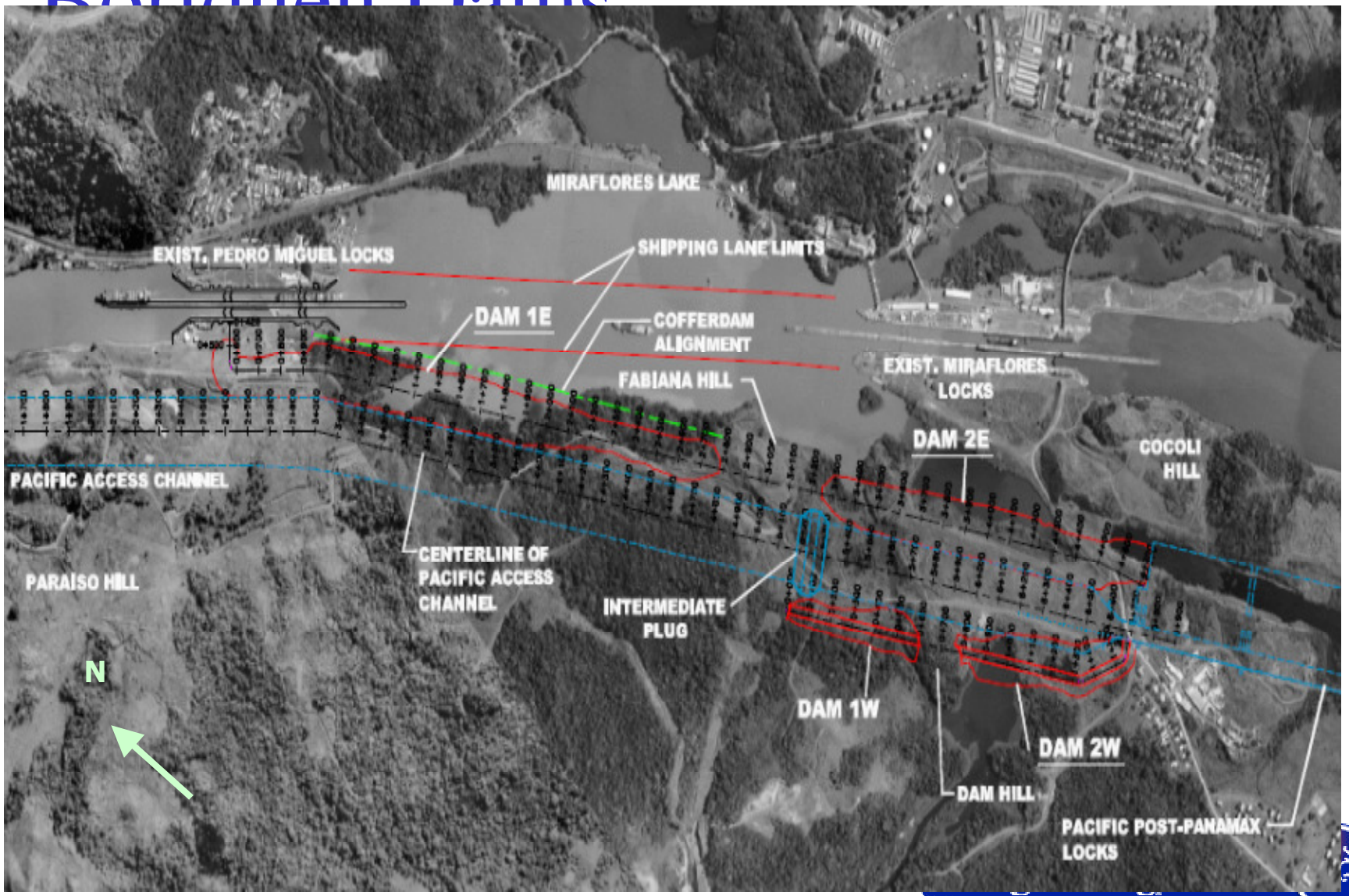
Borinquen Dam 1E



CANAL DE PANAMÁ

1E & 2E 4km 1W & 2W 1.4 km

Boriquen Dams



UNIVERSITY OF

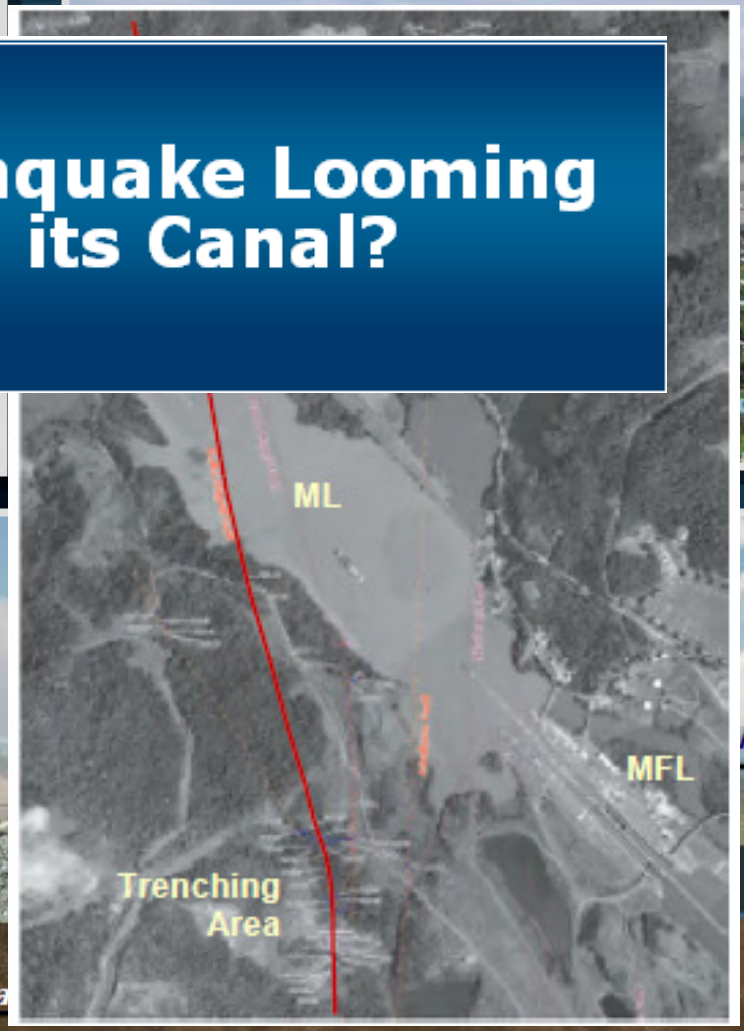
Borinquen Dam

Article:

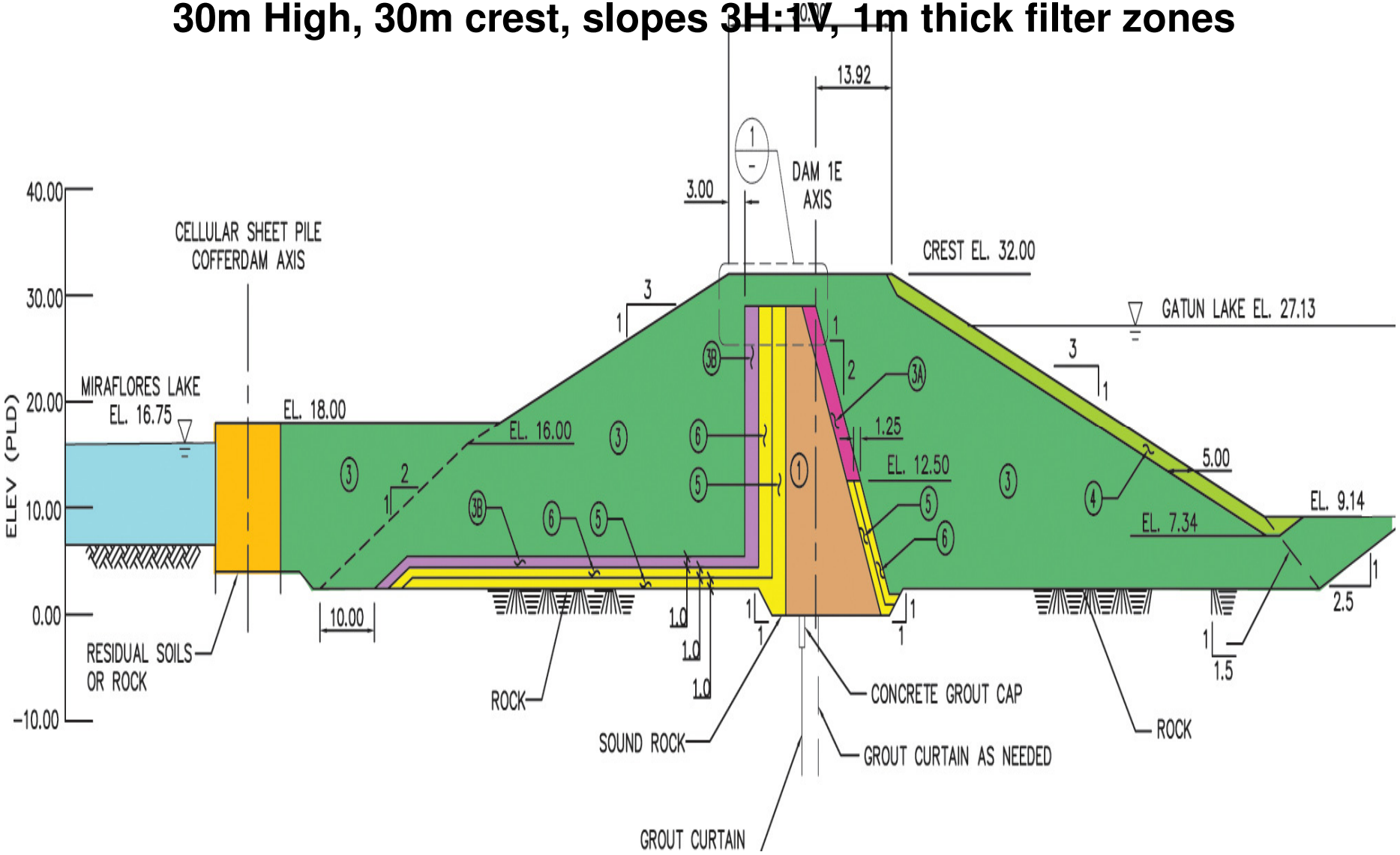
Is a Major Earthquake Looming for Panama and its Canal?

Andrea Mustain

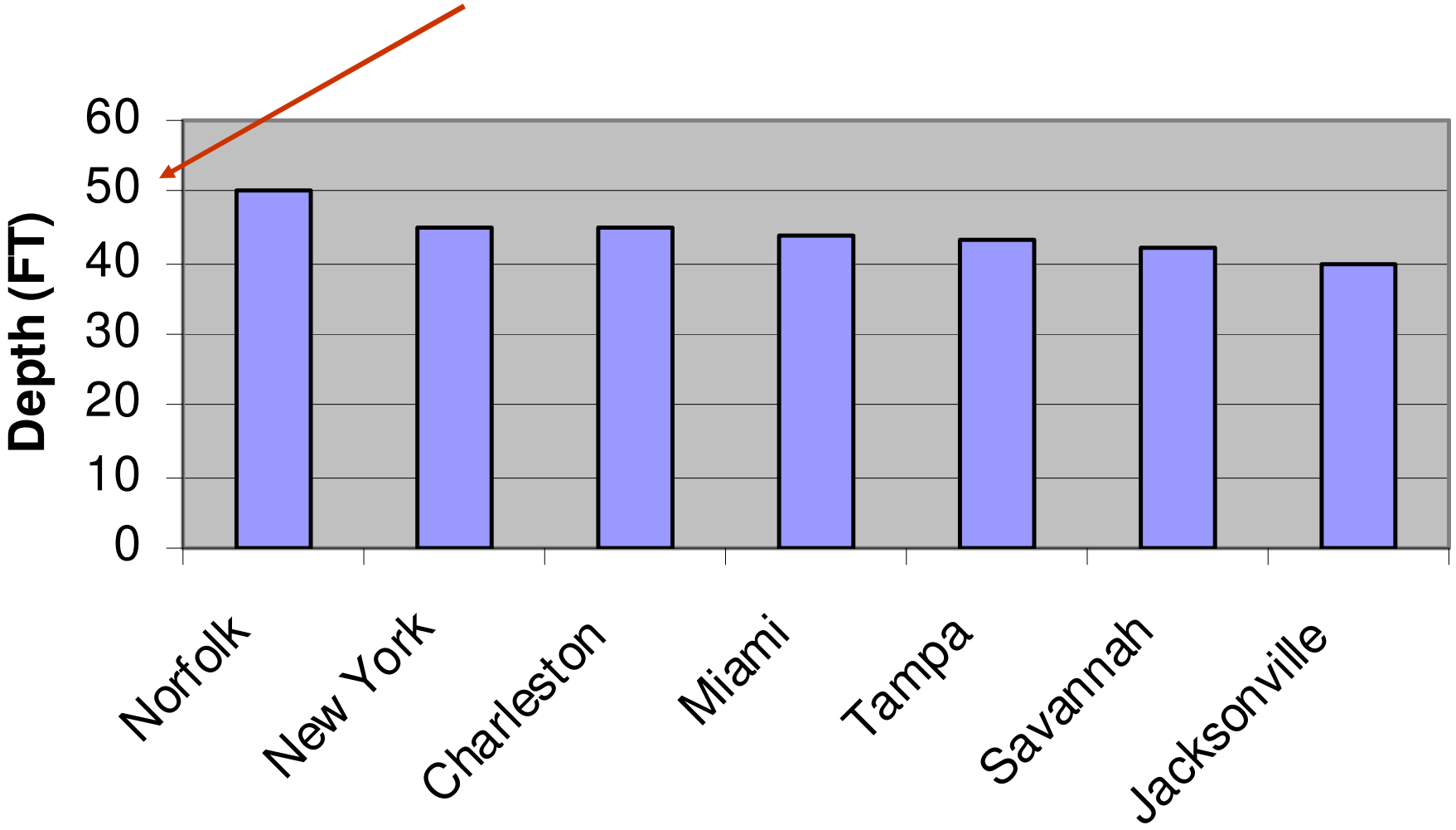
Date: 18 November 2010 Time: 10:53 AM ET



30m High, 30m crest, slopes 3H:1V, 1m thick filter zones

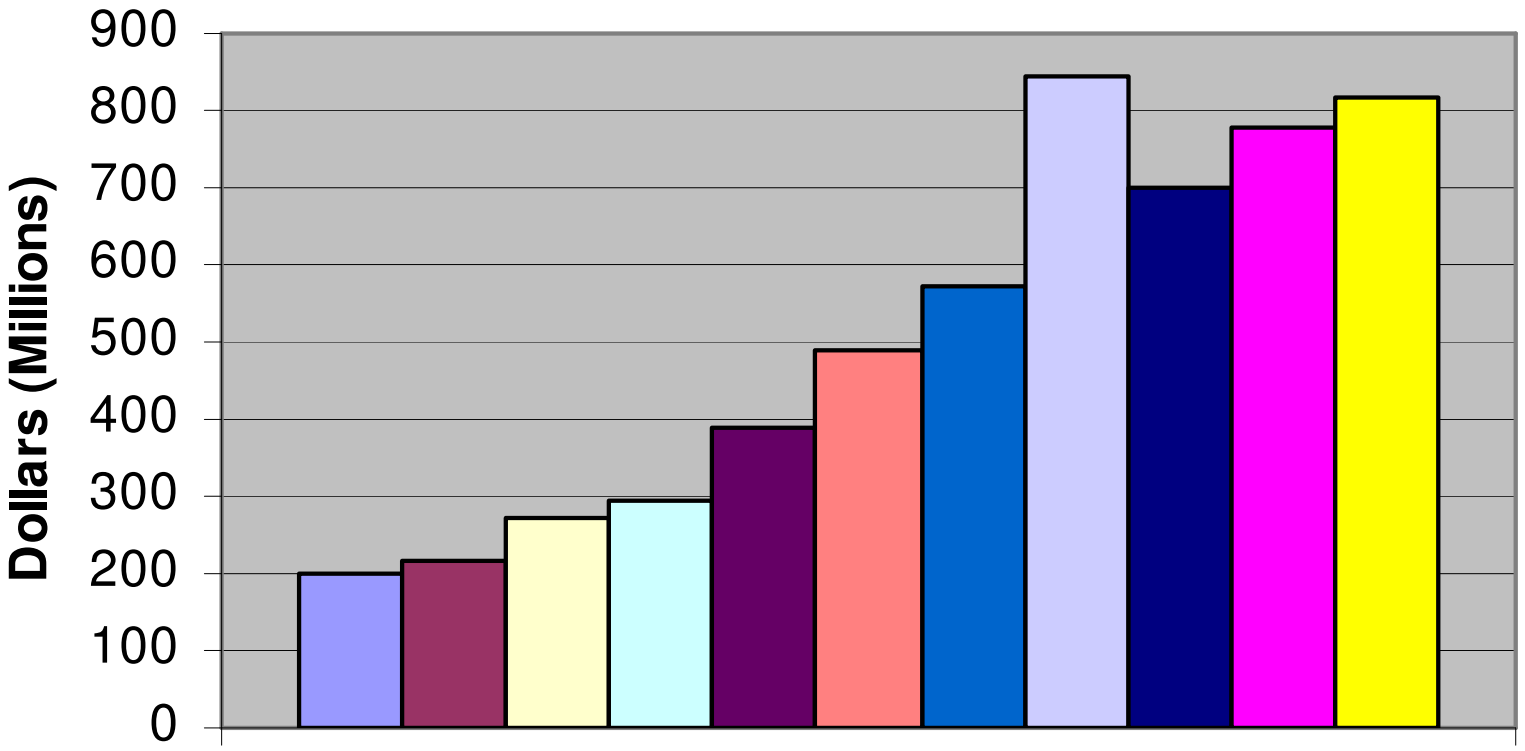


East Coast Channel Depths




The End

Current Profits



11 year total = 5.6^{B}

Tolls

- Most Expensive: Disney Magic (2008)
- $331,200

- Least Expensive: Rbt Halliburton (1928)
- $0.36

Toll Increases (2007 – 2011)

- 2007 $54.00
- 2008 $63.00
- 2009 $72.00
- 2010
- 2011 $74.00
- Cost per TEU = 20 ft Container

Main Contractors

	Design	Construction
Post-Panamax Locks Project		
Sacyr-Vallehermoso - Spain		
Impregilo - Italy		
Jan De Nul – Belgium		
CUSA – Panama		
Montgomery Watson Harza - US		
Pacific Access Channel – Phase 4		
ICA - Mexico	CANAL DE PANAMÁ	
FCC - Spain		
MECO – Costa Rica		
Atlantic Entrance		
Jan De Nul - Belgium	CANAL DE PANAMÁ	
Pacific Entrance		
Dredging International - Belgium	CANAL DE PANAMÁ