

**Container Model and Analysis:  
Longer Term Analysis of  
Infrastructure Demands and Risks**

*Research in progress*

*By Dr. William W. Wilson, NDSU*

# Elements of the Problem

- Growth in container trade
  - Increased 10 % in 2005; 9.8% in 2006 (Clarkson)
  - 4%/year through 2022 (*GWTS*)
  - China container exports
    - Increase by 16% in 2005 and 12% in 2006
- Container fleet capacity
  - growth rate 12% and 16% in 2006
  - Thus, trends will be persistent

# Growth Rates by Type of Ocean Freight (*Global Insight* Jan 2005)

	2000-05	2005-20	2020-15	2015-22
Dry Bulk	3.6	2.6	1.5	1.2
Tanker	1.2	1.8	1.4	.7
General Cargo	3.1	3.6	2.8	2.2
Container	6.1	4.5	3.4	2.8

# 5 Largest Container Exporting Nations (mil TEUs)

	2004	2005	2006	2007	2003-2021 CAGR %
China	16.3	19.1	31.8	24.2	6.4
US	7.3	7.5	7.8	8.0	2.2
Japan	4.2	4.5	4.7	4.9	3.6
S. Korea	2.9	3.2	3.4	3.6	4.4
Taiwan	2.8	2.9	3.0	3.1	3.5

# Source of Container Imports North America (mil TEUs)

Region	2003	2008	Ann Growth Rate %
N. America	.3	.4	1.4
N. Europe	1.7	1.8	1.2
NE Asia	7.9	13.4	5.1
SE Asia	1.3	1.5	.1
E. Europe	.1	.2	6
L. America	1.9	2.5	1.2
Med	.7	.9	1.9

# Asia/N American TEU Trade (% Growth Rate)

	2004	2005	2006	2007	2008	
Asia to N. Am.	13.7	12.6	10.9	8.3	4.6	
N. Am. to Asia	6.1	5.1	4.7	4.1	3.8	

# Major N. American Ports for Containers (mil TEUs)

	1997	2003	5-Yr trend %
Charleston	1.2	1.7	6
Long Beach	3.5	4.7	3
L Angeles	2.9	7.2	16
Ny/NJ	2.5	4.1	10
Oakland	1.5	1.9	4
Seattle	1.5	1.5	-1

# China expanding

- Dredging Yangtze
- Guangdong Province
  - to invest in Pearl River Delta 60\$billion in routes and hubs over 6 years to cope with volume anticipated in 2010 to be 100 mill TEU
- Shanghai International Ports Group
  - seeking foreign investment to expand
- Taiwan
  - 12\$ billion in 4 years for port expansion
- Ship expansion in Panamax sector..
  - 134 ships ordered in 2004 up from 102 in 2003 and 25 in 2002
  - Reflects growing number of Far East to US East Coast services through the Panama Canal
  - Panamax fleet
    - 2005 1.98 mill TEU
    - 2007 to increase to 2.5 mill TEU

# Constrained Vessel Calls (DRI-WEFA)

- Previous analysis:
  - 27% without planned Corp projects
  - 8.3% with planned projects
- 2003
  - 40% without planned Corp projects
  - 4% with planned Corp projects
- More problematic at Atlantic Ports
  - But, greater growth at Pacific ports

# DRI Other

- Container fleet
  - 2001 40% had draft of more than 42 feet
  - More new-builds in larger ship size categories

# Calamities (*Clarkson*)

- Height of recent congestion
  - Hong/Kong/NYork via LA
    - 19 day container transits
    - Increased to 26 days
  - Reshuffled traffic away from Calif
- Some traffic shifted to
  - W.Coast Mexican ports

# Other routes being explored

- Panama Canal
- Possible Canal crossing Nicaragua
- Railway system along the Amazon river to the Pacific from Brazil to Ecuador
- A major highway in Honduras connecting several ports and the possibility of additional services for the Post Panamax generation in the Suez Canal.
- Mexico
  - W. Coast Mexico ports to serve US markets
  - Ensenada in Mexico
  - Grupo Mexico investing in 3 intermodeal terminus in Mexico to speed shipments between Mexico and US

*Atlantic Ocean*



Gatun Dam

Gatun Locks

Gatun Lake

Gamboa

**GAILLARD CUT**

Pedro Miguel Locks

Miraflores Locks



*Pacific Ocean*





# Pricing Canal Transits 1

- Differentiated pricing schemes by vessel type with key differences between containers vs.. dry bulk
- Change in tolls in October 2002
  - Since 1912, rates based on flat rate for all ships
  - Change is based on ship size and type
  - Segmentation started in 2002
  - Replaced the PC/UMS (Panama Canal Universal Measurement System) with TEU for containers
- Container Rate Increases
  - 13% increase in tolls in 2003
  - Proposed double digit price increases in 2005-2007
    - 2005 \$42 per TEU
    - 2006 49 per TEU
    - 2007 54 per TEU

# “Transit Reservation System”

- Conventionally: first-come-first-serve for Canal transits
- Due to demands of ship-owners/operators wanting to assure and reserve their transits
- Mechanics: --All items are in tariff, and, last changed in 2004
  - Ship-owners can book a slot for transit in advance by paying a fee. Technically, this is “the booking fee for reserving a transit slot ....
    - Fee=\$.39 per PC/UMS net ton for dry bulk;
      - Containers: \$5.30/teu
    - Cancellation: a vessel agent may cancel the transit reservation of a vessel by giving notice...and a cancellation fee will be charged. The fee depends on the amount of notice (days/hours) received by the Canal in advance of arrival time..
    - Changes in transit date: allowed with no charge so long it is requested 60 days ahead
    - Premium booking fee: whenever the total number of vessels awaiting transit at both terminals is projected to be 90 or more for at least 2 consecutive days, there would automatically be charged a booking fee
      - \$.83 per pc/ums net ton or \$.52/mt

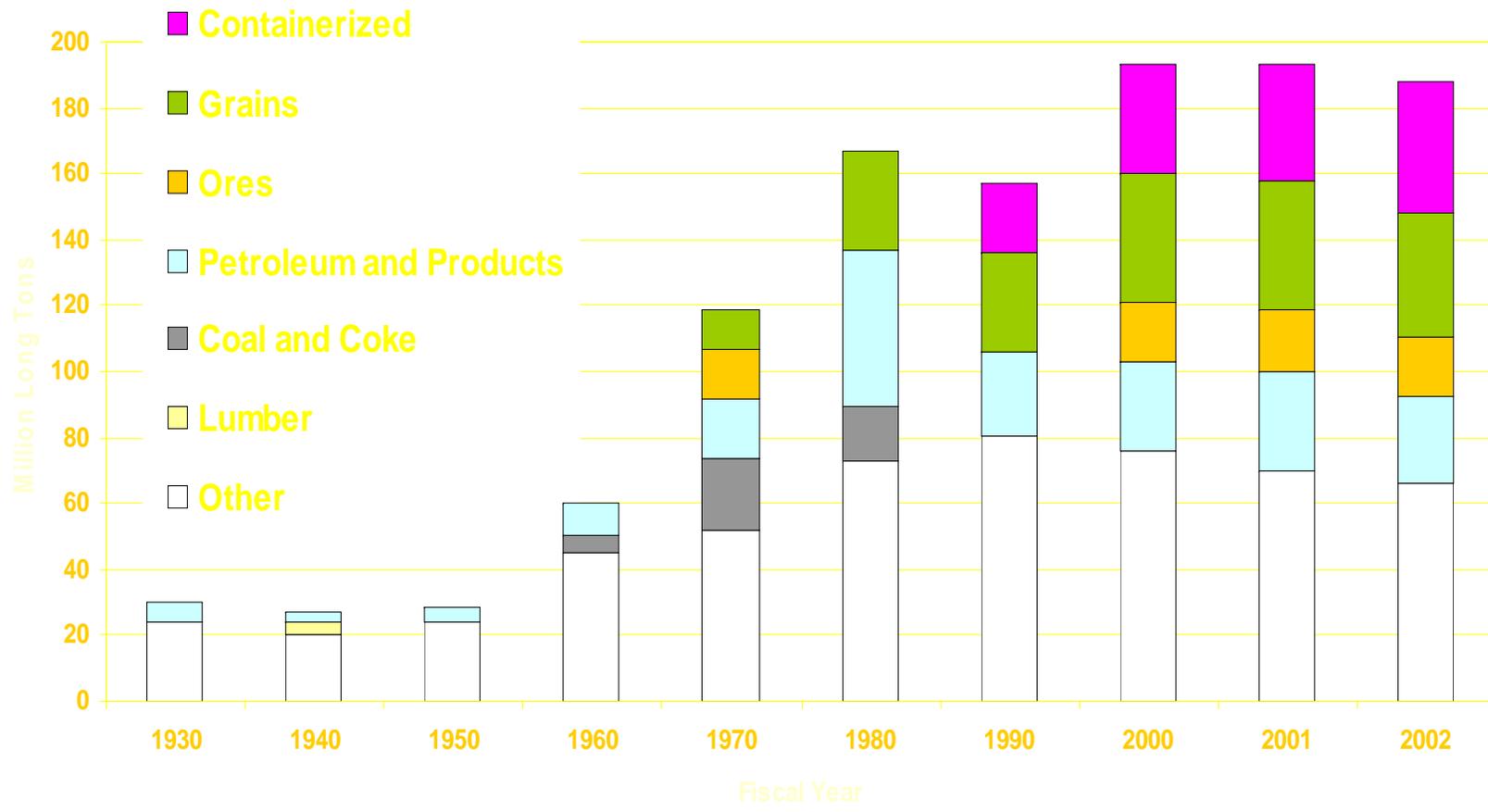
# Reservation System

- Allocates space for 50% of demand.
- Allows transits to occur within 17 hours of intended day;
  - vs., without a reservation of approximately 36
- Used extensively for container ships
  - 2003, more than 90% of vessels book transit through this reservation system;
  - in the most recent year is at 95%
- For dry bulks, this has increased from 26-35% in the past year

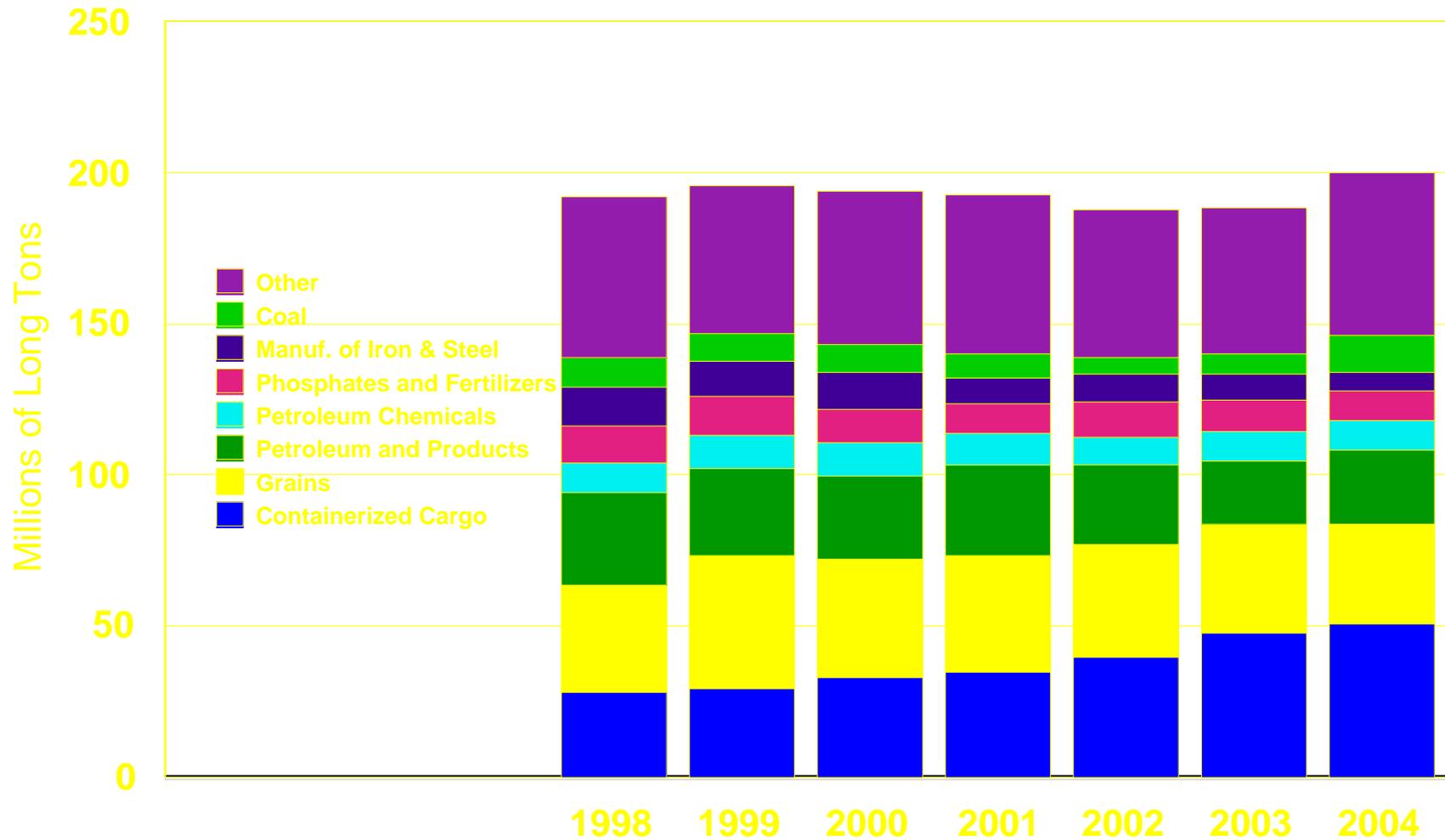
# Main Cargo Routes - FY 2003



# EVOLUTION OF CANAL CARGO FLOWS 1930- 2002

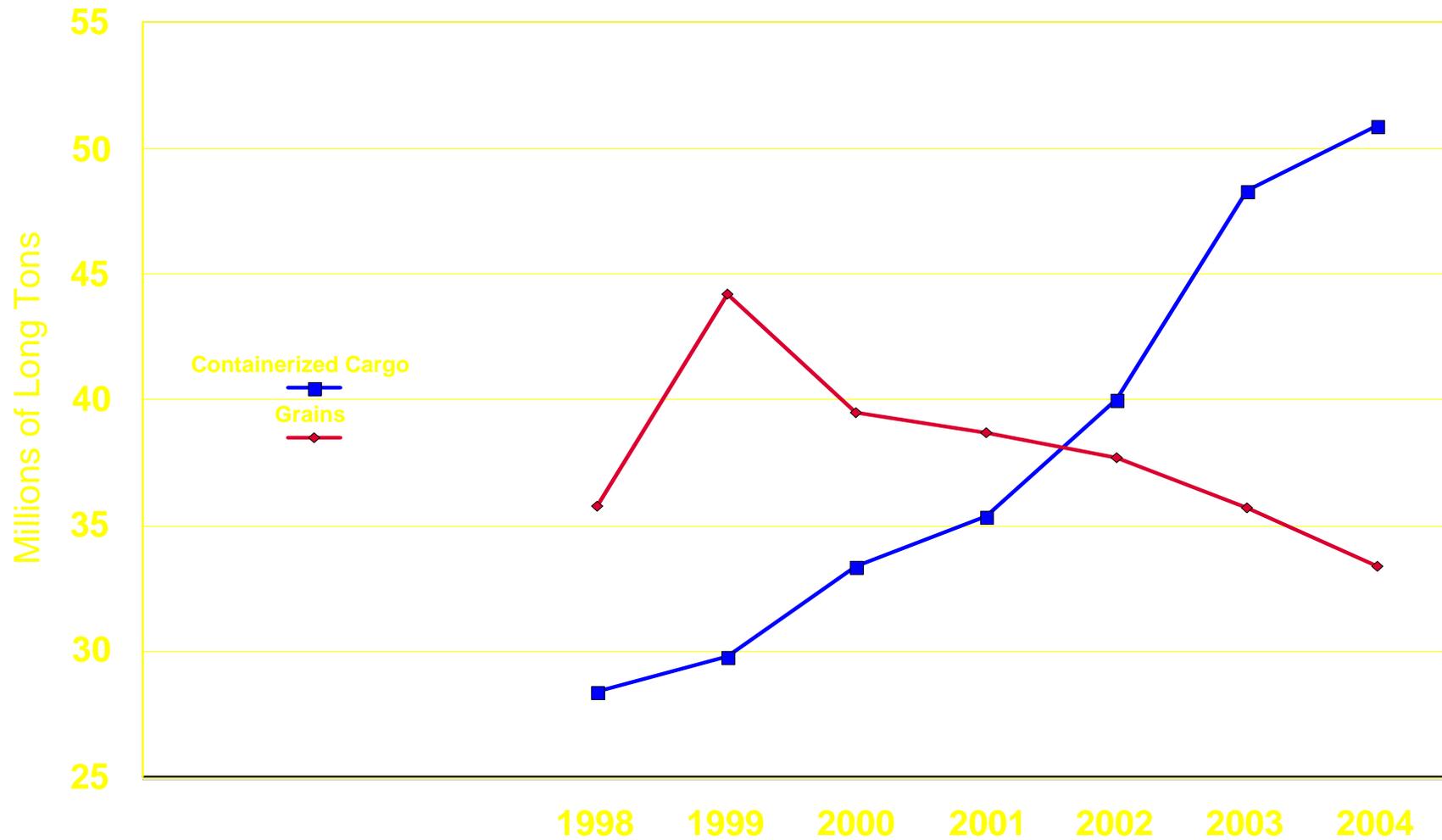


# EVOLUTION OF CANAL CARGO FLOWS 1998- 2002



Source: Panama Canal Annual Reports and ACP Ship Data Bank

# EVOLUTION OF CANAL CARGO FLOWS 1998- 2004



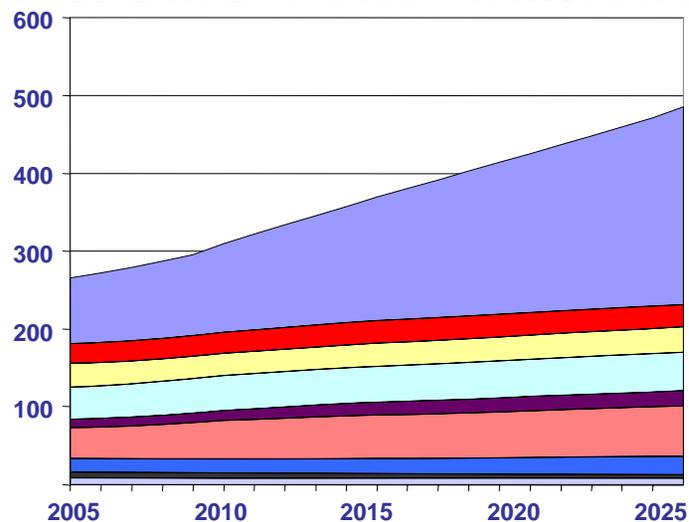
Source: Panama Canal Annual Reports and ACP Ship Data Bank

# Demand Forecast

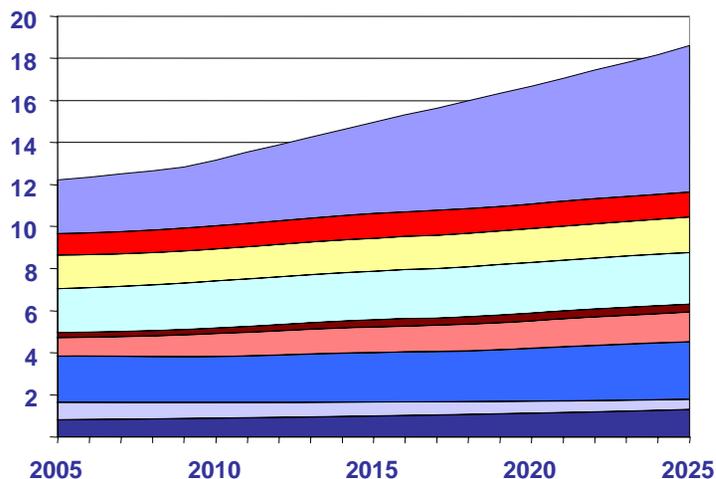
## Cargo Growth rates

	2005-2025
Containerships	6.2%
Grains	0.1%
Other Dry bulks	0.9%
Liquid Bulks	0.2%
Passenger Vessels	2.9%
Vehicle Carriers	2.3%
Reefers	1.5%
General Cargo	-2.7%
Other	-3.1%
<b>Total</b>	<b>3.3%</b>

## PC/UMS Tons- millions



## Transits



# Expansion Plans/process and Pressures

- Capacity: 200 mill long tons per year
  - In July they were at Capacity
- Since 2000 the Canal has studied extensively virtually all aspects of expansion
- Steps to move forward
  - Board of Directors proposed expansion
  - President of Panama to obtain Congress' approval
  - Submit to nationwide referendum in November 2005
    - Postponed to mid-2006
    - Currently supported by 70-80% of population
- Proposed cost \$5 billion (more likely 7-8\$billion but estimates to 11\$ billion)
  - GDP of Panama=\$12 billion (debt would make Panama 10<sup>th</sup> poorest)
- 10 years duration to be completed--2017
- Project financed through a “surcharge” on current Canal tolls—once project is approved
- Critique (Global Insights—July 15)
  - Highest probability: tolls result in more than doubling
  - Tolls may have to increase 4-fold current values if worst traffic case evolves
  - Competition from competing movements (Suez for Asia to N. America)

# Technical features of the expansion

- Add
  - parallel set of locks to accommodate giant container cargo ships
  - 5 mile bypass of the current canal on its Pacific side and designed for larger ship
- Increase capacity from
  - 965 ft to 1265 feet;
  - Draft from 39 feet to 50 feet
- Expansion would allow both bigger ships, and more of them.
- Target
  - Asian cargo for southern and eastern US ports (N Orleans, Houston, Tampa, Savannah and Norfolk),
  - Potentially westbound grains from Brazil to Asia (unlikely—within 50c/mt)

*Atlantic Ocean*



Gatun Locks

Gatun Dam

Gatun Lake

Gamboa

**GAILLARD CUT**

Pedro Miguel Locks

Miraflores Locks



*Pacific Ocean*

Madden Dam

# CANAL PROFILE



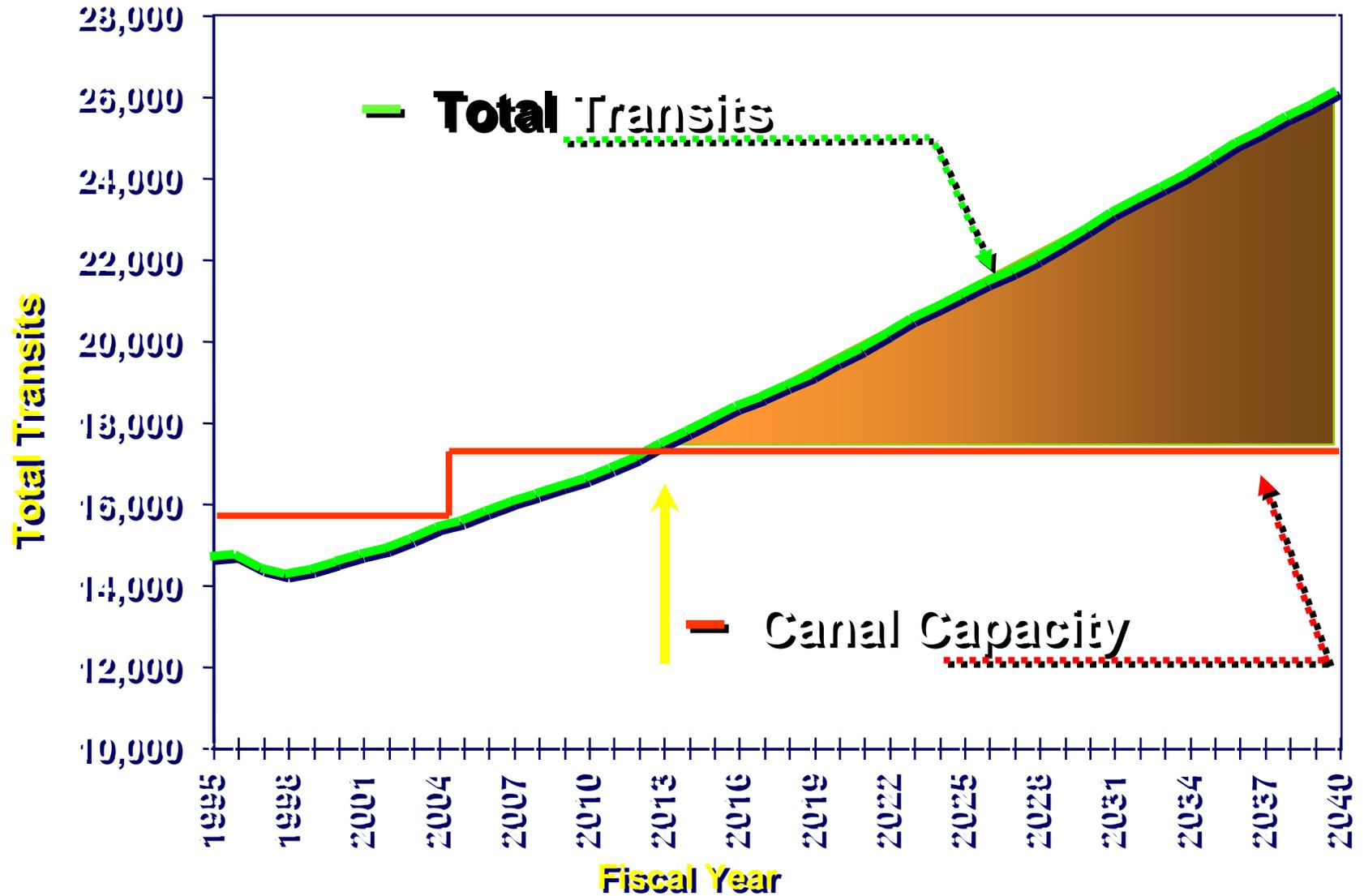
# Gaillard Cut Widening

New width 192m

Previous width 152.4m



# Transit Projections



Source: ACP Forecasting Model/Mergeglobal, Inc

# Panama Canal Expansion: Recent Press Release

- <http://www.mercopress.com/Detalle.asp?NUM=6984>
- <http://www.mercopress.com/Detalle.asp?NUM=6984>
- The **Panama Canal will be obsolete by 2013** when it won't be able to service large vessels, larger than the current capacity of the inter-oceanic passage, warned a paper from the Panama Canal Authority, ACP.
- If the canal is not widened, "it can be anticipated that much of the Relevant demand which can not be serviced will migrate to the Suez Canal **and the inter-modal United States system**", pointed out the paper which has elaborated 120 assessments reports related to the future expansion of the waterway.
- The canal "could in the mid term see its client base considerably reduced, losing relevance in the market", and left "in a strategic and disadvantageous position, dependent on few routes with predominantly few users", underlines the report.
- Some of the potential competitors facing the Panama Canal are **a possible canal crossing Nicaragua, the railway system along the Amazon river to the Pacific from Brazil to Ecuador, a major highway in Honduras connecting several ports and the possibility of additional services for the Post Panamax generation in the Suez Canal.**
- The Post Panamax vessels given their size are unable to operate in the Panama Canal because of the locks dating back to 1904 and 1914. The canal currently has an annual handling capacity of 325 million tons of cargo which represents 13.000 vessels.
- Next year the Panamanian government is scheduled to call a referendum to decide on the expansion of the canal. An undertaking that is estimated will demand over 800 million US dollars.

Pressures for Responding to Changes  
“Steering Closer to the Wind”,  
*World Trade*, Dec 2005

- Pressures from all fronts on container industry
  - Customers demanding greater reliability
  - Poor port productivity, port and inland bottlenecks “especially in North America” are making it increasingly difficult to meet customers demands for reliability
  - Trade flows becoming more imbalanced
    - More containers being sent back empty resulting in increasing cost of reposition

Pressures for Responding to Changes  
“Steering Closer to the Wind”,  
*World Trade*, Dec 2005

- A view of the future
  - Freer and more open markets and growth in container shipping
  - More concentrated industry structure
    - 10 players controlling about 80% of the market
  - Differentiated customer relationships

# Sources of uncertainty

- Size and uncertainty of growth in container shipments
  - GDP...other
- Spatial distribution of growth by port
- Changes in demand, spatially, within US
  - $\text{Import} = f(\text{popn}, \text{income}, \text{logistics characteristics} \dots)$
  - Backhauls
- Alternative routes
  - Panama Canal expansion
  - Development of other port/transit points....

# Major Analytical Steps

- Review of previous studies on container shipping
  - with a focus on infrastructure and projections.
- Describe historical movements in world trade
  - include developing a historical data set on sources of supply and demand for container shipments.

# Analyze historical movements in US markets

- Rail waybill data will be used.
  - Other data sources exist
- Describe demand by product, geography and through time
- Use econometrics where container demand (at major US cities) is a function of demographic (geographic population and income) and industry variables.
  - this will be a pooled analysis, maybe using spatial autocorrelation techniques.

# Modal rate Analysis: Rail

- Waybill data
  - Prospective problems in
    - Rate reporting (bundled with other elements of movement)
    - Flows being terminated by rail; but, not destination
  - Regressions of current rate structures

# Modal Rate Analysis: Ocean rates

- Identify and develop a data set and sources for ocean shipping rates by containers
- Analyze rates for container shipments.
  - Critical is the impact of size, distance etc as well as routes, etc

# Major Analytical Steps

- Port Constraints and Expansion possibilities (costs)
  - Review studies to identify the current state of knowledge about port constraints and expansion possibilities and costs.
  - Defining capacity or limits
    - Draft
    - Handling capacity
- Defining routes, and potential routes
  - W. Coast Mexico to US
  - Panama expansion
  - Ship sizes by route/port by draft
  - Traffic diversion

# Model development alternatives:

- Based on above, and in the experience of the longer-term grain model
  - review and critique alternative models that can be used to
    - analyze flows, restrictions, expansion possibilities
    - make projections.
- Alternatives for handling and quantifying risk will be identified.
- Stochastic optimization
  - GAMS (new version)
  - Alternative algorithms
    - Risk Optimizer which may be better
    - but, requires a smaller model than we are currently using in grain.

# Questions for Keith

- Global Insight...projections....
  - Are they current enough
  - Can we use these
  - Ask Global to generate prob distributions of projected flows
- Rail waybill
  - Status of ability to use waybill
  - Chris D as consultant....and/or role to play
- Scope
  - World model, or, n. American import/export model . How important is N. American distribution and demand
- Data sets
  - Numerous data sets exist on containers
    - Clarkson,
    - Intermodal assoc of N. America .... Market trends, 5 years etc
    - Which, if any, does ACE currently have
- What are major questions for the ACE/IWR?
- Capacity constraints at ports
  - Dredging/dept
  - Or, handling capacity
  - Focus on imports, exports or both
- Consultant scope/suggestions: anticipated responsibilities of the consultant:
  - Assist in defining current major flows of containers in the world, and US domestic market (What is being hauled and why?)
  - Describe current and future technologies in container shipping
  - Identify major logistical routes in the US domestic market and costs (though, these can be supplemented by Chris rail analysis above)
  - Identify port capacity constraints, and prospects for increasing them
  - Review and critique alternative analytical models
- Date: March 21 meet