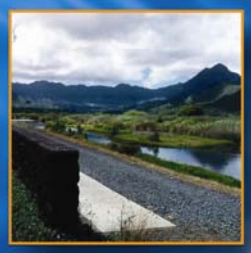
Water Resources Outlook

13 March 2007

Maritime Transportation System: *Trends and Outlook*

2007-R-5



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Water Resources Outlook

Water is an essential resource in the U.S. economy. It plays a crucial role in supporting many economic activities and ensuring the quality of human life and the health of ecological systems. Despite this, the value of water may not be widely appreciated because only some water resources and water uses are easily visible or noticed while others are not.

Among the Institute for Water Resources (IWR) Future Directions program activities are the identification of emerging water challenges and opportunities and the tactical engagement of U.S. Army Corps of Engineers (USACE) senior leaders on these issues. Such critical thinking is an essential prerequisite to strategy development and planning.

IWR has developed this series of Water Resources Outlook papers, commissioned utilizing outside experts, to identify emerging issues and implications for the Nation. These issues and implications will be presented in the form of "provocation sessions" with external and internal subject matter experts and stakeholders and will inform the USACE strategic planning process.

Maritime Transportation System: Trends and Outlook

USACE major responsibilities for waterborne commerce include dredging, development and maintenance of the inland and coastal waterways and related maritime infrastructure, and navigation aids. A firm understanding of marine transportation conditions and trends is critical in discharging those responsibilities.

The U.S. Maritime Transportation System (MTS) no longer exists in isolation, but must interact with ports, land carriers, customers, communities, environmental restrictions and security concerns. This second in a series of Water Resources Outlook papers is intended to develop an understanding of the challenges faced by the MTS over the next 30 years and suggests roles for the private and governmental sectors, including the Corps. It is intended to provide a strong, fact-based foundation for policy, planning and priorities.

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Executive Summary

ES.1 Background

Waterborne commerce is a key factor in the world and U.S. economies, and depends on a safe, efficient and reliable maritime transportation system. U.S. ports and waterways handle more than 2.5 billion tons of trade annually, most of the country's international cargo and much of the total domestic production. The resulting benefits are ready access to a wide variety of products and services and lower costs for consumers.

The U.S. Maritime Transportation System (MTS) no longer exists in isolation, but must interact with ports, land carriers, customers, communities, environmental restrictions and security concerns. Maritime shipping—liner as well as bulk—is likewise integrated into the U.S. and world economies at the supply-chain level and must respond and adapt to a wide range of economic and logistics trends. U.S. marine and inland infrastructure is being strained by the size of vessels, the number of vessels and the cargo they carry. Global warming and other environmental issues will have significant impacts on the marine transportation system and U.S. Army Corps of Engineers (USACE) projects.

The USACEs major responsibilities for waterborne commerce include dredging, development and maintenance of the inland and coastal waterways and related maritime infrastructure and navigation aids. A firm understanding of marine transportation conditions and trends is critical in discharging those responsibilities. This U.S. Maritime Transportation System "Outlook Paper" is intended to give USACE a strong, fact-based foundation for policy, planning and priorities.

The trends discussed in this paper are extensively interlinked. Changes in transportation activity and practice are driven by changes in the underlying demand occasioned by foreign and domestic trade, changes in logistics practices, changes in environmental constraints, changes in the political arena and changes in technology and resource costs. The team reviewed both government planning and policy documents and the applicable commercial literature to determine and describe cause-and-effect relationships. This report uses the most recent data available in consistent formats for tables and graphs. In most cases data are now available through 2005, but in some cases the comparable data series end in 2004. Forecasts, likewise, are on a consistent basis wherever possible, but are sometimes limited to the source data.

ES.2 World U.S. Economics and Trade Trends

ES.2.1 Moderate World Economic Growth

The world economy is growing at a moderate pace (Exhibit ES.1) and is expected to continue on that path. These rates reflect foreseeable trends rather than growth to a specific target date. Trade disruptions are generally expected to be short and localized but are unpredictable by nature. Currencies will rationalize over time with "soft landings" predominating.

Growth in Real GDP (% change)

Region	Actual 2004	Actual 2005	Outlook 2006	Outlook 2007	Outlook 2008+
United States	4.2	3.5	3.2	2.6	3.2
Canada			3.1	3	3
Mexico			3.7	3.1	3.4
NAFTA	4.2	3.6	3.4	2.7	3.3
United Kingdom	3.1	1.7	2.2	2.6	2.7
France	2.2	1.4	1.8	1.7	1.7
Germany	1.1	1.1	2	1.1	1.1
Italy	0.8	0.2	1	1.2	1.2
Euro Zone	1.7	1.4	2	1.7	1.9
Japan	2.3	2.7	3.2	2.3	2
China	10.2	9.9	9.6	9	8.8
South Korea	4.6	4	5.8	5.3	5.2
India	7.2	7.8	6.8	6.4	6.4
Taiwan	6.1	4.1	3.7	3.6	3.6
Hong Kong	8.6	7.3	5.2	4.6	4.6
Central Europe and Balkans	6.8	5.6	5.2	5.2	5.2
Comm. Of Indep. States	8.2	6.8	6.5	5.7	5.6
Mid East & Africa	5.8	5.7	5.6	5.5	5.4
Latin America & Caribbean	6.3	4.9	4.8	4.2	4.3
OVERALL WORLD	**4.1**	**3.6**	**3.7**	**3.4**	**3.4**

EXHIBIT ES.1
WORLD ECONOMIC OUTLOOK

Emerging economies, of which Brazil, Russia, India and China (the "BRIC" countries) are the top tier, hold the most near-term potential for dramatically expanded trade.

- Brazil has lost some export market share to China (e.g., in footwear) but will remain an engine of growth for South America.
- Russian economic progress may be slowed by cultural and political issues as the nation tries to build a modern industrial economy. Oil production will remain a central concern.
- India will slowly and unevenly emerge as a producing and trading nation, first in China's shadow and then as a prominent economic power in its own right. Infrastructure will remain a problem. Much of India's economic growth, however, may occur in non-cargo sectors such as services and software development.
- China will continue to industrialize, although the pace will slow as a matter of government policy and environmental consequences. Chinese population growth will also moderate. Large-scale Chinese auto exports are likely, but timing is uncertain.

Western European economies and the "Euro zone" will progress toward policy coordination with a minimum of backsliding. Balkan, Central and Eastern European nations will see strong, but uneven growth with infrastructure, institutional issues and energy prices acting as brakes. Individual sectors will be bright spots. South and Central American economic growth will be

steadier than in the past but will still be occasionally disrupted by political upheaval. Mexico will gradually join the top tier of emerging economies.

Energy prices will continue to rise, driven more by escalating demand than by supply restrictions. Although the current price of crude oil has fallen slightly from its previous peak, energy is likely to remain a significant constraint to world economic growth. Although the U.S. will remain a net importer, competing demand from developing countries may shift the worldwide pattern of petroleum and petroleum products movements.

ES.2.2 Trade Shifts

Rise of the Service Sector. Global outsourcing of services, information processing and technical support has enabled economic growth without traditional transportation infrastructure, particularly in India. Aggregate transportation capacity in ton-miles need no longer grow as fast as national Gross Domestic Products (GDPs). From USACEs perspective, this shift will require careful reexamination of transportation demand forecasts based on past relationships.

Shift of Asian Manufacturing Center. The geographic "centroid" of Asian manufacturing and exports has been expected to shift from China toward India (Exhibit ES.2). India is generally regarded as the breakpoint at which liner service to North America through the Suez Canal has an advantage over transpacific liner service. As the exports from Southeast Asia and India grew in importance the Suez services to the U.S. East Coast ports were expected to grow apace.

Source: Transystems, Inc.

EXHIBIT ES.2
POTENTIAL SHIFT OF ASIAN MANUFACTURING "CENTROID"

Despite rapid economic growth in India the widely anticipated growth of Indian maritime exports has not happened. A more realistic scenario is gradual growth of exports as India eventually overcomes infrastructure barriers and other limits. The expansion of the Asia-U.S. trade via the Suez Canal will likewise be more gradual than explosive.

Shift of Asian Production to Mexico. There is a foreseeable increase in "near sourcing" of production to Mexico to take advantage of faster delivery, greater flexibility and immunity from seaport congestion or labor shutdowns. A change from "outsourcing" to "near sourcing" will reduce both volume and service pressure on West Coast ports and increase pressure on U.S./Mexico border crossing and Mexican ports. The "near sourcing" trend has so far been relatively small and focused on a few industrial sectors. If it remains small, it will have little impact on USACE responsibilities. If the trend grows and expands, it could reduce or delay cargo growth at U.S. West Coast ports.

ES.2.3 Freer Trade

Trade will become progressively freer, with occasional backsliding and short trade wars. Globalization will continue without a major retreat, although there will be periodic local retrenchment. Transaction costs are declining for several reasons.

- Tariff reduction and simplification.
- Emergence of free trade agreements (FTAs) and regional trading alliances such as the European Union.
- Development of enterprise management systems (EMS) enabling shipper control over complex multi-national supply chains.
- Electronic communications linking global suppliers and customers.
- Widespread improvements in the stability of banking and financial institutions.

Greater trade freedom and reduced transaction costs will both encourage trade growth and tend to reduce dramatic swings. The increasing fluidity of trade facilitates quicker recovery from disruptions, making the global trade network more resilient and stable.

ES.2.4 Moderate U.S. Economic Growth

Although U.S. economic growth for the first half of 2006 has been robust, growth will begin to slow due to a stagnant housing market. The most logical assumption is that growth will return to long-term moderate trend levels sometime after 2007. The continuing current balance deficit will keep downward pressure on the dollar and moderate import growth. Control of the U.S. economy by the Treasury and Federal Reserve will be generally successful (e.g., mild inflation, moderate unemployment), but the business cycle will persist in a softer form. There are no indications of major changes in the U.S. economy that would impact USACE responsibilities. The outlook for long-term moderate U.S. growth without major setbacks implies moderate growth in demand for foreign and domestic goods and the required marine transportation.

When and if the U.S. experiences mild recessions, the usual result is a delay in growth. A major recession could cause a permanent setback but is not foreseen. Much of the U.S. import growth is propelled by consumer spending and consumer debt, including equity loans on bubble-priced houses. A declining housing market or other factors leading to more conservative spending might slow import growth.

ES.2.5 Growing U.S. Trade

The United States tonnage growth is shown by vessel type in Exhibit ES.3. Tanker tonnage, driven by petroleum imports, has grown at an average of 4.2 percent since 1956. Liner and non-liner trades have both grown at 2.7 percent in tonnage terms over the long period in Exhibit ES.3. As noted earlier, the rapid growth in liner trade has occurred in the last three decades, propelled by containerization. The non-petroleum bulk trades are dominated by movements of minerals (coal, ores, gypsum, etc.) and grain.

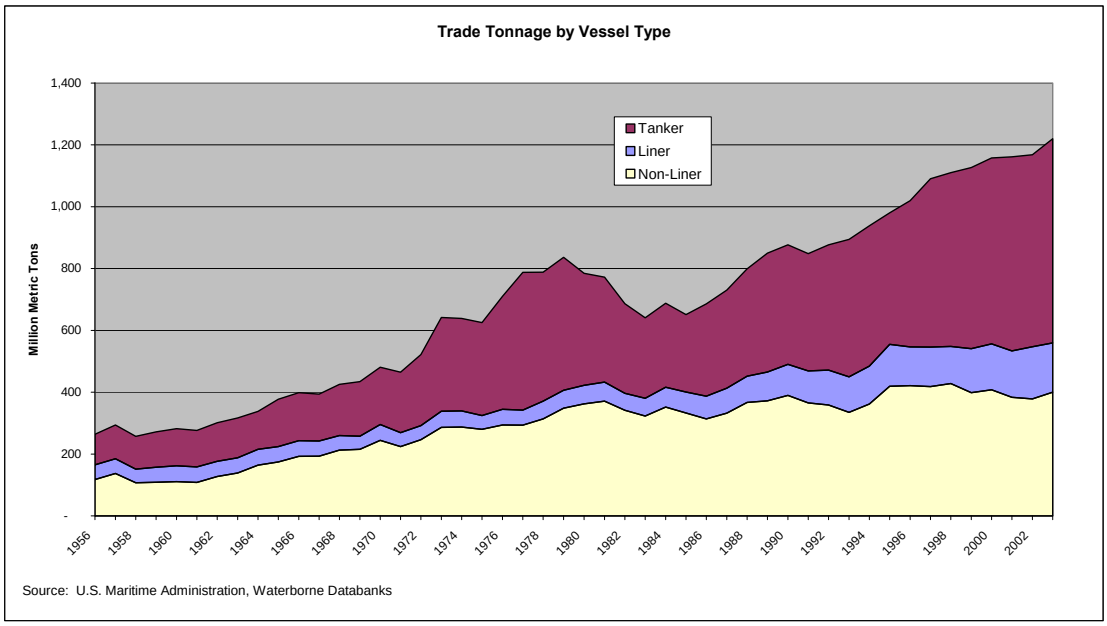


EXHIBIT ES.3
U.S. TONNAGE GROWTH BY VESSEL TYPE

ES.2.6 Growing Trade Imbalance

Dollar Deficit. The United States has sustained a large and growing balance of trade deficit over a sustained period. The deficit rose 3.9 percent in the third quarter of 2006, largely due to higher oil prices (which are expected to moderate). Despite concerns, there is no theoretical limit to the trade deficit. This deficit will persist and probably grow further. Foreign accumulation of U.S. dollars is a source of potential disruption through dumping if not addressed slowly over time.

Tonnage Imbalance. Exhibit ES.4 shows the widening gap between U.S. inbound and outbound maritime shipping in tonnage terms. In the late 1980s and mid 1990s export growth spurts lead to forecasts of balanced or nearly balanced tonnages. As the chart indicates, those tendencies fell short of achieving a balance and the gap has been widening since.

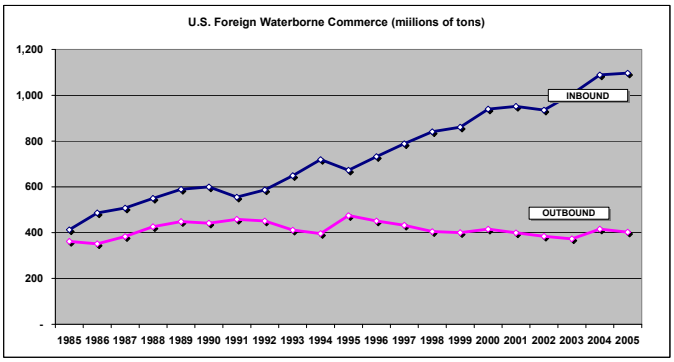


EXHIBIT ES.4
U.S. TRADE TONNAGE

In the container shipping industry, the imbalance leads to a buildup of empty containers in the U.S. which must eventually be repositioned as non-

revenue moves to Asia and other source regions. The need to move massive quantities of empty containers strains the economics of container shipping. The unidirectional nature of many trades has contributed to the specialization of many U.S, ports and their terminals, and their vulnerability to volatile trade conditions and individual company shipping strategies.

Global Competitiveness. The need for U.S. industry and exports to compete in the global market is often cited as a justification for transportation infrastructure investment. In reality, however, the U.S. freight transportation system is arguably the most efficient in the world and transport costs are a small part of most commodity values. The competitiveness of U.S. resources (e.g., minerals, etc.) is probably affected more by geography and extraction costs than by transportation costs. For containerized exports, U.S. West Coast ports already have lower costs than Asian ports and westbound container rates to Asia are about half the eastbound rates. The ability of transportation infrastructure to materially affect "global competitiveness" of U.S. products is therefore very limited.

ES.2.7 Potential Backlash

Protectionism. National concern over the impact of outsourcing and globalization on U.S. jobs and over the escalating trade deficit is likely to hinder the overall trend toward freer trade. Protectionist measures can slow the overall growth of trade but can also have dramatic impacts on specific trade flows at specific ports, particularly when applied to break bulk commodities such as imported steel. The extent or impact of protectionist actions is unknown and unpredictable. The possibility of protectionist impacts on specific trade flows should be considered in analyzing USACE projects.

Regional Antipathy Towards Trade. Entrenched regional antipathy toward trade and the environmental/community externalities of port activity may be the single largest obstacle USACE faces in discharging its present and future responsibilities. Maritime trade and shipping activity have adverse consequences; documentation and analysis of those externalities has led to significant regional antipathy toward both current trade and trade growth. The antipathy is greatest in Southern California but also apparent elsewhere. Regional antipathy toward trade and concern over externalities has sharply curtailed the ability of the Southern California ports to expand or improve infrastructure. USACE will face increased difficulty managing project development schedules or budgets.

ES.3 U.S. Domestic Logistics and Transportation Trends

ES.3.1 Pressure on Logistics Costs

The pervasive trend in logistics will be continued pressure to move freight "better, faster, cheaper" with the application of that trend specific to each commodity. Having exhausted most of the potential savings through outsourcing, customers will increasingly turn their attention to logistics as a potential area of cost reduction or competitive advantage. Logistics costs, which have been on a downward trend as a share of GDP for a decade, have recently taken an uptick but are still less than 10 percent of GDP. Customers will be more likely than in the past to switch carriers, ports or routes for better, faster or cheaper transportation, although still less willing-to-change modes (e.g., between truck, rail and barge).

ES.3.2 Transportation Capacity Limits

U.S. Highway Capacity. One of the major drivers of increased logistics costs is highway congestion. Since the 1980s the pace of highway construction has not met the increase in demand. Initially there was an overcapacity situation, but as time past demand has caught up. The resulting congestion produces delays and along with higher fuel costs and other factors, drives up freight rates.

U.S. Rail Capacity. The railroads are also experiencing capacity constraints. Rail ton miles have increased by approximately 14 percent between 2002 and 2005. To balance the desirability of traffic increases with the perceived scarcity of capital North American railroads will continue to add capacity just barely ahead of demand—and sometimes behind demand.

Where the inland or coastal waterway systems are alternatives to highway and rail transport constraints on inland capacity should sustain if not expand the need for domestic maritime transportation. The inland modes also serve as a complement to the marine mode, however, and it may be difficult to expand inland or deep-sea shipping without landside access and capacity.

Fuel Price Impacts. Expected rises in fuel prices are unlikely to shift much new traffic to the inland waterways. The most recent Annual Energy Outlook published by the Energy Information Administration anticipates that distillate (diesel) fuel prices will actually decline at an average rate of 0.2 percent annually between 2005 and 2030, leaving the 2030 price 6 percent lower than in 2005. Residual fuel (bunker) prices, however, are expected to rise at a rate of 1.6 percent annually, yielding a 50 percent cost increase by 2030. This increase will disadvantage those maritime operations still using bunker fuel rather than diesel.

The impact of fuel price changes is unlikely to tip the competitive balance between barge and rail significantly, especially with the relatively stable fuel prices being forecast. It is generally agreed that waterborne transportation, particularly barging, is more fuel-efficient than rail, which is in turn more fuel efficient than truck. Rail unit trains that compete directly with large-scale barge movements, however, are more fuel efficient than barges by Congressional Budget Office (CBO) estimates.

ES.3.3 Minimal Technology Impacts

Maritime technology trends are not likely to have much impact on USACE responsibilities. Radio frequency identification (RFID), for example, is a supply chain technology that may affect the movement of goods through warehouses or marine terminals, but will not have an impact on infrastructure needs. Advanced container crane designs may enable terminals to turn inbound vessels faster, but their impact on USACE projects would only be perhaps a slight postponement of terminal expansion needs. Shipbuilding technologies that permit construction of larger vessels will contribute to the influx of larger container ships. That trend is considered in a separate section.

Electronic Navigation Aids and Information Technology. One area in which technology has potential implications for USACE projects is electronic navigation aids and the application of information technology to vessel operations. For example, vessels typically require at least 3 feet

of under keel clearance to allow for variations in the channel bottom and in vessel trim. If better information would allow vessels to sail at 2 feet above a more precisely known channel bottom, dredging needs would be reduced. The Load Max system used on the Columbia River is an example of such an application. Improved mathematical/computer models of harbors and their dynamics would contribute to the utility and application of navigation aids.

Agile Ports. The term "agile port" has taken on many shades of meaning from a precise definition tied to military deployment to a generalized notion of increased port efficiency linked to inland transport. The objective of agile port operations is to reduce container dwell time at port terminals and increase their throughput capacity. The core of the concept is rail transfer of unsorted inland containers from vessel to an inland point where sorting takes place. The agile port concept trades off additional cost (handling) and inland space for increased port throughput. While elements of efficient marine terminal concepts have been implemented at conventional marine terminals, the agile port concept as a whole has yet to be implemented anywhere. Few if any ports have the available terminal space to devote to an agile port terminal for which there is not an obvious commercial demand. The rapid loading/unloading technology and accompanying vessels are almost certainly feasible, but would require costly development and up-front commitment. No sponsors have stepped forward.

FastShip. FastShip is a proposed high-speed transatlantic container service using "agile port" terminals and gas-turbine powered "Jet Ships." The FastShip proposal, however, appears likely to fall short of real-world implementation. In September 2006, FastShip announced plans to issue a tender in November 2006 for 1.3 million tons of trans-Atlantic capacity. The tender was not issued as of mid-December 2006.

ES.3.4 Minimal Security Impacts

The enormously increased marine transportation security measures introduced since 2001 add friction or drag to the growth of trade and will likely retard it to some extent. For shippers and consignees cargo security is an added cost of doing business. Cargo, port and vessel security programs will also continue to divert resources from port infrastructure needs. Since 9/11, over $708 million has been allocated in grants to facilities for security programs. The Security and Accountability for Every Port Act (SAFE) consolidates the authority and mandate for a number of the U.S. Department of Homeland Security (DHS) port-related programs. Total DHS discretionary spending is budgeted at about $34.8 billion. A base case view would call for steady, deliberate implementation of additional security measures. Overreaction to incidents or other stimuli could lead to disruptive and costly interventions.

ES.4 Container Shipping Trends

ES.4.1 Containerized Trade Growth

Since 1980, U.S. containerized trade has grown at an average annual rate of 6.3 percent (Exhibit ES.5).

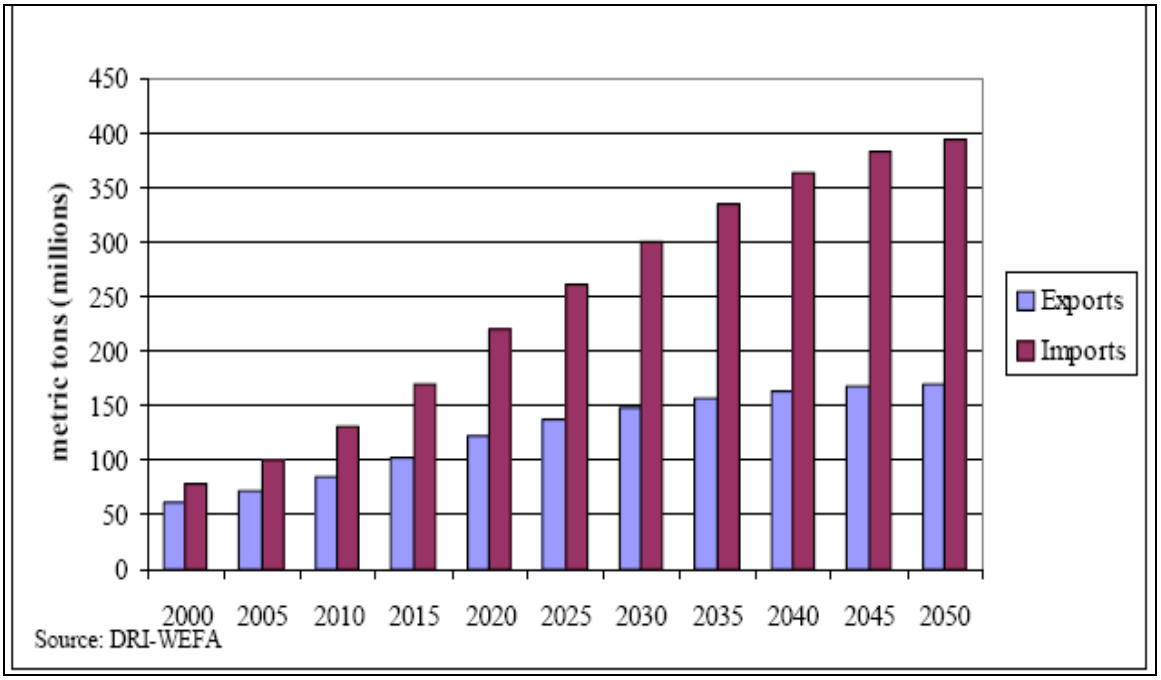


EXHIBIT ES.5
CONTAINERIZED TRADE GROWTH

The near term outlook is for slightly faster growth but returning to similar rates beyond 2010. In broad terms, the growth trends will continue.

As Exhibit ES.6 suggests, container trade through Pacific Coast parts has been growing faster, at an average of 6.8 percent annually. Atlantic Coast container trade has grown at 5.5 percent; Gulf container trade has grown at 5.4 percent.

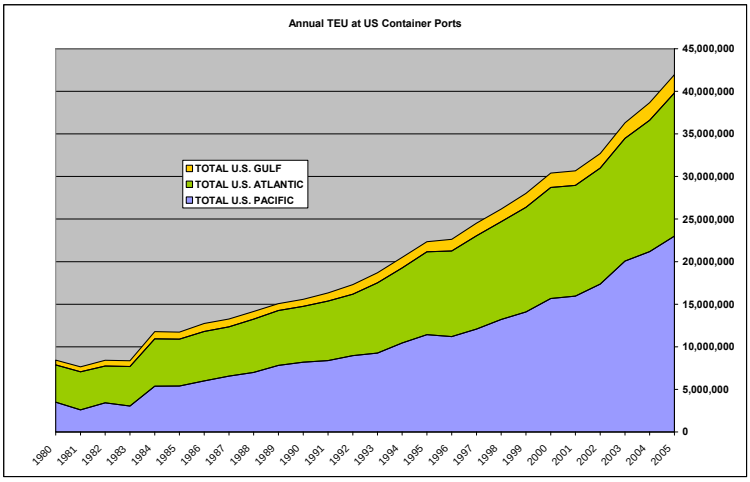


EXHIBIT ES.6
COASTAL CONTAINER TRADE GROWTH

ES.4.2 Larger Container Vessels

Container vessels are becoming larger, faster, "greener" and capable of carrying more refrigerated cargo. Future vessel sizes, drafts and deployments will translate directly into demands for maintenance dredging and channel deepening. Every port would like to handle every ship and project sponsors invariably cite increasing vessel sizes in dredging project justifications.

Sizes and Drafts. The maximum and average size of container ships will continue to increase. The container vessel fleet changes slowly, however, despite the attention given to the newest largest vessels, smaller vessels are still being built and deployed. The most recent 2006 new buildings for Maersk are 13,000+ TEU with 52-foot draft , but the upward trend is by no means uniform. A comparison of the 2000 and 2005 container vessel order books reveals that the distribution has shifted upward, yet over half the vessels on order in 2005 were under 4,000 TEU. Some observers suggest that container vessel sizes will likely max out at 12,000 TEU for transpacific and transatlantic trades, but will reach 18,000 TEU (Malacca max) for the Europe/Asia trade. The general trend in deployment of new container vessels is well known and has persisted for some time.

- The newest large vessels (currently 10,000+ TEU) are deployed in the Asia-Europe trade where the long voyages can best exploit lower operating costs and scale economies. These vessels can transit the Suez Canal but not the Panama Canal.

- The next-largest vessels (currently 4,000 to 8,000 TEU) are deployed in the Transpacific, which also receives the former Asia-Europe vessels displaced by larger ships. Transpacific trade growth has regularly absorbed the increased capacity. These "post-Panamax" vessels over 4,000 TEU generally cannot transit the Panama Canal.

- The smallest vessels, less than 3,000 TEU, were typically deployed in smaller trades with shorter voyages. Some carriers have used smaller vessels in "second string" services to smaller ports.

The larger vessels being displaced from the Asia-Europe and Transpacific trades can have drafts of over 40 feet, limiting their deployment at some ports.

The Mercator study[1] completed for the Ports of Los Angeles and Long Beach does not foresee 10,000+ TEU vessels with 48 foot drafts arriving in Southern California until 2015 and then only in small numbers. The 10,000 TEU vessels being built and any larger ones to follow will be deployed in the Europe-Asia trade and the 8,000 TEU vessels being used in that trade will cascade into the Transpacific. Most other ports on the West Coast have or will soon have sufficient draft for 10,000+ TEU vessels. This is particularly true if the added vessel capacity is gained by increasing width at the same or small draft.

The growing size of containerships is shifting the relationship between vessel dimensions and capacity in TEU, with potential impacts on berthing and dredging requirements. The

[1] *Forecast of Container Vessel Specifications and Port Calls*, Mercator Transport Group, 2005.

logarithmic trend line shown in Exhibit ES.7 suggests that dredging may not be an indefinite task: current and proposed designs are topping out at about 15.5 meters (50 to 51 feet). From a national perspective, therefore, there does not seem to be a near-term barrier to the scale economies of larger vessels.

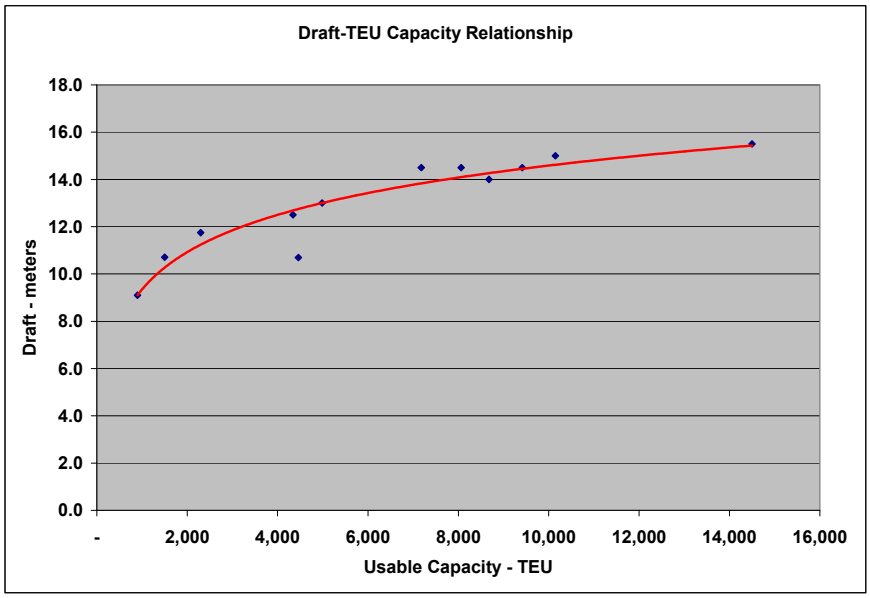


EXHIBIT ES.7
DRAFT-TEU CAPACITY RELATIONSHIP FOR REPRESENTATIVE VESSEL DESIGNS

Speed. Along with the increase in container vessel size has come an increase in speed. Besides offering faster transit times the faster vessels allow carriers to operate services with fewer ships.

Greening. The transpacific and transatlantic fleets will become "greener" (e.g., more environmentally friendly). The strong Southern California efforts to reduce emissions from vessels of all kinds will likely spread to other ports on the West Coast and eventually to much of the nation. Provisions for "cold ironing" – shutting down main engines in port and using shore power for electricity – are costly and have been greeted with wariness by other port regions.

ES.4.3 Load Centering

Load centering was a widely discussed "trend" in the 1990s that never had much impact. The advent of containerized "megaships" in the 6,000 to 8,000 TEU range was expected by many observers to concentrate cargo in a few coastal "load centers" with truck, rail or vessel feeders to smaller ports. Instead, rapid cargo growth and fleet expansion has led to "megaship" services at multiple ports as major carriers and alliances attempt to provide direct service in every market. The few ports that may have been victims of load centering include Portland, Oregon and Boston, both of which have had trouble holding on to multiple container lines. Load centering as a strategy has had more validity in Europe and Asia where marine feeder services are well developed. In North America any tendency toward "load centering" has been superseded by capacity concerns at the largest ports and expansion in secondary markets.

ES.4.4 Liner Trade Consolidation

The container shipping industry continues to consolidate more business in fewer firms and this trend is expected to continue indefinitely. As of late 2005, the 10 largest carriers controlled 72 percent of the world container fleet capacity. The overall size and trade coverage of the largest carriers and alliances permits them to exploit the scale economies of very large vessels. The volume of trade under single control also enables to justify separate all-water and Suez services on an economic scale. Finally, the largest carriers, have the internal financial strength and cargo volume to participate directly in development of new port terminals.

ES.4.5 Containerization of Break-Bulk Cargo

The world's merchandise trade is effectively containerized. The remaining break-bulk commodities mostly consist of items that either do not fit in conventional containers or can be more efficiently handled by other means. Over the years the list of such commodities has been shrinking and the remaining break-bulk trades are focused on steel, lumber, machinery, newsprint and project cargoes. The imbalance in major U.S. container trades continues to maintain low export rates and encourage containerization. The break-bulk sector continues to shrink in terms of commodities carried. Port and channel requirements of break-bulk vessels may be short-lived. USACE projects to accommodate such trades must acknowledge the potential volatility and risk.

Over time, more and more of the refrigerated tonnage is moving in containers. This is a strong trend as the products are shifted from conventional bulk reefer ships into boxes. In 1985, 80 percent of the world's refrigerated cargo was carried in conventional reefer ships. In 2005, only 43 percent of the reefer cargo volume was carried on conventional reefer ships. The number of new reefer ships continues to drop and the fleet is dwindling with the advanced age of the older vessels.

ES.5 Bulk Shipping Trends

The bulk trades lack the strong growth expected in the container trades. Most dry and liquid bulk commodities are handled at specialized private terminals rather than public ports. Marked growth is likely to be localized. Specific bulk movements can be volatile, starting and stopping based on currency values and the strategic choices of individual importers and exporters. The major driver of bulk shipping is the petroleum trade. The rest of the trade consists of grain, coal, iron ore, petroleum products and many other less prominent commodities.

As of the National Dredging Needs Study, the dry bulk trade was expected to grow at about 3.5 percent annually between 2005 and 2050, with enough balance between imports and exports (Exhibit ES.8).

The National Dredging Needs Study anticipated that tanker trade would peak in 2025 to 2030 and decline slightly to 2050 (Exhibit ES.9). The decline was anticipated due to increased fuel efficiency, competition from natural gas, domestic production and other influences.

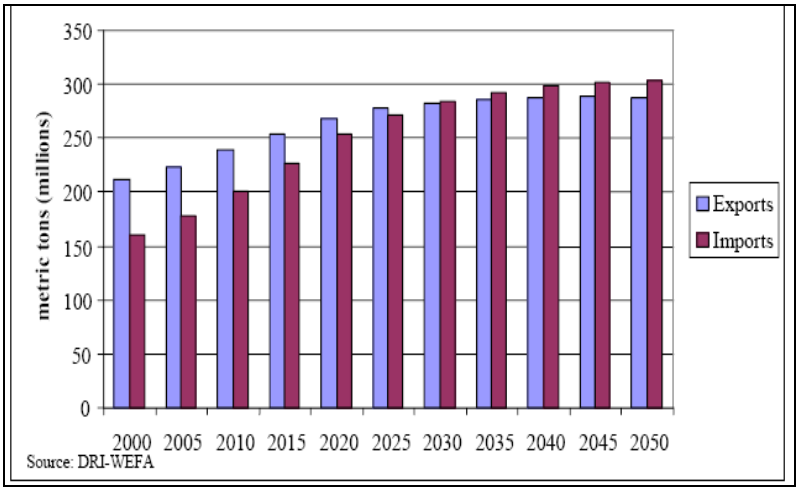


EXHIBIT ES.8
U.S. DRY BULK TRADE

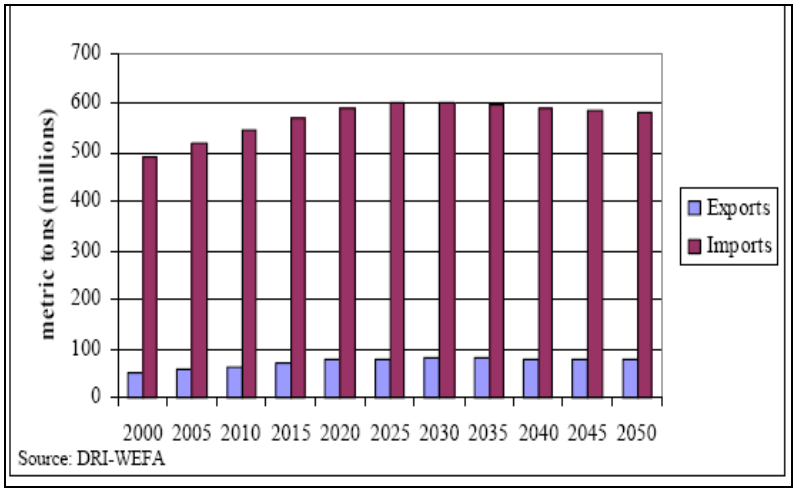


EXHIBIT ES.9
U.S. TANKER TRADE

Regional Resource Supply. Resource exhaustion can dramatically increase bulk import flows in a short period, with much more shipping demand than would be predicted on the basis of cargo history and demand growth. Where regional resources have been exhausted or cannot be expanded for environmental reasons the gap is being filled by imports. Candidate commodities include sand and gravel, cement and lumber. As the issue is local or regional, it will be difficult to predict on a national basis.

ES.5.1 Bulk Vessel Shifts

There has been a general increase in vessel size across the board but the transfer and bulk orders have varied considerably compared to the clear trend in container ships. In the bulk vessel fleet, the Supramax and Capesize categories will grow, pending Suez and Panama expansions. A Supramax vessel is typically about 52,000 pounds dry-weight tonnage (DWT). Handymax dry bulk vessels range in size from 35,000 to 60,000 DWT and transport a broad range of major and minor bulk cargoes, including iron ore, coal, grain, cement and fertilizer. The average age of Handymax vessels is about 15 years. The Handysize category of 43,000 pounds DWT is expected fade due to the age of the fleet, replaced by specialized vessels where needed. The key issue for USACE is likely to be the draft requirements of Supramax (typically 42 feet, plus 3 feet of clearance or 45 feet total) versus Handymax bulk vessels (typically 39 feet plus 3 feet of clearance or 42 feet total). Because bulk vessel deployments are determined by specific commodity movements conditions may vary widely.

ES.5.2 Liquid Natural Gas Shipping

Escalating demand for natural gas as an economical and relatively "green" fuel is leading to rapid expansion of the Liquid Natural Gas (LNG) shipping sector. LNG terminals and vessel operations, however, are completely separate from other port and vessel operations. Industry observers have noted that potential projects are announced frequently and others are cancelled just as frequently. It will be difficult to predict which projects will actually be implemented. The impact on USACE responsibilities would primarily be in the issue of draft.

ES.6 Inland Waterways Trends

ES.6.1 Domestic Shipping Volume

The trend in domestic water ton miles presents a complex story. From 1985 through 2004 tonnage on U.S. inland and coastal waterways has grown at an average of just 1.4 percent annually. As suggested by Exhibit ES.10, that growth took place prior to 1995 and waterway tonnage has been essentially flat since. Ton miles are down for the coastwise segment reflecting the decline in production of Alaskan crude oil. More specifically, in 2004 pre-Katrina, internal volumes were approximately 7 percent below the peak of 1995.

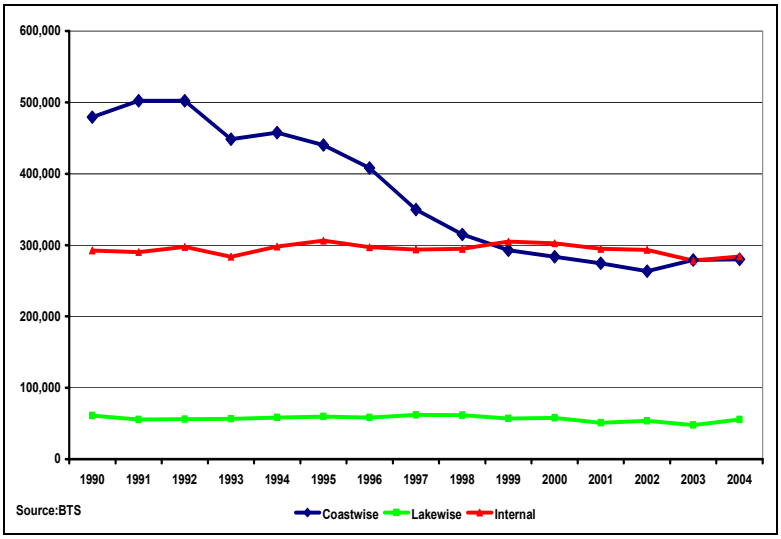


EXHIBIT ES.10
U.S. DOMESTIC WATERBORNE TON-MILES
(millions)

A review of the Waterborne Commerce tonnage statistics shows that inland commerce was growing in 2004 and 2005 prior to Katrina.[2] This positive trend reflected the overall growth trend in surface freight transportation. Katrina clearly depressed the volume at the end of 2005 and recovery continues well into 2006. Tonnage in second quarter 2006 was still 7 percent below second quarter 2005 but has been trending upward. Indications are present, particularly current rate levels and barge construction activity, which indicate that the tight market conditions in the rail and highway modes are now also being experienced in the barge industry. Inland waterway tonnage will likely be constrained by the underlying growth of the commodities that make up most of the large business: coal, petroleum and products, grain, steel, chemicals and minerals. The major commodities supporting inland waterway tonnage have mixed outlooks in the long term. None are expected to either grow or decline dramatically and all are subject to outside influences ranging from rail competition to diversion of end uses. USACE will have to periodically monitor commodity projections and evaluate the risks of specific commodity flows drying up.

ES.6.2 Inland Waterways Business Conditions

The U.S. barge industry itself is experiencing variable business conditions that may affect the long-term inland waterways tonnage outlook. Poor profits in prior years led to widespread scrapping of older barges and few replacements. The total U.S. fleet of covered barges has reportedly shrunk 12 percent since 2000[3]. More recent upswings in demand have reportedly pushed up barge rates by 45 percent[4] and filled the order book for new barges. Hurricanes Rita and Katrina and the subsequent reconstruction have drawn off a significant part of the barge industry labor force, increasing costs and reducing capacity. These "boom and bust" conditions are unlikely to contribute to the industry's long-term health.

These reports are entirely consistent with the overall trend in the surface freight industry described above. Strong demand relative to capacity means the tug and barge industry is obtaining higher rates than previously possible and expanding capacity to meet the market opportunity.

ES.6.3 Waterway System Funding

The greatest concern of the inland waterways industry appears to be funding maintenance and modernization of infrastructure rather than accommodating growth. The House passed a new Water Resources Development Act (HR 2864) in 2005 and the Senate passed the bill in the summer of 2006. The Senate and House are working to compromise differences in the two bills. The June 2005 version of HR 2864 allows $1.8 billion for seven new 1,200 foot locks on the Upper Mississippi. Regardless of the outcome, over the long term it is clear that any work on the inland waterway system that increases or maintains capacity for commerce will be difficult and therefore slow to implement.

[2] U.S. Army Corps of Engineers Waterborne Commerce Statistics Center.
[3] Informa Economics.
[4] Darrel Good, University of Illinois Extension.

ES.6.4 Short-Sea Shipping Initiatives

Despite a swell of public sector and industry interest after the 2004 peak season congestion in Southern California no upward trend in short-sea shipping (SSS) has emerged. Efforts to increase inland waterways traffic through SSS or container on barge (COB) initiatives have yet to bear fruit and the real potential of these efforts is open to question. The much-heralded Albany-New York container on barge service initiated as part of PANYNJs Port Inland Distribution network (PIDN) was recently discontinued.

Four case studies completed for U.S. Department of Transportation (USDOT) in August 2006 yielded mixed results with few clear advantages for SSS over truck or rail intermodal alternatives "Status quo" short-sea options did not yield a competitive advantage in any of the four cases studied. The "best in class" short-sea options could offer significant cost savings only at substantial transit time penalties. Stakeholders interviewed for the study were concerned over reliability, the high costs of U.S. shipbuilding required under the Jones Act and the adverse impacts of the Harbor Maintenance Tax.

ES.6.5 Great Lakes

Domestic and U.S.-Canadian tonnage on the Great Lakes themselves has grown at an annual average rate of just 1.0 percent for the last 20 years and shows no prospect for dramatic change in the near future. The Great Lakes Navigation Study, now underway, is intended to address a wide range of issues facing the Great Lakes and the St. Lawrence Seaway.

- Draft loss due to the long delays in maintenance dredging.
- Growing use of Integrated Tug-Barge vessels (ITBs), which typically require less draft and may reflect carrier strategies for coping with draft loss.
- The outlook for a second "Poe-sized" lock. The Poe Lock is the only one able to handle the 1,000-foot lakers that together provide about 70 percent of the United States' fleet capacity on the lakes.

ES.7 Panama Canal

Perhaps the greatest source of uncertainty and speculation in deep-sea shipping is the future of the Panama Canal. The capacity of the Panama Canal is limited by width and total throughput.

- The width of the canal limits "Panamax" vessels to a width of 105 feet. Larger "post-Panamax" bulk and container vessels exceed this limit and cannot use the Canal.
- The throughput capacity of the two sets of locks and the narrower parts of the Canal restricts vessel transits to 23 per day.

The Canal will reach its throughput limit in the near future, leading to capacity rationalization and higher transit fees. The Panama Canal will become increasingly congested as it approaches capacity in the next 2 to 3 years. The following scenarios appear possible.

- Capacity restrictions, reduced reliability and higher costs due to increased transit fees will blunt cargo growth in the all-water Asia-USEC trade. Mini-landbridge services through the West Coast will regain share.

- Allocation policies favoring high-revenue container vessels will reduce the available capacity for bulk and break-bulk trades, forcing changes in underlying cargo flows and changes in U.S. port calls.

The Panama Canal Authority (ACP) plans a major Canal expansion including a third set of parallel locks and selected deepening and widening of existing channels. The expansion would effectively double capacity of the Canal and allow it to handle much larger vessels. The current situation and expansion proposal together raise a number of uncertainties.

- Now that the expansion has been approved, how long will it take the ACP to raise funds and begin construction?

- Projects of this magnitude are rarely completed as scheduled. When will the third set of locks actually open?

- Projects of this magnitude usually exceed their budget, even with contingency reserves. How much will the expansion actually cost and what are the implications for transit fees?

- What happens in the 6 years or more between 2008 to 2009 when the Canal reaches its existing capacity and 2015 or beyond when the third set of locks opens?

ES.8 Port Trends

Major U.S. (and Canadian) ports will expand within existing outlines; expansion through fill or on new land will be rare. Major ports will gradually phase out ancillary and non-cargo functions within their borders to focus on major cargo handling capabilities. Ports will operate closer to capacity and will be more vulnerable to disruption.

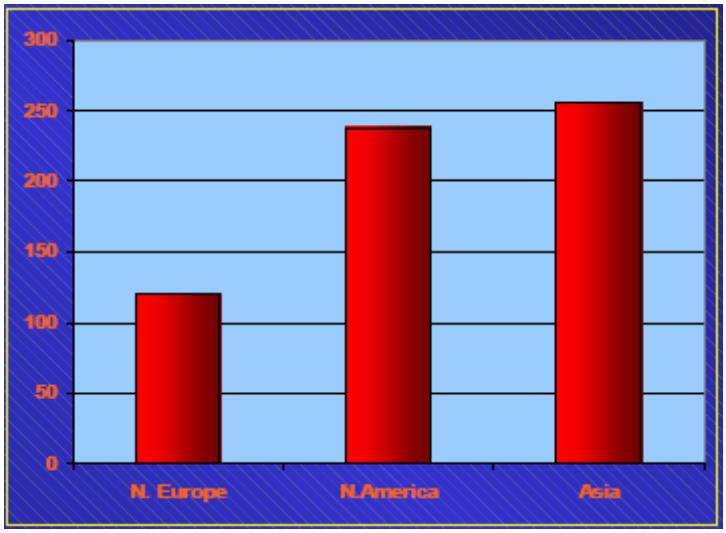


EXHIBIT ES.11
COMPARATIVE TERMINAL COSTS PER CONTAINER

ES.8.1 Container Port Capacity and Productivity

United States container terminals are frequently disparaged for being less "productive" than the leading Asian and European terminals in terms of annual TEU per acre. This criticism has always been

misplaced and obscures key facts and trends. U.S. ports compare very favorably with Asian and European ports in total throughput and cost per TEU, measures more important to the industry than TEU per acre. As Exhibit ES.11 shows, average North American costs per TEU are below average Asian costs.

The San Pedro Bay ports of Los Angeles and Long Beach handled a very large share of total U.S. container trade and are a bellwether for the industry. While the San Pedro Bay ports averaged 5,275 TEU per acre for 2005 as a whole, they averaged 537 TEU per acre in the peak month of October—the equivalent of 6,450 annual TEU per acre. The San Pedro Bay ports as a whole have significant latent capacity within existing boundaries.

- Conversion from wheeled operations (containers parked in chassis) to stacked operations can improve throughput per acre substantially.
- Pooling chassis and moving chassis storage and empty container storage off-terminal can free up terminal space for cargo handling.
- Extended gate and operating hours will likewise improve throughput.

Were the ports of Los Angeles and Long Beach really at capacity there would be little point in deepening drafts to handle ever-larger vessels. With apparent latent capacity, expansion of trade at San Pedro Bay is both possible and expected, along with eventual use of larger vessels. The latent capacity at San Pedro Bay also implies that Canadian and Mexican port expansion predicated on "overflow" from congested Southern California ports may be bound for disappointment.

With a need to increase overall throughput and limited expansion room, U.S. ports of all types are increasingly pursuing operational refinements, smaller-scale capital improvements and other methods of maximizing productivity of existing terminals. Successful expansion at San Pedro Bay and elsewhere will require alignment of efforts and coordinated action by multiple parties. Given the sometimes fragility of cooperative industry efforts and public-private understandings, both the timing of successful expansion and the expansion itself are somewhat uncertain.

ES.8.2 Public-Private Partnerships

Within the port industry, examples of public-private cooperation predate the broader "partnership" trend and will likely gain momentum despite the limited success elsewhere. Joint-venturing between port authorities and terminal operators has taken hold in port terminal development. This trend is attributable to:

- Emergence of large, global marine terminal operators who can finance and sustain multiyear development efforts and profit from the outcome.
- Customers (ocean carriers) who can make long-term commitments to capacity being developed (Sometimes these are the parent companies to the terminal developers.)
- Unambiguous long-term demand with known economics.

Public-private partnerships are viable in the port industry and their importance will likely increase. They will not be a major source of transportation infrastructure funding in other sectors, but will likely see niche applications.

ES.8.3 Port Consolidation and Coordination

Port consolidation and cooperation are frequently proposed in states such as Washington and California with major competing ports and no single state port authority. Consolidation is typically proposed as an antidote for what critics see as "wasteful" competition between ports (but which shippers and carriers regard as "healthy" competition). Claims are also made for potential efficiency improvements that might better be termed rationalization benefits. Although there are thus multiple reasons advanced for cooperation or consolidation between ports, there may be limited scope for actual combinations. Many states already have single port authorities. In regions such as the Columbia River or San Francisco Bay the ports tend to be specialists with their own niches. Under those circumstances the benefits of consolidation are limited.

ES.8.4 Break-Bulk Terminals

"Break-bulk" cargoes are what remains of maritime trade that is neither handled in bulk or containerized, or driven off ro-ro vessels. Major break-bulk commodities include lumber, steel and newsprint. "Project cargoes" include movements of assembled machinery, heavy lift items, outsized shipments and other one-time or short-term cargo flows usually handled in the same terminal as break-bulk trade. For large container ports under pressure to increase capacity, the question is whether the lower productivity of general cargo terminals can justify their continued existence. The volatility of break-bulk and project cargoes translates directly into uncertainty for dredging and navigation projects. The uncertainty can be particularly acute for terminals handling project cargoes. Project cargoes tend to be linked to regional public or private infrastructure initiatives and can dry up for months or years at a time, jeopardizing the financial health of the terminal and port.

ES.8.5 West Coast Port Competition

Every West Coast U.S., Canadian and Mexican port has expansion plans designed to increase market share and competitive position. The outcome of this competition combined with the influx of very large container ships will determine the long-term need for West Coast port dredging.

As noted above, only if the ports of Los Angeles and Long Beach can sustain growing container trade will there eventually be a regular need to handle very large container ships there. Many industry observers interpreted the 2004 peak season congestion as a sign that the ports of Los Angeles and Long Beach had reached capacity. Yet the two ports handled additional traffic in 2005 and 2006 without comparable problems. As the preceding section points out the San Pedro Bay ports have substantial latent capacity within their existing outlines and they also have some room to expand physically. If San Pedro Bay can sustain another decade or so of trade growth, carriers may find it advantageous to serve the ports of Los Angeles and Long Beach with larger vessels cascaded from the Asia-Europe trade or built for the purpose. If so, there maybe a demand for dredging San Pedro Bay channels and berths to perhaps 53 feet (50 feet of draft and 3 feet of underkeel clearance).

The ports of Los Angeles and Long Beach will plateau when and if the ports, terminal operators and railroads are no longer able to make incremental productivity improvements. The limit is political and institutional, not technical. If San Pedro Bay tops out, the alternatives to San Pedro Bay include:

- The U.S. ports of Oakland, Seattle, Tacoma and (to a lesser extent) Portland;
- The British Columbia ports of Vancouver (including Deltaport) and Prince Rupert;
- The Mexican ports of Lazaro Cardenas and Manzanillo (and perhaps others); and
- All-water service via the Panama Canal. (The Suez Canal routing option depends on growth of Indian exports and is not included in this discussion.)

When and if the ports of Los Angeles and Long Beach plateaus, the overflow traffic would probably go first to Tacoma and then to either Vancouver/Deltaport or Oakland, depending on which is ready first. Most likely, the overflow traffic would be split among the three ports. Prince Rupert, if successful, would be a fourth alternative. The Panama Canal and the Mexican Ports are more distant alternatives. The issue comes down to timing.

- By 2008, Oakland's dredging program, Deltaport's expansion and Prince Rupert's development should all be complete, providing multiple alternatives to the Ports of Los Angeles and Long Beach.
- By 2010 the Panama Canal will likely be out of capacity, eliminating it as an option for additional diversions.
- By 2010, Prince Rupert will have either proven itself or not and Oakland will likely have additional rail capacity.
- In 2014, the new Panama Canal locks are planned to open.
- In 2015, the Mercator study expects 10,000 to 12,000 TEU vessels to start calling the ports of Los Angeles and Long Beach. Only a few terminals can handle them.
- In 2020 Mercator forecasts 11 weekly calls by 10,000 to 12,000 TEU vessels at the ports of Los Angeles and Long Beach, implying need to dredge at least some of the terminals to provide a uniform 50 feet of draft or more.

There are multiple uncertainties in this scenario.

- The ability of the ports of Los Angeles and Long Beach to make incremental productivity improvements within existing and available space.
- The ability of Oakland and Vancouver to add capacity as scheduled.
- The ability of Prince Rupert to attract substantial trade that might otherwise have used the ports of Los Angeles and Long Beach.

- The ability of the Panama Canal Authority to handle growing traffic and build a third set of locks on schedule.

- The actual development pattern of Mexican ports and Mexican trade.

ES.8.6 East Coast Port Competition

Container port competition on the East Coast is, if anything, more intense than on the West Coast. There are more ports, they are closer together and there is less total cargo to fight over. Each port's market share with and without dredging depends on:

- Competition with other East Coast ports for local and regional trade;
- Competition with West Coast ports for regional and national trade; and
- Ocean carrier routing and capacity deployment practices.

East Coast ports are seeing diversions from the West Coast (e.g., the ports of Los Angeles and Long Beach) as a major component of their growth potential. The all-water route through the Panama Canal has captured a growing share of the Asia-U.S. East Coast market. Available estimates suggest that as of 2004 the Panama Canal route had about 23 percent of the cargo. As 2004 was the year of dramatic congestion in Southern California, it is likely that the all-water share grew further in 2005 as customers sought alternatives to mini-landbridge service. Growth in all-water Asia-U.S. East Coast services will likely slow in the next few years as the Panama Canal reaches capacity, tolls rise and reliability declines.

- The serious, well-documented Southern California port congestion during the 2004 peak season was not repeated in 2005 or 2006, reducing the impetus to seek all-water routings.

- Ocean carriers have been limited in their ability to expand Panama Canal services by a tight charter market with a shortage of available Panamax ships. The Panama Canal has limited room for growth. Panama Canal Authority forecasts anticipate 3 percent growth in container traffic through 2025 without capacity expansion and 6 percent with additional capacity.

There are three scenarios that could bring larger vessels to the East Coast ports.

Larger Vessels Transiting the Current Panama Canal Locks in the Asia-U.S. East Coast Trade. As noted in the Panama discussion the Canal is becoming congested and may be out of capacity for more transits by 2008 to 2010. If container ship operators want to increase capacity, they will have to either maximize the vessel dimensions or supplant other kinds of vessel transits. Maximum Canal vessel draft is 39.5 feet, which requires 43 feet of water to provide 3 feet of underkeel clearance. Maximizing vessel size and draft through the Canal could disadvantage ports such as New York/New Jersey and Philadelphia which have just 40 feet of draft in some locations.

Larger Vessels Transiting New Panama Canal Locks. The new set of locks is designed to provide 52 feet of draft, allowing vessels larger than can be accommodated at East Coast ports. NY/NJ and Norfolk (Virginia) would be able to handle the largest vessels if the improvements listed are implemented.

Larger Vessels in Suez Canal Services. A major shift in the Asian manufacturing and exporting "centroid" to the Indian Subcontinent could conceivably result in the deployment of large (10,000+ TEU vessels in the Suez Canal routes to the U.S. East Coast. To fill such vessels, however, East Coast ports would also have to handle intermodal cargo for the rest of the nation. The East Coast ports may find that intermodal rail capacity, rather than draft, becomes a limiting factor.

ES.9 Gulf Port Trends

Ten of the twelve highest-tonnage U.S. ports are Gulf ports. Two factors account for the high tonnages moved through Gulf ports.

- Massive concentrations of crude petroleum, petroleum products, grain, minerals and other heavy bulk cargoes.
- Large domestic cargo shares averaging 42 percent of the total at Gulf ports (and at NY/NJ) versus 18 percent at LA/LB.

For the immediate future, discussions regarding Gulf ports will be prefaced by discussions of the impacts of Hurricanes Katrina and Rita. While most ports have recovered their cargo volumes, the storms resulted in large diversions of USACE funds from improvements and maintenance to repair and restoration. In the absence of increased regional funding from Congress, the diversion of resources will delay planned channel improvements.

ES.10 Climate Change: Global Warming

Global warming remains a contentious issue with multiple unknowns. While global warming appears to be generally accepted as a reality, its causes, magnitude and effects are still imperfectly understood. The most prominent anticipated impacts of global warming include increased flooding, increases in storms, higher sea level, opening of the Northwest Passage and changing water levels in inland waterways. It is impossible to determine what actions mankind will take to reduce global warming or what impact those actions will have.

ES.10.1 Increased Flooding and Storms

The "100-year flood" is a widely used design benchmark for water-related infrastructure ranging from drainage ditches to levee systems. Global climate change is expected to result in increased frequency of heavy flooding in many areas, effectively invalidating statistical estimates of 100-year floods. From the perspective of the MTS, floods are a source of disruption. Higher than expected water levels in navigable waterways are dangerous and lead to accidents and closures. Floods damage maritime infrastructure and leave debris in channels, disrupting marine transportation even after the waters have receded. Increased flooding will also lead to relocations of manufacturing plants and distribution centers, with secondary implications for marine transportation. Global warming is expected to increase the frequency and magnitude of storms, including hurricanes. For marine transportation storms equate to disruption and damage.

- The transportation industry can adapt to more frequent storms and floods in several ways.
- Increasing inventories and safety stocks to buffer the impact of more frequent service disruptions in transportation of all types.
- Changing vessel routes and port calls to reduce exposure in storm-prone regions such as the South Atlantic and Gulf Coasts.
- Strengthen infrastructure in storm-prone areas.
- Increase use of sophisticated weather prediction systems.

All of these steps will increase costs and therefore reduce trade to some extent, perhaps insignificantly. More frequent floods and larger storms will increase weather-related damage to port and waterway infrastructure. The outcomes will likely include:

- Demands for USACE to buffer or mitigate the impacts.
- Increased costs to port authorities, marine terminal operators, ocean carriers, shippers and USACE associated with damage to infrastructure and equipment.
- A tendency to withdraw service and cargo from ports and routes suffering greater and more frequent damage.

One possibility is the emergence of a reduced "shipping season" for the areas most affected, just as the Great lakes and Upper Mississippi have a reduced season due to ice in the winter.

ES.10.2 Inland Waterways Water Level

Global warming is likely to change the timing and frequency of both low-flow and flood events in ways that cannot yet be predicted with confidence. The IWR study found that different climate models gave different results. A 2005 IWR study[5] of climate change impacts on the Middle Mississippi focused on water flow changes and economic impacts. The study found that in the past low-flow events that disrupt barge and river transportation occurred most frequently in December, January and October. The frequency of winter low-flow events has decreased since the 1960s and can be expected to decline further as global warming yields less snow and more rain. Some models suggest that the flood season will shift from spring to summer while others do not.

ES.10.3 Rising Sea Level

World wide sea level has been rising at the rate of roughly 3 millimeters per year since 1995. Weather models suggest continuation of this trend at a similar rate. The expected rate of 3 mm per year translates roughly into 1 foot each 100 years. The rise will have effects on shoreside structures and environments, ports and vessel operations. Where USACE has responsibilities in such areas there can be widely differing needs for repair, upgrades or replacement. Vessel

[5] Climate Impacts on Inland Waterways. IWR, July 2005.

operations may be made slightly easier or slightly harder. A rising sea level will provide slightly greater draft. The combination of warmer water and decreased salinity (from increased freshwater run-off), however, will decrease vessel buoyancy, offsetting the added draft from sea level rise. The broad impacts of sea level rise on the MTS are likely to be gradual and small. The USACE may need to anticipate predictable climatic impacts as part of the EIR/EIS process.

ES.10.4 Northwest Passage Opening

Opening of the Northwest Passage across the top of Canada between the Pacific and Atlantic oceans (Exhibit ES.12) would be the single most dramatic result of global warming and would have substantial impact on world shipping patterns.

EXHIBIT ES.12
NORTHWEST PASSAGE

The Northwest Passage would create a short-cut between Europe and Northern Asia, saving between 2,500 to 4,000 miles compared to the Panama Canal route (and avoiding canal tolls). Diversion of Europe-Asia trade to the Northwest Passage would open up Panama Canal capacity for other trades, notably the all-water Asia-East Coast trade. Canal tolls might be reduced as well. The Northwest Passage itself would not be as useful for U.S.-Asia trade. By freeing up Panama Canal capacity, the availability of the Northwest Passage to Europe-Asia trade could increase the volume of all-water Asia-East Coast cargo and thus the pressure on U.S. East Coast ports. The date at which the Northwest Passage would be available to commercial shipping, however, is highly speculative. Estimates run from as soon as 2015 (the year after the scheduled opening of new Panama Canal locks) to 2090.

ES.11 Shifting Roles

The USACE will likely have an indefinite future backlog of meritorious and perhaps economically cost-beneficial projects. Funding may be less of a constraint than approval, since the difficulty of approving projects has kept many organizations from spending the available funds. The critical steps for future project delivery will likely be:

- Alignment with local and regional plans and priorities;
- Coalition-building to combine and coordinate resources; and
- Consensus building on environmental impacts and mitigations.

The decreased ability of USACE, ports and other public agencies to fund, approve and complete projects in a timely fashion is creating both an incentive and a power vacuum. In the most contentious environment, namely California, the approval process itself is the governing factor since technical input and funding together are still not enough to get the project built.

Federal Role. Although remaining the official project leads, Federal agencies such as USACE will no longer dominate the project initiation, approval and delivery process. Federal approval processes have institutionalized crucial roles for local, regional and state agencies as well as local stakeholders of all kinds.

State Role. The state role in water and port project delivery will continue to vary with state budgets and governance patterns.

Regional Government Role. The role of regional planning agencies has been significantly expanded by the series of highway and multimodal funding bills[6]. The largest regional government roles, however, have been in highways and transit, with much less activity in ports and waterways. This may change as regions recognize the important and impact of ports and waterways and the need to integrate their planning and development.

Local Role. There has been a very limited role for municipal governments in USACE projects outside of instances where ports are municipal entities. Any participation shortfall by local government, however, has been more than made up by the ability of local stakeholders to create ad hoc interest groups around specific projects.

Private Sector Role. If the above observations about the changing nature of project approvals are correct, the private sector role might increase for several reasons.

- As private sector organizations such as international steamship lines and marine terminal operators increase in size and scope their ability to finance and benefit from port and waterway projects increases as well.

- Private sector stakeholders are given increased legitimacy by outreach requirements.

- Private sector organizations can often move faster and with less public input than USACE or other government entities.

- Trade and freight facilities such as logistics ports and marine container terminals are beginning to attract the interest of institutional investors.

[6] For example: Intermodal Surface Transportation Efficiency Act (ISTEA); Transportation Equity Act for the 21st Century (TEA 21); Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAEETEA).

ES.12 A Pro-Active Environmental Role?

The USACE is becoming increasingly proficient at managing the environmental reviews and analysis that now must accompany every significant project in the maritime sphere. The USACE role, however, has been essentially reactive. On the horizon is a potential opportunity or need for USACE to become proactive and to encourage or solicit projects that improve the marine shipping environment. By doing so, USACE might set the stage for future benign expansion rather than simply mitigating the harm from new projects.

Pragmatically, USACE may need to get "out in front" of the environmental issues if it entertains any hope of efficiently discharging its traditional responsibilities for infrastructure development, dredging, etc. The notion of a paradigm shift may be a cliché, but it is appropriate in this context. In the long run, USACE may need to become environmentally proactive to control its own destiny and to fulfill its historic mission.

ES.13 National Policy Outlook

The U.S. Army Corps of Engineers, the ports and the waterways have functioned at their present level for a long time without a coherent national policy. Success in "muddling through," however, tends to postpone the difficult but perhaps necessary process of developing a national policy. At any given moment the *de facto* national policy towards ports, waterways and USACE responsibilities is the sum of Federal government laws, regulations, procedures, funding and attitudes toward the subject. While there have been a number of policy-related reports and analyses, there is no current integrated, written national policy document.

The Maritime Transportation System is a crucial part of the national economy by any measure. The trends, implications and uncertainties cited in this report often imply a need for Federal action. There are also opportunities for USACE to take a proactive role in improving and protecting the maritime and waterway environment. It would indeed be unfortunate if the needs went unmet, the action delayed and the opportunities ignored while the nation waits for a crisis.

Section 1
Introduction

1.1 Background

Waterborne commerce is a key factor in the world and U.S. economies and that commerce depends on a safe, efficient and reliable Maritime Transportation System (MTS). U.S. ports and waterways handle more than 2 billion tons of domestic and import/export cargo annually. By 2020 the total volume of cargo shipped by water is expected to be double that of 2001 volumes. In 2003 international trade was about $3.2 trillion. International trade accounts for 24 percent of the U.S. Gross Domestic Product (GDP) as compared to only 9 percent in 1960 and is expected to reach as much as one-third of the GDP by 2020. More than 13 million American jobs depend on import and export trade.

Much of total domestic production of basic commodities and finished products is shipped by water, including petroleum products, grain, lumber, iron ore, steel, scrap steel, chemicals and machinery.

Economic impacts in the U.S. of waterborne cargo movements in 2002 reportedly include[7]:

- 1.1 million direct, induced and indirect jobs
- 3.8 million jobs generated by waterborne exports
- $44 billion in personal income
- $56 billion in transportation service revenue
- $729 billion in GDP
- $16.1 billion in Federal, state and local taxes

The commercial U.S. ports are also a large and important industry by themselves. Port-related jobs reportedly employ about 5 million workers who earn $44 billion in annual personal income. Cargo through the ports of Seattle and Tacoma, for example, currently affects nearly 200,000 local jobs.

Navigable channels and ports are links in the transportation chain that allow manufacturers, buyers and sellers to send and receive goods quickly, safely and efficiently. The resulting benefits are ready access to a wide variety of products and services and lower costs for consumers.

The U.S. Army Corps of Engineers (USACE) maintains some 300 commercial harbors through which pass 2 billion tons of cargo a year. Over 90 percent of the nation's top 50 ports in foreign waterborne commerce require regular maintenance dredging. Funding for the Corps' Civil Works program, however, has reportedly decreased by 50 percent in the last 30 years, with many dredging projects falling victim to the cuts.

The USACE currently maintains more than 12,000 miles of inland waterways that provide irreplaceable transportation capacity and highly efficient transportation of major bulk

[7] American Association of Port Authorities, U.S. Public Port Facts, http://www.aapa-ports.org/Industry.

commodities. Inland waterways—including rivers, lakes and coastal bays—carry 15 to 20 percent of U.S. intercity freight at a time when highways and rail systems are becoming congested and hard to expand. Inland waterways carry freight at a cost per ton-mile about half that of rail and one-tenth that of trucks. The Corps maintains direct control of over 600 dams and maintains and/or operates over 250 navigation locks. The transportation industry believes that the ability of the inland waterway system to support continuing trade growth is in jeopardy due to unresolved funding needs for channel maintenance and deep-draft construction projects.

Whether measured by the level of industry concern or by the level of overall important to the national economy, there is a need for periodic assessment of the MTS, its future and the USACE role.

1.2 Purpose

The preparation of this U.S. Maritime Transportation System "Outlook Paper" is viewed as a pragmatic assignment to give USACE a strong, fact-based foundation for policy, planning and priorities. A firm understanding of marine transportation conditions and trends is critical in the current planning context:

- The U.S. Maritime Transportation System no longer exists in isolation, but must interact with ports, land carriers, customers, communities, environmental restrictions and security concerns.
- Maritime shipping—liner as well as bulk—is likewise integrated into the U.S. and world economies at the supply-chain level and must respond and adapt to a wide range of economic and logistics trends.
- U.S. marine and inland infrastructure is being strained by the size of vessels, the number of vessels and the cargo they carry.
- The geographic and commercial patterns of U.S. trade are being redefined by shifts in foreign sourcing, changes in inbound logistics strategy and differences in regional economic growth.
- Global warming and other environmental issues will have significant impacts on the MTS and USACE projects.

The purpose of this paper is to bring together in one document a broad range of interlinked and relevant trends affecting maritime shipping and, ultimately, USACEs responsibilities.

1.3 Scope

The USACEs major responsibilities have included dredging, development and maintenance of the inland and coastal waterways and related maritime infrastructure and navigation aids. The demand for USACEs activities is driven by the underlying demand for maritime transportation, itself derived from the demand for foreign and domestic goods.

Ongoing trade with current or similar vessels using existing ports and waterways creates a need for maintenance and renewal of dredged channels, upkeep of locks and dams, and periodic replacement of obsolete infrastructure. While any infrastructure requires maintenance to some extent, the Corps is faced with the need to hold back the forces of nature that will otherwise silt up channels and waterways. In the absence of maintenance dredging and other costly efforts, capacity would decline.

The patterns of trade are dynamic. As commodity flows shift between ports, the need for infrastructure shifts as well. The world vessel fleet is likewise dynamic, with increasing vessel sizes and drafts increasing the draft and berthing requirements.

There are thus a few overriding concerns.

- The extent to which established trade volumes, commodity flows and vessel deployments will persist and require USACE to maintain and renew infrastructure.
- The extent to which features of the trade and how it is carried will change and will require USACE to develop new or expanded infrastructure.
- The potential for change in the way that infrastructure is developed, financed and maintained, which will alter USACEs infrastructure responsibilities.
- Changes in the way infrastructure is used in its productivity or in other aspects of the relationship between trade and infrastructure that would affect USACEs responsibilities.

The paper therefore focuses on a few major themes.

- The outlook for the world and U.S. economies and therefore for the trade those economies generate.
- The outlook for international liners and bulk trades and the ways in which they are conducted.
- The outlook for domestic and international trade on the inland and coastal waterways and on the Great Lakes.
- The outlook for the U.S. ports and their infrastructure requirements.

Trends can be regarded as observable, directional changes affecting a relevant issue or aspect of the MTS. The table below (Exhibit 1) gives a breakdown of trend elements and descriptors and an example from containerized shipping.

Scope	Trend Elements	Example
Scope of Paper	*Issue*	*Container Vessel Size*
	Direction of Change	Increasing vessel size
	Drivers/Factors	Scale economies, price competition
	Limiting Factors	Draft, width of sea routes and canals
	Quantification	Maximum size in TEU, distribution of orders, etc.
	Distribution/Occurrence	Vessel deployment by route/trade
	Impacts	Port draft, terminal and throughput demands
	Implications	Increased dredging demands
	Prediction/Forecast*[8]	Future sizes and fleet composition
	Timing*	Future vessel fleet composition by year

EXHIBIT 1
TREND EXAMPLE

- The scope of this paper includes increasing average and maximum container vessel sizes as a trend.

- This paper also includes the practice of "cascading" vessels displaced by these new ships into other trades as trend.

- This port paper does not discuss one-time or limited changes (e.g., development of the first 13,000 twenty-foot equivalent unit (TEU) container ships).

In addition to observable or predictable, trends, this paper also discusses selected "trends" that have ended or failed to emerge, such as container trade load centering.

1.4 Approach

The trends discussed in this paper are extensively interlinked. Changes in transportation activity and practice are driven by changes in the underlying demand occasioned by foreign and domestic trade, changes in logistics practices, changes in environmental constraints, changes in the political arena and changes in technology and resource costs. The influence and linkage patterns can be generalized as follows.

Economic Influences

- Supply and demand of goods
- Foreign and domestic trade volumes
- Input costs
- Cost and availability of capital

Social Influences

- Attitudes toward consumption versus savings
- Environmental tolerance/concern

[8] The paper will cite available forecasts and projections, but will not make original quantitative forecasts.

- Labor supply
- Coexistence with freight transportation

Political Influences

- Protectionism
- Infrastructure funding
- Public investment priorities
- Trade disruption (war, unrest, terrorism)

Technological Influences

- Transportation equipment technology
- Transportation facility (terminal) technology
- Transportation information and control technology
- Environmental and security solutions

Environmental Influences

- Regulatory cost and delay
- Development/infrastructure limits and costs
- Climatic changes (global warming)

Security Influences

- Friction—added cost and delay
- Diversion of resources and attention
- Competition for capacity

To create a paper of maximum value to USACE, the study team has attempted to establish current trends and their underlying causes and place past and future developments in context.

The team reviewed both government planning and policy documents and the applicable commercial and academic literature to determine and describe cause-and-effect relationships.

The study team also attempted to:

- Link together developments in marine shipping with developments in transport technology (e.g., "green" vessels) infrastructure (e.g., inland ports, rail capacity) and logistics (e.g., time-definite delivery, import transloading).

- Acknowledge and describe geographic differences by coast and inland region.

- Investigate possible timelines for trends.

- Take explicit account of possible marine and port developments in Canada, Mexico and the Panama Canal.

- Discuss the potential influence of future events and uncertainty and the alternative courses that marine transportation development might take.

The item-by-item discussion offered in this draft comment on implications for USACEs mission and responsibilities, for other public agencies (e.g., the port authorities) and for the private sector.

This report uses the most recent data available in consistent formats for tables and graphs. In most cases data are now available through 2005, but in some cases the comparable data series end in 2004. Forecasts, likewise, are on a consistent basis wherever possible, but are sometimes limited to the source data.

Section 2
Maritime Transportation System: Trends and Uncertainties

2.1 Overview

Maritime transportation is a response to underlying demand for place utility. The wealth of people and nations has historically been based first on natural resources and second on valued-added manufacturing. Transportation is the means of moving raw materials and finished products from places of abundance where their value is low to places of scarcity where their value is higher. The difference in value pays for the transportation and should yield a margin for profit.

The capacity and efficiency of transportation determines the feasibility of profitable trade. Trade and transportation are thus closely interrelated. History is full of instances where resources could not be developed and traded until tapped by some form of efficient transportation. More recent examples illustrate fundamental but complex relationships.

- The leading U.S. containerized export to Asia is waste paper, a commodity whose value is so minimal that exports depend on low westbound backhaul rates in an imbalanced trade.
- The value of a FedEx parcel is increased so much by being delivered overnight that it can be flown from Los Angeles to Memphis to Seattle at a profit.

To trace these complex linkages, this paper begins with a brief discussion of the relevant world and U.S. economic trends that drive the need for maritime transportation. The paper then considers other outside influences, including political and environmental issues and security concerns. Deep-sea liner and bulk trades and movements on the inland waterways are analyzed next, followed by port trends.

2.2 World Economic Trends

2.2.1 Overall Economic Growth

The world economy is growing at a moderate pace (Exhibit 2). These rates reflect foreseeable trends rather than growth to a specific target date. No large-scale or persistent crashes are foreseen and political unrest is having limited impact.[9]

The growth rates shown in Exhibit 2 are typical of those cited in recent projections by government bodies, industry observers and econometric forecasters. The absolute figures are less important than the relative figures, which suggest which economies will grow faster or slower.

[9] Note: The recent coup in Thailand is a bellwether. The working hypothesis is that the Thai economy is resilient enough to survive with minor hiccups and that future political upheavals will not reverse economic progress there or elsewhere in Asia.

Growth in Real GDP (% change)

Region	Actual 2004	Actual 2005	Outlook 2006	Outlook 2007	Outlook 2008+
United States	4.2	3.5	3.2	2.6	3.2
Canada			3.1	3	3
Mexico			3.7	3.1	3.4
NAFTA	4.2	3.6	3.4	2.7	3.3
United Kingdom	3.1	1.7	2.2	2.6	2.7
France	2.2	1.4	1.8	1.7	1.7
Germany	1.1	1.1	2	1.1	1.1
Italy	0.8	0.2	1	1.2	1.2
Euro Zone	1.7	1.4	2	1.7	1.9
Japan	2.3	2.7	3.2	2.3	2
China	10.2	9.9	9.6	9	8.8
South Korea	4.6	4	5.8	5.3	5.2
India	7.2	7.8	6.8	6.4	6.4
Taiwan	6.1	4.1	3.7	3.6	3.6
Hong Kong	8.6	7.3	5.2	4.6	4.6
Central Europe and Balkans	6.8	5.6	5.2	5.2	5.2
Comm. Of Indep. States	8.2	6.8	6.5	5.7	5.6
Mid East & Africa	5.8	5.7	5.6	5.5	5.4
Latin America & Caribbean	6.3	4.9	4.8	4.2	4.3
OVERALL WORLD	**4.1**	**3.6**	**3.7**	**3.4**	**3.4**

EXHIBIT 2
WORLD ECONOMIC OUTLOOK

The outlook for the world economy is for continued growth, but at an uneven rate. Growth will continue at above-trend levels for 2006, but is likely to fluctuate more in 2007 and beyond.

The economies of the United States and Western Europe appear headed for slower growth. Those of some other areas, for example, East Asia, Eastern Europe and Latin America, appear to be strengthening, although continuing high energy prices will act to dampen growth. The issue will be whether higher growth in those emerging economies can offset the slowing elsewhere.

- Emerging economies, of which Brazil, Russia, India and China (the "BRIC" countries) are the top tier, will increasingly affect world trends.

- Western European economies will progress toward policy coordination with a minimum of backsliding. Balkan nations will be slow to recover and will have minimal economic presence.

- Eastern European economic development will be slow, with infrastructure, institutional issues and energy prices acting as brakes. Individual sectors will be bright spots. The former Soviet bloc nations will be plagued with regional unrest but most will grow overall. Russia will continue its growth as an "emerging economy." The Russian energy sector will be a source of volatility.

- South and Central American economic growth will be steadier than in the past but will still be occasionally disrupted by political upheaval. Mexico will gradually join the top tier of emerging economies.

- China will continue to industrialize, although the pace will slow as a matter of government policy and environmental consequences. Chinese population growth will also moderate.

- Japan will slowly regain economic momentum. Other Asian nations will industrialize (or continue to industrialize) in fits and starts, with localized slowdowns or setbacks.

- India will slowly and unevenly emerge as a producing and trading nation, first in China's shadow and then as a prominent economic power in its own right.

- Middle East unrest will continue indefinitely, preventing significant economic growth and adding to the cost and volatility of energy supply.

- African nations will continue to experience uneven growth, due partly to competition with China and India.

- Foreign accumulation of U.S. dollars is a source of potential disruption if not addressed slowly over time.

- Widespread policy and regulatory reforms will be a steadying influence, reducing the global impact of national economic problems and speeding recovery.

Canada and Mexico. Canada and Mexico have both benefited from current higher oil and other commodity prices. While this led to higher values for resource exports, it also may presage a rise in their currency values relative to the dollar. That rise (which has already happened to a certain extent with the Canadian Dollar) should not affect commodity exports to the U.S. (e.g., Great Lakes traffic), but could adversely affect exports in other sectors (for example, manufacturing).

In addition, the political situation in Mexico remains unstable. Mexico's President Calderon will almost certainly experience difficulty assembling an effective coalition to create the sorts of reforms needed for sustainable, higher growth rates. Mexican growth rates likely will suffer as a result, but some manufacturing currently taking place in Asia will continue to be moved to Mexico because of its proximity to the U.S. market.

Mexico and Canada are already the largest U.S. trading partners. U.S. trade with Mexico is expected to grow faster than U.S. trade as a whole. While a small part of U.S.—Mexico trade moves by water the majority moves by rail or truck and will continue to do so. The growth in U.S.—Mexico trade will therefore have little impact on USACE responsibilities with the

exception of the small portion that moves by barge or deep sea vessel. Most U.S.—Canada trade likewise moves by truck or rail, with the major exception of bulk waterborne traffic on the Great Lakes.

For both nations there are noteworthy waterborne movements of minerals, lumber and other bulk commodities to the U.S. In some areas these will increase due to rising demand and declining local U.S. production.

Development of Canadian and Mexican container ports is discussed separately.

Western Europe. Western Europe is likely to continue growth at rates that are below historical trends and significantly less than those of the U.S. and of emerging economies elsewhere in the world. Real GDP growth in the 2 percent annual range is likely.

The United Kingdom economy should continue moderate growth and should remain the strongest in the region. Even with the pending end of the Blair government next year, likely successors in Labour or any likely Tory leader, would not differ from current economic policy in any radical way.

The Euro Zone countries will continue their trend toward economic coordination. The major economies of the region all face significant growth issues, however. Germany's economic performance has been disappointing. Germany faces difficulty paying for its social programs with its declining birthrate and high labor costs. Chancellor Merkel's increase in the Value Added Tax, to go into effect January 1, 2007, will likely further depress growth. Consumer spending is expected to remain relatively flat and the economy will continue its heavy dependence on exports. France's problems are similar to those of Germany. The recent unrest over attempts to reform employment laws suggests that its structural difficulties will not be solved quickly, if at all. Italy's new government has inherited a fairly dismal situation. The limitations on Euro countries limit it Italian devaluation. Italy must transform its industries. Unfortunately, the coalition partners needed to create that government (e.g., the "reformed" Communists) are unlikely to support policies needed to increase growth. Real GDP growth of as little as 1 percent annually is likely.

South and Central America. Economic growth in South and Central America will be steadier than in the past. Political upheaval and some lingering fiscal and monetary problems will cause some disruptions. Strong commodity prices have bolstered several economies throughout South America. Chile has used that increased revenue to balance its budget and fund its future pension requirements. These actions should insure that the Chilean economy will continue to be the best performer in this region and will continue growing at current trend levels. Venezuela's oil production continues to decline. Although the Chavez Regime bears much of the blame, it is likely that this trend would continue to a lesser extent in any case. The Chavez government in Venezuela, as well as the socialist-leaning ones in Ecuador and Bolivia, is unlikely to effect policies that encourage private investment or promote economic growth. These countries' growth will remain at lower levels as a result. Argentina and Brazil continue to recover from their past financial crises, although Argentina has been experiencing fairly rapid recent growth. In addition, inflation in Argentina and corruption scandals and high interest rates in Brazil will

moderate growth. Until these issues are resolved, growth will continue at a slower pace in these areas.

Japan. Japanese consumer spending has begun to rebound and should continue growing. Corporate restructuring has made significant progress. That restructuring is still incomplete, however, and will not be resolved until at least the end of 2007. Monetary policy seems to have ended the deflationary trend. This, coupled with a tighter fiscal policy has led to a strengthening of the Yen relative to the dollar, as well as higher interest rates. These factors will dampen growth in export manufacturing. Japan has a relatively high public debt-to-GDP ratio. If Japan raises taxes to cover this debt, that could, in turn, lower growth rates. The major long-term challenge for Japan, as in most other mature industrial economies, will be to maintain its social welfare state in the face of a declining working-age population.

China. China will continue strong growth in manufacturing. Most of this activity has been confined to the coastal areas and wages and costs have risen as a result. This will make inland areas more attractive in the future, particularly given that China's natural resources are largely located in the interior. The existing infrastructure and trained labor force remain in the coastal areas, however, and this will make unit labor costs more attractive there than anywhere else. For that reason, manufacturing growth will continue in largest concentration in the coastal regions. State investment will decline because the state cannot afford to continue subsidizing losses at its current rate, particularly in the energy industries. This will lead to more moderate growth. The Renminbi will continue its appreciation relative to the dollar. This will moderate, to a certain degree, the investment and exports that have driven China's rapid economic expansion. In addition, the expansion of the Chinese economy will continue to increase the demand for consumer goods and imports. The stronger currency and likely continued high crude oil prices, will add to the upward pressure on imports. Finally, the expansion of the Chinese economy probably cannot continue at its current rate without changes in the Chinese government. An open market economy cannot continually coexist with a government that lacks transparency and flexibility. For all of these reasons, Chinese economic expansion is likely to remain robust, but to moderate slightly for the forecast period.

Among other things, the export expansion will continue to drive China's appetite for raw materials, including iron ore.

Chinese auto exports are on the horizon. Imported vehicles are the major driver for ro-ro traffic at U.S. ports. Over the last two decades Japanese and European automakers have established assembly plant in North America, reducing the volume of ro-ro vehicle imports and increasing the volume of imported parts and subassemblies in containers. The general trend has been for automakers to enter the U.S. market with assembled vehicles and establish assembly plants once they are justified by steady volume and market share. The more recent market entry by Korean makers Kia, Hyundai and Daihatsu has not yet resulted in North American plants, so those vehicles are still imported. Japanese and European makers split their production with some models imported and others assembled in North America.

China produced about 6 million vehicles in 2005, passing Germany to become the world's third largest auto manufacturer after the U.S. and Japan. Chinese manufacturers are exporting to other Asian nations and have ambitious plans to enter the North American market in the near

future. Successful large-scale entry by Chinese manufacturers such as Chery and Geely (or by joint ventures such as one between Daimler Chrysler and Chery) could substantially increase import ro-ro traffic through U.S. ports. The net impact will depend on whether Chinese imports displace other imports, displace vehicles assembled in North America from imported (containerized) parts (some of which come from China), displace North American production from North American parts or are propelled by market growth. The magnitude, timing and long-term success of Chinese auto imports to North America are highly uncertain. Chery and Geely have announced plans to enter the U.S. market within the next three years but the plans are relatively vague. China has recently announced the creation of eight "auto enterprise zones" near major ports to promote exports.

India. The Indian economy will continue to increase rapidly in the areas of "business process outsourcing." While manufacturing will also expand, there are factors that will retard growth in that sector. In particular, India does not yet have a workforce of likely manufacturing employees properly trained, nor does it yet have an infrastructure needed to support the growth that would otherwise take place. India's governmental policies need to change before growth, particularly in manufacturing, can take place in any sustained manner. India has relatively high tariffs, as well as much government interference that generates a substantial non-tariff entry barrier. The government seems to be opening the economy to more trade and investment, but has been moving slowly. Also, the government has yet to control the large fiscal deficit. India's population continues to grow at a 1.5 percent annual rate. The sheer size of the population creates substantial problems, but also gives it a large population of well-educated, English-speaking people. This has been the force increasing India's export growth. Overall, India should sustain real GDP growth in the range of 6 to 7 percent annually. The best near-term prospects for economic growth in India are in electronics, software and services. Rapid growth in these sectors is likely to shift talent, attention and capital away from more traditional export manufacturing ventures.

Other East Asia. The political situation in North Korea casts its ominous shadow over any predictions for East Asia, but has yet to demonstrate any measurable economic impact. The South Korean economy has strengthened. Both investment and consumer spending have grown and should continue to do so. South Korea should continue its strong economic expansion during the forecast period. Both Hong Kong and Taiwan will continue export growth, although the amount exported to the U.S. will likely decelerate. In addition, the political instability in Taiwan will further moderate growth there in the short run. The expected boom in Southeast Asia has yet to materialize. The recent coup in Thailand will likely further retard growth. Indonesia will continue to be a steady petroleum supplier, but may slow or actually decline in value of exports if petroleum prices continue their short-term decline.

Middle East. While no other area has more serious political concerns, no other area has more dependable petroleum exports. Economic activity should remain at or slightly above its current rate, but could vary dangerously if the Iraqi instability spreads or the Iranian crisis worsens.

Africa. Nigeria's sectarian violence in its interior areas has confined new investment to the coastal regions. Although its petroleum exports have remained strong, the likelihood of significant improvement depends on an end to the violence. North African economic development is still largely oil-dependent and will likely continue to be. The governments in

the region have not shown an ability to attract substantial foreign investment, nor have they been able to use oil revenues to better their economies. Sub-Saharan Africa has not shown any change from long-term trends.

Eastern Europe. The "EU-10" (the former Communist countries that are now members of NATO) have enjoyed very strong economic growth. Their growth should continue to be more robust than that of the U.S. and Western Europe, but will moderate to the 5 percent per annum range. Part of this is simply caused by economic maturity, but much more is because of a clouded outlook on governance. There has been political instability in Poland and, more recently, Hungary and surveys show widespread discontent in much of the Balkans. Until investors have some assurance of political stability, it is unlikely that they will invest sufficiently to allow growth to reach former levels.

Commonwealth of Independent States. The situation in the former republics of the Soviet Union is much the same as that of Eastern Europe. There has been strong economic growth but deep political concerns. Recent actions of the Putin administration in Georgia are simply a symptom of possible disastrous unrest elsewhere in the region. Internal affairs in Russia similarly bring into question the desirability of investment in the Russian Republic. The economies of these countries will continue to expand, simply because they have significant resources in people and materials but growth will continue to moderate unless there is a significant shift in governance.

Implications: With few exceptions the outlook for world economic growth implies a continuation of existing trends with moderate overall growth. The "BRIC" (Brazil, Russia, India, China) countries hold the most near-term potential for dramatically expanded maritime trade but thus far Brazil and China are realizing the potential while Russia and India are not.

Uncertainties: Relative steady overall growth seems likely but year-to-year and regional variations can be significant. Trade disruptions are generally expected to be short and localized but are unpredictable by nature.

The two recognizable uncertainties from the discussions above are the extent and timing of Chinese auto exports to the U.S. (and their impact on U.S. ports) and the extent and timing of large-scale goods exports from India.

2.2.2 Freer Global Trade

Trade will become progressively freer for the foreseeable future, with occasional backsliding and short trade wars.

- Globalization will continue, without a major retreat, although there will be periodic local retrenchment.
- "Trade multiples" (the relationship of import to GDP growth) will be cyclical, with rapid run-ups as countries become trading nations and moderation as import penetration and export growth top out.

- Currencies will rationalize over time with "soft landings" predominating, but with some "hard landings."

Freer trade continues as a major agenda item for the Bush Administration. President Bush affirmed this commitment in a recent address in Singapore and expressed support for a free trade agreement among Asia Pacific Economic Cooperation (APEC) members. (APEC members include all of the major Pacific trading nations and many of the lesser ones).

Economists use "transaction costs" to describe the variety of costs incurred by buyers and sellers other than the costs of goods and services themselves. Transaction costs can include the efforts made to locate and visit a supplier and negotiate the sale and are often cited as reasons why customers hesitate to change suppliers or supply chain practices. Considering a broad definition of transaction costs to cover all non-price costs, there is a definite trend towards reduction that should facilitate trade and trade growth. Globalization of trade is due in significant part to this underlying trend toward lower transaction costs. There are several reasons why transaction costs are declining:

- Tariff reduction and simplification
- Emergence of free trade agreements (FTAs) and regional trading alliances such as the European Union.
- Development of enterprise management systems (EMS), enabling shipper control over complex multi-national supply chains.
- Electronic communications linking global suppliers and customers.
- Widespread improvements in the stability of banking and financial institutions.

The ability to document and manage complex supply chains efficiently through EMS, electronic data interchange (EDI), web-enabled databases, bar coding and radio-frequency identification (RFID) has dramatically reduced the overhead expense and risk of global sourcing. Electronic transmission of bills of lading, cargo manifests, letters of credit, purchase orders and other critical documents has accelerated trade while reducing errors and rework.

Individual consumers have been quick to take advantage of worldwide web resources to locate vendors and shop on-line. There is a parallel trend in business-to-business ("B2B") information access and transactions over the worldwide web that has greatly facilitated globalization. It is now not appreciably more difficult to arrange for injection molding in China than in another state.

Implications: Greater trade freedom and reduced transaction costs will both encourage trade growth and tend to reduce dramatic swings. More stable trading and commercial conditions will help prevent disruptions such as the Asian financial crisis of the late 1990s.

Uncertainties: As noted elsewhere, protectionist backlash could undo some of the progress made and retard the general trend toward freer trade. Protectionism can take two forms: "white

collar" efforts by domestic industries to protect their markets and "blue collar" efforts to protect jobs.

2.2.3 Energy Outlook

Energy prices will continue to rise, driven more by escalating demand than by supply restrictions. Although the current price of crude oil has fallen slightly from its previous peak, energy is likely to remain a significant constraint to world economic growth. Energy prices will become a constraint on industrialization of emerging economies (e.g., Africa, Eastern Europe) and a moderating factor on growth in industrialized nations.

The "problem" has both a supply and demand aspect. The supply problem arises largely from the location of known petroleum reserves. The proposed OPEC reduction in supply is not likely to affect long-term prices if, for no other reason, the inability of some OPEC members to make their current quotas. The more difficult supply issue concerns the governments of, particularly, Venezuela and Iran. Venezuelan output has declined since the Chavez government nationalized oil resources. The Iranian government's hostility toward the United States is unlikely to change, regardless of which political party is in power. For these reasons the price of petroleum will continue to extract a "risk premium." On the demand side, the emerging economies of India and China will continue to make increasing demands of world supplies. The U.S. market will moderate its demand as prices stay high by changing the mix of vehicles and vehicle usage, but overall world demand is likely to increase, with no likelihood of new supplies. In addition, environmental concerns will continue to constrain any possible new hydroelectric projects and possibly other technologies (such as wind) as well. All of these factors will lead to increasing real energy costs.

The most recent forecasts of the International Energy Agency (announced in November 2006)[10] call for a 53 percent increase in world energy demand by 2030. More than 70 percent of that increase would come from "developing" countries led by China and India. World oil demand is expected to rise 38 percent between 2005 and 2030, with the increased production coming from a small number of major OPEC producers. The outlook is driven primarily by economic growth and less by policy decisions. The combination of rising demand and concentrating production is thought to make consuming nations such as the U.S. more vulnerable to supply and transport disruptions.

Implications: Rising energy prices will increase transportation costs and affect the competitive positions of modes and routes. Rising energy costs will also put a premium on scale economies and could accelerate the trend toward larger vessel sizes with deeper draft requirements. Although the U.S. will remain a net importer, competing demand from developing countries may shift the worldwide pattern of petroleum and petroleum products movements.

Uncertainties: The highly politicized nature of petroleum supply creates inherent uncertainty. The possibility of new sources of supply (such as recent discoveries in the Gulf) could also alter maritime shipping patterns in the energy sector.

[10] IEA press release, November 7, 2006.

2.2.4 Higher-Valued Goods/Service and Information Economies

The traditional linkage between economics, trade and transportation is also being altered by the rise of the service economy and the growth of the information industry. Global outsourcing of services, information processing and technical support has enabled significant economic growth without traditional transportation infrastructure. From USACEs perspective, for example, the transportation needs of California's Silicon Valley are negligible. What impact that center of economic activity has on maritime transportation is indirect, e.g., dredging needs at the Port of Redwood City to accommodate growing imports of cement and gypsum to support the regional construction boom. The growth of technical and information services in India, as another example, has fueled rapid economic growth despite inadequate freight transportation infrastructure.

Implications: The linkage between value of goods and transportation requirements is changing. The rapid growth of the electronics sector has created a category of trade with much higher values and more modest transportation requirements than previous norms. The past functional relationship between economic growth and transportation needs is therefore shifting and aggregate transportation capacity in ton-miles need not grow as fast as national GDPs. From USACEs perspective, this shift will require careful re-examination of transportation demand forecasts based on past relationships.

Uncertainties: This trend is not likely to abate, but which economies shift this direction and when is uncertain.

2.2.5 Shift of Asian Manufacturing Center

Many world trade observers have anticipated that the geographic "centroid" of Asian manufacturing and exports would shift from China toward India (Exhibit 3). India is generally regarded as the breakpoint at which liner service to North America through the Suez Canal has an advantage over transpacific liner service. As the exports from Southeast Asia and India grew in importance the Suez services to U.S. East Coast ports were expected to grow apace.

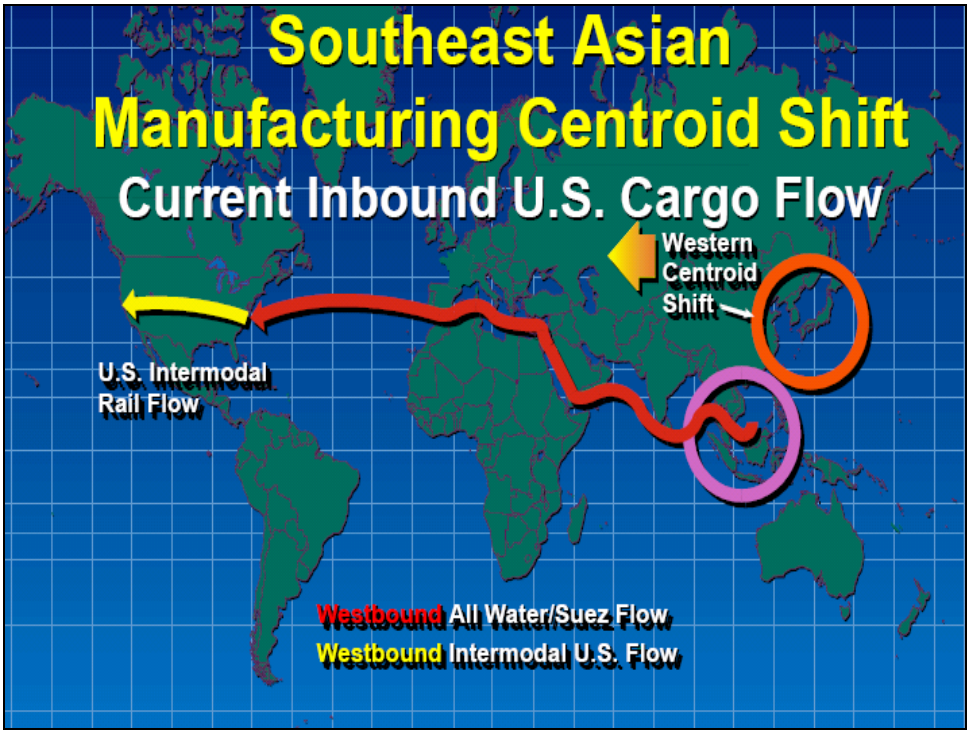
The widely anticipated growth of Indian maritime exports has not happened. Although India's exports continue to grow substantially they are still far outweighed by Chinese export growth. Suez services to the U.S. East Coast remain scarce.

Growth in the Indian manufacturing and export sectors has been constrained by several factors.

- Indian port capacity. India has struggled to expand container port capacity but continues to encounter political and financial setbacks.

- Commercial and logistics infrastructure. Inland transportation linking Indian ports to production centers has also lagged. Some Indian cities that might otherwise be poised for growth in manufacturing and distribution lack good road or rail connections and periodically suffer electrical power shortfalls, flooding or other disruptions that deter commercial development.

- Political divergence. India's diversity makes for a dynamic culture but hinders sustained political consensus or economic development.



Source: Transystems, Inc.

EXHIBIT 3
POTENTIAL SHIFT OF ASIAN MANUFACTURING "CENTROID"

- Service economy growth. India's fastest growing economic sectors include services and intellectual property which attract investment and entrepreneurship that might otherwise be devoted to manufacturing and export goods. Software development, engineering and technical support are "exports" that do not require transportation infrastructure or shipment through the Suez Canal.

- Competition. India faces strong competition from the other developing nations such as Brazil, Russia and China, as well as from other Asian nations such as Vietnam.

Implications: A more realistic scenario is gradual growth of exports as India eventually overcomes or mitigates the barriers noted above. The expansion of the Asia-U.S. trade via the Suez Canal will likewise be more gradual than explosive.

Uncertainties: The Indian economy could accelerate export growth if a political and social consensus emerged.

2.2.6 Shift of Asian Production to Mexico

There is foreseeable increase in "near sourcing" of production to Mexico as opposed to "outsourcing" of production overseas. Companies are shifting production to Mexico to take

advantage of faster delivery, greater flexibility and immunity from seaport congestion or labor shutdowns. To the extent that outsourced production is shifted to Mexico from overseas locations, the U.S./Mexico transportation requirement will shift from marine to truck or rail.

- Lengthening of supply chains in both time and space increases vulnerability to disruption, as illustrated by the 2004 peak season congestion in Southern California. While that congestion did not reappear in 2005 or 2006, some importers have seen Mexico as a more reliable trading partner.

- Expansion and modernization of Mexican ports catering to transpacific trade.

- Growing need for flexibility and responsiveness has led some manufacturers to combine global component sourcing with assembly in Mexico. Dell Computers is the best known example, but Motorola and others have chosen the same strategy for some product lines.

- Increased Mexican technical capabilities and entrepreneurship have enabled maquilladora companies to climb the "value added" ladder to fabrication and assembly of more valuable products in direct competition with Asian nations.

Implications: A change from "outsourcing" to "near sourcing" will reduce both volume and service pressure on west coast ports and increase pressure on U.S./Mexico border crossings and Mexican ports. The change is likely to be small compared to the overall growth of U.S. imports from Asia.

Uncertainties: The "near sourcing" trend has so far been relatively small and focused on a few industrial sectors. If it remains confined and specific, it will have little impact on USACE responsibilities. If the trend grows and expands, it could reduce or delay cargo growth at U.S. west coast ports.

2.3 U.S. Economic Trends

2.3.1 Overall Economic Growth

Although economic growth for the first half of 2006 has been robust, growth will begin to slow due to a stagnant and possibly declining housing market for the remainder of 2006 and into 2007. At this time, it appears that the economy will avoid a recession, but one is likely if lower housing prices and rising interest rates combine to cause a steep decline in household wealth and ability to borrow. To the extent that ready availability of consumer credit and perceptions of wealth through increased home equity have had supported the rapid growth of imports, a decline in both could reduce import growth rates.

If there is no recession in 2007, the current slowing in housing prices will still cause some slowing in consumer spending even beyond 2007, because many people bought homes with little down and interest-only short-term (i.e., five years of less) financing. As these loans become due, they may not qualify for conventional financing and this could depress housing prices further, reducing consumers' borrowing ability. Until then, current high housing prices, particularly in the Sunbelt and the coastal areas, are moderating growth in those areas.

For these reasons, the most logical assumption is that growth will return to long-term moderate trend levels sometime after 2007. The continuing current balance deficit will keep downward pressure on the dollar. This will moderate import growth.

Control of the U.S. economy by the Treasury and Federal Reserve will be generally successful (e.g., mild inflation, moderate unemployment), but the business cycle will persist in softer form.

- U.S. military spending will gradually peak and taper off but continue to impinge on infrastructure funding.
- U.S. workers will feel the effects of globalization in reduced real wages as much or more than in lost jobs. There is a potential for a backlash.
- Periodic terrorism threats or incidents will disrupt specific U.S. sectors or localities. The U.S. will become like Great Britain in this regard.

Discernible U.S. industrial trends will continue, with some nascent trends gathering momentum.

- The pace of production outsourcing will slow and become more deliberate.
- Consolidation will continue in some major industries, including retail and communications.
- Some resources will hit regional limits (e.g., cement, sand and gravel, lumber) moderating growth and increasing specific imports.
- U.S. growth in energy consumption will slow slightly due to energy prices and the influx of hybrid vehicles.

Implications: The outlook for long-term moderate U.S. growth without major setbacks implies moderate growth in demand for foreign and domestic goods and the required marine transportation. There are no indications of major changes in the U.S. economy that would impact USACE responsibilities.

Uncertainties: When and if the U.S. experiences mild recessions, the usual result is a delay in growth. A major recession could cause a permanent setback but is not foreseen. Much of the U.S. import growth is propelled by consumer spending and consumer debt, including equity loans on bubble-priced houses. A declining housing market or other factors leading to more conservative spending might slow import growth.

2.3.2 Growing Trade Imbalance

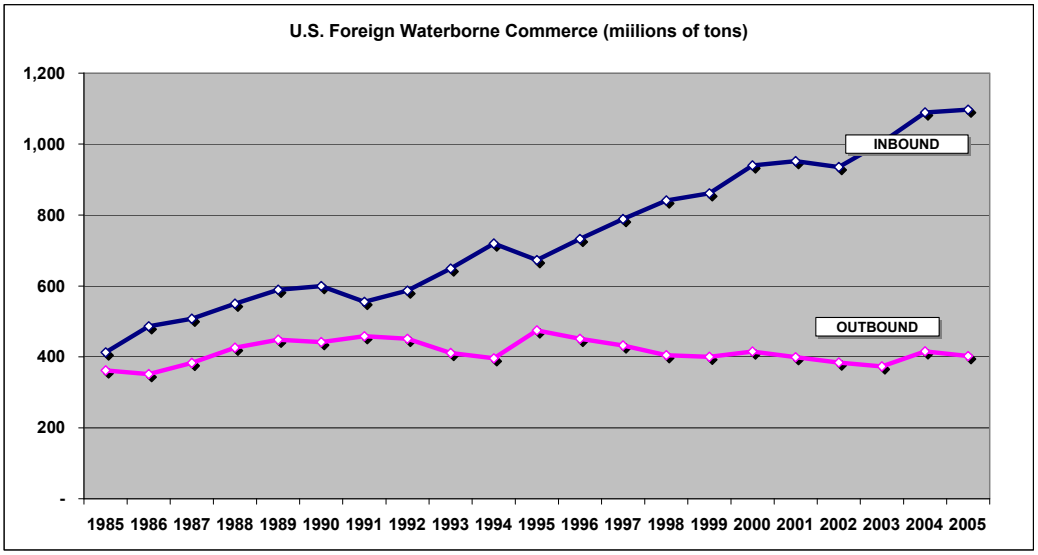
The U.S. has sustained a large balance of trade deficit over a sustained period of time. This deficit will persist and probably grow further, although some adjustments will take place. First, the trade balance reflects a dynamic process in which both imports and exports are growing. Many foreign economies, particularly emerging ones, have grown initially through net exports to the U.S. In general, those countries' exports to the U.S. increased before imports from the U.S. did so. Put another way, many emerging economies cannot afford or use many products currently made in the U.S.; that demand increases as the economies mature.

As both exports and imports increase, the trade deficit of the U.S. will continue or even increase on a static basis, but dynamically both imports and exports are working toward a new equilibrium. This trend will likely continue regarding emerging economies throughout the foreseeable future. In addition, continuing trade imbalances will lead to periodic revision of exchange rates. This has been happening between the Euro and the dollar and will also likely take place between the dollar and East Asian currencies. The regional economic outlooks contain several specific expectations of currency revaluations.

In summary, while there may exist a theoretical limit to the U.S. trade imbalance, that limit is not a static one. As other economies grow, their demand for the sorts of goods exported by the U.S. also grows. As long as all economies expand, the trade imbalances will probably lead to nothing more than some mild currency corrections.

2.3.3 Tonnage and Container Imbalance

The chart below (Exhibit 4) shows the widening gap between U.S. inbound and outbound maritime shipping in tonnage terms. In the late 1980s and mid 1990s export growth spurts lead to forecasts of balanced or nearly balanced tonnages. As the chart indicates, those tendencies fell short of achieving a balance and the gap has been widening since.



Source: Waterborne Commerce of the United States

EXHIBIT 4
U.S. TRADE TONNAGE

Balance of payments issues aside, the gap has implications for vessel and port utilization, total shipping industry efficiency and other matters affecting USACE responsibilities.

In the container shipping industry, the imbalance leads to a buildup of empty containers in the U.S. which must eventually be repositioned as non-revenue moves to Asia and other source regions. Most containers are built in Asia, especially in China, and the low construction costs can make it more economical to buy new containers than to reposition old ones. The need to move massive quantities of empty containers strains the economics of container shipping and leads to higher inbound rates. Outbound rates are depressed, which actually encourages U.S. exports.

The unidirectional nature of many trades has contributed to the specialization of many U.S. ports and their terminals and their vulnerability to volatile trade conditions and individual company shipping strategies.

2.3.4 Regional Resource Supply

The demand for bulk shipping, bulk waterway movements and bulk port terminals is heavily influenced by regional resource supplies. The extent to which minerals, ores, crude petroleum, aggregates and other basic industrial inputs are exported or imported depends on the balance between local production and consumption. Where regional resources have been exhausted or cannot be expanded for environmental reasons the gap is being filled by imports.

For example, the major sources of bulk import growth in Northern California are aggregates and cement. The San Francisco Bay Area has historically sourced aggregates from regional quarries, with the three largest being east of the Bay Area in Livermore. One of these three large quarries has closed leaving a major producer with drastically reduced local resources. Opening a new quarry in Northern California is considered impossible for both cost and environmental reasons, so closure of the local quarry has led to rapid short-term growth in aggregates imports from British Columbia and/or Mexico.

This pattern is likely to be repeated across the nation regional supplies of basic resources are depleted. Waterborne shipping is the most cost-effective means of moving bulk and neo-bulk materials, so regions served by bulk ports will likely see new inbound flows as their own supplies run out. Candidate commodities include sand and gravel, cement and lumber.

Implications: Resource exhaustion can dramatically increase bulk import flows in a short period, with much more shipping demand than would be predicted on the basis of cargo history and demand growth.

Uncertainties: As the issue is local or regional, it will be difficult to predict on a national basis.

2.4 U.S. Social and Political Trends

2.4.1 Protectionism

The shift in congressional party power in the November 2006 elections has been generally ascribed to voter dissatisfaction on many fronts. One issue of importance to the maritime transport system is free trade and the potential for protectionist sentiments to slow or reverse the growth of imports. This possibility was given credence by Congressional rejection of the Administration's proposal to relax trade restrictions with Vietnam.

National concern over the impact of outsourcing and globalization on U.S. jobs and over the escalating trade deficit is likely to hinder the overall trend toward freer trade. The lopsided trade with China is an obvious target for objections, with Chinese trade facing the same kind of criticism leveled at Japan in the expanding years of that trade. The small scale of U.S. exports to China is often attributed to undervalued Chinese currency or Chinese import tariffs, with the implication that Chinese imports should be tariffed or otherwise restricted until the terms of the trade are equalized.

However expressed in quotas, regulations or tariffs, protectionist measures typically depress imports without a comparable increase in exports. The terms of trade—currency values, tariffs, etc.—are most likely to affect undifferentiated commodities such as minerals, scrap metal or waste paper. These commodities account for a large part of U.S. exports, but growth in waste paper exports to China is unlikely to satisfy protectionist critics of the trade deficit.

Protectionist measures can slow the overall growth of trade but can also have dramatic impacts on specific trade flows at specific ports. The imposition of tariffs on imported steel in 2001 dried up steel imports at some ports and idled their terminals.

Implications: The outlook for continued moderate trade growth may be diminished by protectionist measures in the U.S.

Uncertainties: The extent or impact of protectionist actions is unknown and unpredictable. The possibility of protectionist impacts on specific trade flows should be considered in analyzing benefits of USACE projects.

2.4.2 Regional Antipathy Towards Trade

Maritime trade and shipping activity have adverse consequences for surrounding communities. Documentation and analysis of those externalities has led to significant regional antipathy toward both current trade and trade growth. The antipathy is greatest and most prominent in Southern California but is also apparent in Northern California and the Pacific Northwest.

The most objectionable externalities include:

- Traffic congestion. Containers on chassis are readily identifiable to commuters stuck in traffic jams. Even though containers may be a small portion of total truck and vehicle traffic, community members retain the impression that their highways are clogged with containers. In the most notorious example, Interstate 710 in Southern California, containers are a large and significant part of the traffic mix.

- Diesel emissions. The dramatic health consequences of diesel particulate matter have come to the forefront of regional concerns in Southern California, Oakland and elsewhere. The problem is unquestionably serious and stands in the way of port and trade expansion.

- Vessel emissions. In Southern California emissions from vessels at port terminals have been identified as one of the worst air pollution problems.

- Environmental degradation. The scarcity of unspoiled wetlands in major port areas has led to legitimate concerns over port expansion.

Increasingly, port-area communities see foreign and domestic waterborne commerce as benefiting someone else at the expense of local residents. That view has some justification at ports that handle export grain from faraway states or containerized imports headed for points far inland. Local communities are increasingly skeptical of traditional port impact methodologies that use multipliers to estimate regional jobs generated by the ports. Perhaps more significantly, port critics reply that the benefits of employment are outweighed by the health risks, congestion and other externalities. These considerations may affect USACE benefit-cost analyses and the local response to such analyses.

Regional antipathy toward trade and concern over externalities has sharply curtailed the ability of the Southern California ports to expand or improve infrastructure. Proposals to add capacity to Interstate 710 encountered bitter, entrenched community opposition that delayed the effort by at least five years and added millions to the planning costs to date. Regional planning agencies expect to solicit bids for the Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the I-710 improvement in the late fall of 2006. Because of the extent of community concern and the number and complexity of the issues raised, the preparation of the EIS/EIR is expected to cost $25 to 30 million.

The Ports of Los Angeles and Long Beach have not been able to complete the EIS/EIR process on any major projects in the last five years. The Burlington Northern Santa Fe (BNSF) near-dock rail intermodal terminal proposed to serve the ports is imperiled due to community objections.

Besides delaying crucial infrastructure projects, dealing with community concerns has cost the two ports many millions of dollars and diverted management attention. The two ports recently approved their joint Clean Air Action Plan (CAAP). The CAAP, among other measures, anticipates port expenditures of over $200 million to replace older diesel tractors used in drayage service. The total CAAP program is expected to cost in excess of $400 million over the next five years.

Implications: Entrenched regional antipathy toward trade and the environmental/community externalities of port activity may be the single largest obstacle USACE faces in discharging its present and future responsibilities. The Corps has encountered variations on such opposition in numerous dredging projects, notably in Oakland, on the Columbia River and in the Delaware River. The welcome extended to USACE is becoming distinctly mixed, with sponsor encouragement matched or exceeded by adversarial objections.

Uncertainties: Growing opposition is a certainty; the extent, nature and persistence of the opposition is uncertain. USACE will face increased difficulty managing project development schedules or budgets.

2.5 Environmental Trends

2.5.1 Global Warming

Global warming remains a contentious issue with multiple unknowns.

- While global warming appears to be generally accepted as a reality, its causes, magnitude and effects are still imperfectly understood.
- It is impossible to determine what actions mankind will take to reduce global warming or what impact those actions will have.

Global warming in the broadest sense is associated with:

- A gradual increase in average global temperatures and
- Increased weather variability.

The most prominent anticipated impacts of global warming include increased flooding, increases in storms, higher sea level, opening of the Northwest Passage and changing water levels in inland waterways. Higher average world wide temperatures can also have a number of possible implications for maritime shipping and USACE responsibilities that have not been analyzed to the same extent.

- Climatic changes will alter agricultural production and therefore the pattern of maritime agricultural transportation, both inland and deep sea.
- Global warming will shift demand for home heating fuels and power plant output and therefore change demand for coal, oil and other energy products and their transportation.

Attempts to reduce greenhouse gas emissions and consumption of fossil fuels will affect marine transportation (and dredging activities). Emissions from ocean-going ships are a major target of the California Air Resources Board and the Southern California Air Quality Management District. Their work is leading to requirements for cold ironing (use of share power instead of main engines while in port) use of ultra low sulfur diesel and slower vessel speeds in harbor.

Increased Flooding. The "100-year flood" is a widely used design benchmark for water-related infrastructure ranging from drainage ditches to levee systems. The term is a statistical designation, meaning that the chances are 1-in-100 that a flood of that size would happen in any given year. For any given river or waterway the assessment of a 100-year flood is based on at least 10 years of data, preferably more.[11] Global climate change is expected to result in increased frequency of heavy flooding in many areas, effectively invalidating statistical estimates of 100-year floods. The trend can be viewed two ways:

[11] USGS Fact Sheet 229 – 96, "The 100-Year Flood."

- The 100-year floods for which infrastructure was previously designed will occur and be exceeded more often.

- The new 100-year (1-in-100) flood will be significantly larger.

Implications: From the perspective of the MTS, floods are a source of disruption. Higher than expected water levels in navigable waterways are dangerous and lead to accidents and closures. Floods damage maritime infrastructure and leave debris in channels, disrupting marine transportation even after the waters have receded. Increased flooding will also lead to relocations of manufacturing plants and distribution centers, with secondary implications for marine transportation.

Uncertainties: The only thing certain is that there will be widespread problems. As with all climatic trends, projections of timing and magnitude vary widely.

Increases in storms. Global warming is expected to increase the frequency and magnitude of storms, including hurricanes. For marine transportation storms equate to disruption and damage. The transportation industry can adapt to more frequent storms in several ways.

- Increasing inventories and safety stocks to buffer the impact of more frequent service disruptions in transportation of all types.

- Changing vessel routes and port calls to reduce exposure in storm-prone regions such as the South Atlantic and Gulf Coasts.

- Strengthen infrastructure in storm-prone areas.

- Increase use of sophisticated weather prediction systems.

All of these steps will increase costs and therefore reduce trade to some extent, perhaps insignificantly.

Implications: More frequent and larger storms will increase weather-related damage to port and waterway infrastructure. The outcomes will likely include:

- Increased costs to port authorities, marine terminal operators, ocean carriers, shippers and USACE associated with damage to infrastructure and equipment.

- A tendency to withdraw service and cargo from ports and routes suffering greater and more frequent damage.

Uncertainties: One possibility is the emergence of a reduced "shipping season" for the areas most affected, just as the Great Lakes and Upper Mississippi have a reduced season due to ice in the winter.

Higher Sea Level. World wide sea level has been rising at the rate of roughly 3 mm per year since 1993. Weather models suggest continuation of this trend at a similar rate. The expected rate of 3 mm per year translates roughly into one foot each 100 years. The direct impact on ports

is likely to be minor. The life of port infrastructure such as breakwaters, seawalls, navigation aids and terminal aprons is typically around 50 years. Infrastructure put in place now will perhaps have to deal with a 6-inch sea level rise over its working life.

Vessel operations may be made slightly easier or slightly harder.

- A rising sea level will provide slightly greater draft.
- The combination of warmer water and decreased salinity (from increased freshwater run-off) will decrease vessel buoyancy, offsetting the added draft from sea level rise (as well as obsoleting Plimsoll marks).

Implications: The broad impacts of sea level rise on the MTS are likely to be gradual and small.

- Sea level rise may shorten the life of some coastal infrastructure but most should be minimally affected.
- Future USACE projects will need to include sea level rise among the factors for risk and sensitivity analysis.

Uncertainties: While the sea level rise is expected to be small and gradual overall, local impacts may vary widely depending on topography. Moreover, the entire issue is inherently uncertain and will require continued analysis and monitoring as experience is gained.

Northwest Passage. Opening of the Northwest Passage across the top of Canada between the Pacific and Atlantic oceans (Exhibit 5) would be the single most dramatic result of global warming and would have substantial impact on world shipping patterns.

EXHIBIT 5
NORTHWEST PASSAGE

The Northwest Passage would create a short-cut between Europe and Northern Asia, saving between 2,500 to 4,000 miles compared to the Panama Canal route (and avoiding canal tolls). Diversion of Europe-Asia trade to the Northwest Passage would open up Panama Canal capacity for other trades, notably the all-water Asia-East Coast trade. Canal tolls might be reduced as well. The Northwest Passage itself would not be as useful for U.S.-Asia or U.S.-Europe trades.

Implications: By freeing up Panama Canal capacity, the availability of the Northwest Passage to Europe-Asia trade could increase the volume of all-water Asia-East Coast cargo and thus the pressure on U.S. East Coast ports.

Uncertainties: The date at which the Northwest Passage would be available to commercial shipping is highly speculative. Estimates run from as soon as 2015 (the year after the scheduled opening of new Panama Canal locks) to 2090. The Passage is likely to open first to a summer shipping season. At present, cruise ships routinely penetrate fairly far into the Northwest Passage in summer and icebreaking ships frequently traverse the entire passage. Whether or not icebreaking is involved, vessel traffic through the Northwest Passage will cause environmental concerns.

2.5.2 Invasive Species

An "invasive species" is a plant or animal that is non-native to an ecosystem and whose introduction is likely to cause economic, human health, or environmental damage. Invasive species often arrive via maritime shipping, including in ballast water. In the Great Lakes, for example, invasive animals and plants have reportedly displaced native species, increased degradation of coastal wetlands, disrupted municipal water supplies and hindered boating. Efforts to control invasive species include ballast water treatment, electric barriers and prevention strategies.

***Implications*:** Invasive species may affect the cost, operation and maintenance of USACE projects in ports and waterways. Proposed projects will come under increased scrutiny for their potential to introduce or encourage invasive species.

***Uncertainties*:** The study of invasive species is relatively new and the implications may change with the acquisition of additional knowledge and understanding.

2.5.3 Increased Environmental Awareness and Regulation

Environmental movements are gaining influence worldwide, although the strength of the movement varies dramatically between undeveloped nations struggling for an economic foothold and developed nations coping with the downside of success. Broader knowledge of environmental consequences and health impacts will lead some nations to slow development of their resources.

- Gradually increasing worldwide sensitivity to environmental concerns will eventually pressure the U.S. to act on global warming, although economic consequences will be small for the foreseeable future.

- Environmental disregard of issues such as deforestation, over fishing and pollution of water supplies will cause serious localized problems in some nations and disrupt some commodity-specific economic growth.

Implications: USACE is experiencing the impacts of increased environmental awareness and regulation in every project it undertakes. The level of effort devoted to environmental issues is likely to increase further. Increased environmental awareness has at least three major drivers.

- Expanded knowledge of the natural environment and the impacts that USACE projects have had and can have in the future.
- Reduced willingness-to-accept adverse environmental impacts as the price of economic growth, a reflection perhaps of expanding U.S. affluence.
- Empowerment of individuals and ad hoc organizations in the local and regional planning process.

In a very real sense rapid growth of U.S. maritime and port system over the last 100 years has created a mess and the public is demanding that the mess be cleaned up before growth resumes.

Uncertainties: While the extent concern will vary by issue and locality, the overall increase is irreversible.

2.6 Technology Trends

Maritime technology trends are not likely to have much impact on USACE responsibilities. Radio frequency identification (RFID), for example, is a supply chain technology that may affect the movement of goods through warehouses or marine terminals, but will not have an impact on infrastructure needs. Advanced container crane designs may enable terminals to turn inbound vessels faster, but their impact on USACE projects would only be perhaps a slight postponement of terminal expansion needs. Shipbuilding technologies that permit construction of larger vessels will contribute to the influx of larger container ships. That trend is considered in a separate section.

2.6.1 Electronic Navigation Aids and Information Technology

One area in which technology has potential implications for USACE projects is electronic navigation aids and the application of information technology to vessel operators. Vessel operators typically require at least three feet of under keel clearance to allow for variations in the channel bottom and in vessel trim. If better information would allow vessels to sail at two feet above a more precisely known channel bottom dredging needs would be reduced.

The Columbia River LoadMax system is a good example. LoadMax makes real-time and predicted water depth information available to vessel operators, allowing them to make optimal use of the water level at any given time and plan movements with greater precision. LoadMax is not so much a new technology as an application of technology to a new problem. But the benefits are the same.

Improved mathematical/computer models of harbors and their dynamics would contribute to the utility and application of navigation aids.

2.6.2 Agile Ports

The term "agile port" has taken on many shades of meaning from a precise definition tied to military deployment to a generalized notion of increased port efficiency linked to inland transport. For the propose of this project the study team endeavored to identify those elements of the broader agile port concept that would promote greater port throughput consistent with reduced truck Vehicle Miles Traveled (VMT) and emissions. In this connection:

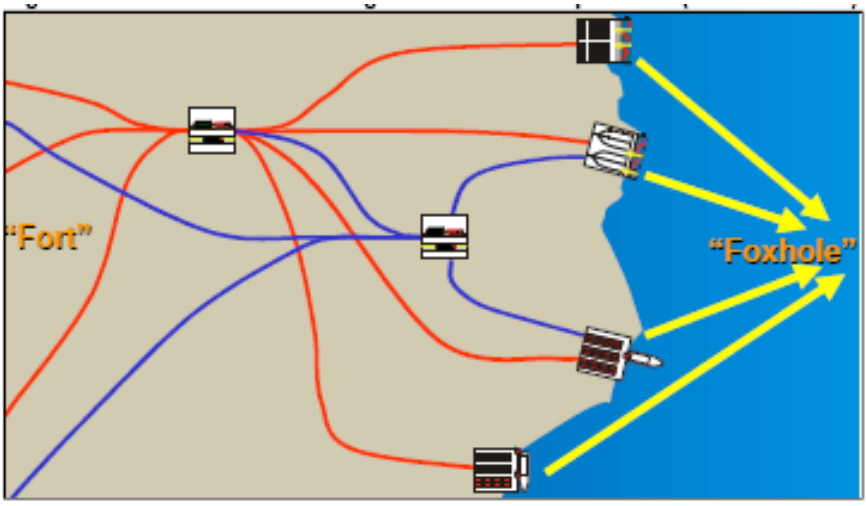
- The objective of agile port operations is to reduce container dwell time at port terminals and increase their throughput capacity.
- The core of the concept is rail transfer of unsorted inland containers from vessel to an inland point where sorting takes place.
- The agile port concept trades off additional cost (handling) and inland space for increased port throughput.

Within the realm of rapid military deployment, port agility is defined as *the ability of a marine terminal to accommodate military load out operations while minimizing disruption to commercial operations* (Center For The Commercial Deployment of Transportation Technologies, CCDoTT)

Exhibit 6 illustrates an Agile Port System and its major components in a "fort to foxhole" system for rapid deployment of military materials. (Note that the agile port system in this manifestation is focused on outbound or export movements.)

The system as envisioned for military application defines five different kinds of terminals (Exhibit 7).

- Conventional marine container terminals are the terminals that are in place today.
- Ro-Ro (Roll-on Roll-off) marine terminals are also in place today for maritime auto carriers and barges,



Source: TransSystems, Inc. Presentation

EXHIBIT 6
AGILE PORTS IN MILITARY DEPLOYMENT

although they do not have the High Speed Sealift characteristics.

- Agile Port terminals, also called Efficient Marine Terminals, are optimized for on-dock rail transfer. The concept was demonstrated successfully in Tacoma, but no terminals have been built or operated on this basis.

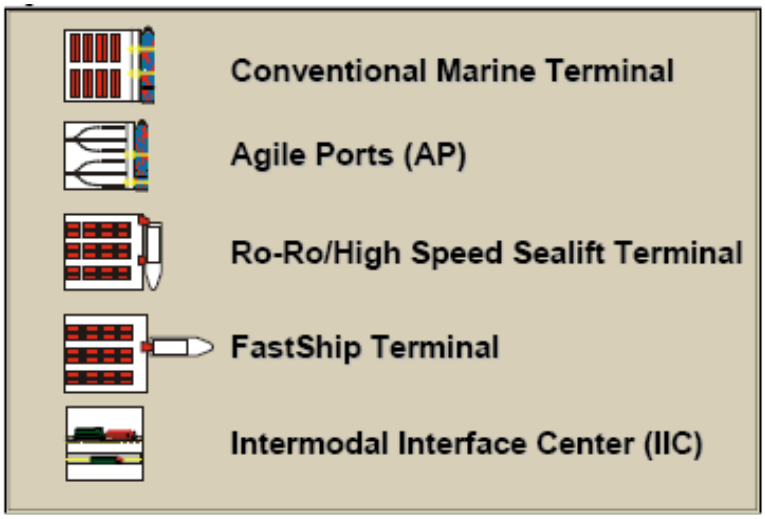


EXHIBIT 7
AGILE PORT TERMINAL TYPES

- Fast Ship Terminal is a concept that uses a Container Platform Train (CPT) optimized for the proposed Fast Ship technology. These terminals have been designed in concept but not built.

- The Intermodal Interface Center (IIC) is an inland port that serves as the "front door" of the port, providing as large a menu of required marine intermodal terminal services as possible.

While elements of the efficient marine terminal concept have been implemented at conventional marine terminals, the agile port concept as a whole has yet to be implemented anywhere. There are some major barriers.

- Few if any ports have the available terminal space to devote to an agile port terminal for which there is not an obvious commercial demand. Agile port terminals are designed to maximize the ability to rapidly unload and load the vessel, but may not otherwise make the best use of available port land.

- The Container Platform Train technology and accompanying vessels are almost certainly feasible, but would require costly development and up-front commitment. No sponsors have stepped forward.

With neither a clear military or commercial demand, the concept has languished and is unlikely to be implemented anywhere soon.

FastShip. FastShip is a proposed five-day high-speed transatlantic container service using "agile port" terminals and gas-turbine powered "Jet Ships" capable of 36 knots fully loaded with a 33-foot draft. The Fast Ship consortium describes their target as a "middle market' faster than conventional container ships yet less expensive than air cargo. The Fast Ship consortium currently envisions transatlantic service beginning in 2009 between Philadelphia and Cherbourg. The "agile port" concepts call for the use of automated guided vehicles similar to double-stack container cars to load and unload the vessel rapidly. While apparently technically

feasible the vehicles do not yet exist in the required form and the concept would be incompatible with existing marine container terminals. There appears to little information on the potential impacts of high-speed vessel operation on sediments or other harbor issues.

The FastShip proposal appears likely to fall short of real-world implementation. In September 2006, FastShip announced plans to issue a tender in November 2006 for 1.3 million tons of trans-Atlantic capacity. (The tender was not issued as of December 8, 2006.) Should the tender attract significant bidders, it would be viewed as a vote of confidence from the industry and, perhaps more critically, would help fund construction of the three proposed JetShips and their specialized terminals.

2.7 Security Trends

2.7.1 Overall Security Trends

The enormously increased marine transportation security measures introduced since 2001 add friction or drag to the growth of trade and will likely retard it to some extent. In general, the U.S. and its trading partners are proposing and implementing layered security processes to protect from possible use of the marine transportation system by terrorists.

Impacts on Trade Growth. Increased security measures offset reductions in other transaction costs. Importers and exporters typically view security requirements as additional overhead.

- Increased documentation requirements and earlier documentation filing.
- Additional steps, equipment, time and expense at marine terminals.
- More frequent inspections, with attendant costs.

For shippers and consignees cargo security is an added cost of doing business. Very few importers ever have a container or bulk shipment physically opened or examined by Customs and Border Protection (CBP) and most view added paperwork, expense and time as a cost without identifiable benefits.

Terrorism may be viewed as a new source of trade disruption or as simply a variation on riot, war, insurrection, strikes, piracy, natural catastrophes and other sources of disruption. The threat of terrorism does, however, leave the marine transportation system more vulnerable to hoaxes, scare tactics and over reaction. A newsworthy incident at one port terminal could easily result in closure of the entire port (through executive order or labor walk out) or of multiple ports. Dramatization of port infrastructure vulnerability could increase the attractiveness of marine transportation infrastructure as terrorist targets.

Diversion of Resources and Attention. Security needs divert both funds and policymaker attention from other needs. Since 9/11, over $708 million has been allocated in grants to facilities for enhancements such as lighting, fencing, security cameras, guard gates and interoperable communications. The Security and Accountability for Every Port Act (SAFE) consolidates the authority and mandate for a number of DHS port-related programs. The Act promises $400 million in Federal grants to ports for each of the next five years. Only $210 million of the first $400 million was actually approved as part of the 2007 DHS appropriation. Total DHS discretionary spending is budgeted at about $34.8 billion. Port-related programs,

including Coast Guard funding, came to about $7.5 billion. The non-Coast Guard portion was roughly $3.1 billion. These funds might otherwise have been devoted to infrastructure projects.

Transport Worker Identification Card. Implementation of the Transport Worker Identification Card (TWIC) is part of the recently signed SAFE Port Act of 2006. The TWIC is viewed by the transportation industry with some trepidation. The American Association of Port Authorities cited the following concerns with TWIC implementation.

- Biometric reader and PIN requirements for port facilities have not been subject to sufficient testing and certification and may not be workable in the anticipated timeframe.
- Rules for TWIC implementation may adversely affect operations (such as Ro-Ro auto terminals) that use casual labor, rail operations at the ports and the wide variety of visitors engaged in business at port terminals.
- Impact on smaller facilities such as bulk terminals handling minerals, steel or other low-risk commodities.
- Costs and the imposition of an unfunded mandate on port authorities.

The industry believes that TWIC requirements will reduce the labor pool available for transportation, both through disqualification and reluctance to register. If so, TWIC will exacerbate labor shortages in trucking and inland waterways. Both capacity and costs will be adversely affected. The transportation industry also views TWIC implementation and administration as an additional overhead or transaction cost. The industry is skeptical of the real security value of the TWIC program, especially since it has been progressively watered down as technology barrier are identified.

Implications: Cargo, port and vessel security programs will continue to divert resources from port infrastructure needs. Although likely to be small, port space devoted to security functions is unavailable to handle cargo. Additional port cargo dwell time due to security concerns also reduces effective port capacity.

Uncertainties: A base case view would call for steady, deliberate implementation of additional security measures. Proposed Congressional measures to greatly increase screening of import containers could significantly impede trade, depending on how such measures are interpreted and implemented. Overreaction to incidents or other stimuli could lead to disruptive and costly interventions.

2.8 Transportation and Logistics Trends

2.8.1 Overall Logistics Trends

The U.S. and world logistics trends will emphasize efficient “sharp pencil” solutions to complex supply chain demands.

- Continued (although less rapid) outsourcing will lengthen supply chains and raise the share of total cost devoted to logistics.
- Having exhausted most of the potential savings through outsourcing, customers will increasingly turn their attention to logistics as a potential area of cost reduction or competitive advantage.
- High-profile logistics practices such as true Just-in-Time scheduling or radio frequency identification (RFID) will be limited in application with minor impact on transportation requirements in most sectors.

The pervasive trend in logistics will be continued pressure to move freight "better, faster, cheaper" with the application of that trend specific to each commodity. Customers will be more likely than in the past to switch carriers, ports or routes for better, faster or cheaper transportation. Customers are less willing to change modes (e.g., between truck, rail and barge). Modal shifts often require extensive changes to the supply chain and perhaps to facilities. The advantages must be very large to overcome both inertia and perceived risk.

Rising Logistics Costs. Logistics costs, which have been on a downward trend as a share of GDP for a decade, have recently taken an uptick (Exhibit 8). The major trend in the U.S. transportation industry as a whole is that demand is strong and capacity in all surface modes is relatively scarce. Price actions are driving increased profitability and capital expansion, particularly in the rail industry. The full impact of spillover demand on the inland tug and barge industry has been delayed by Katrina. Fuel prices are an obvious source of additional

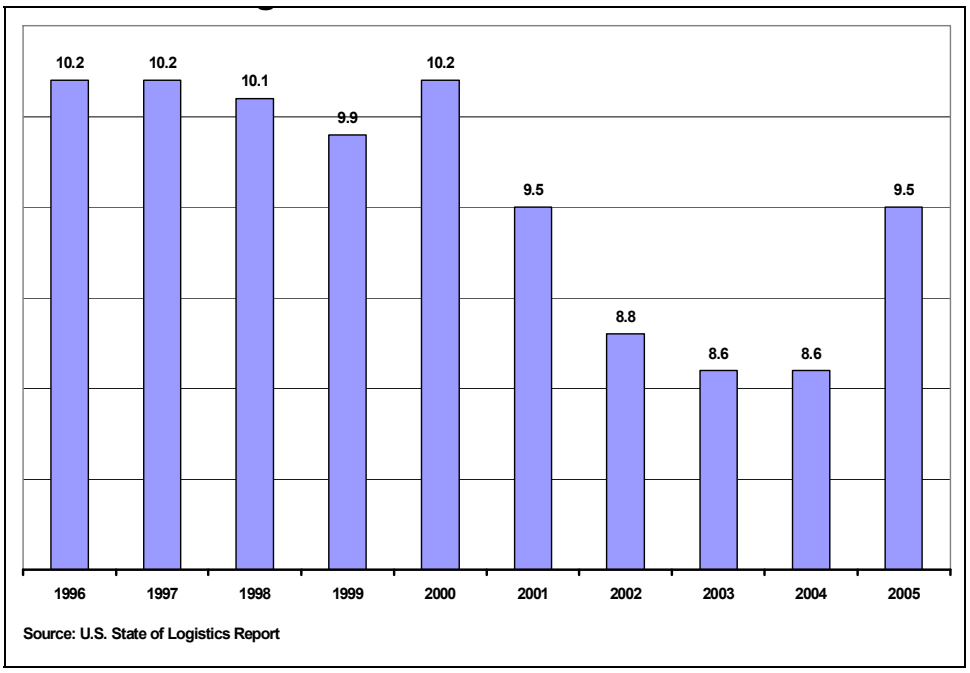


EXHIBIT 8
U.S. LOGISTICS COSTS AS A PERCENTAGE OF GDP

cost, but labor shortages in some modes and rising insurance costs have also increased logistics expenses. The shortage of truck drivers will continue, exacerbated by TWIC limits and immigration restrictions.

Just-In-Time vs. Time-Definite logistics. The so-called trend toward "just-in-time" logistics practices has been widely exaggerated. True just-in-time operations are rare, consisting as they do of assembly lines supported by a near-continuous stream of component deliveries. In many instances, what appear to be "just-in-time" logistics is simply a practice of shifting inventory off-site to vendor locations and requiring more frequent deliveries.

There is a stronger and more fundamental trend toward "time definite" deliveries, meaning scheduled deliveries with a narrower arrival window and less tolerance for variability. This trend is most important for efforts to influence modal choice away from trucking and toward maritime or rail solutions. As related elsewhere, freight industry stakeholders have expressed skepticism of proposed new short-sea shipping initiatives on the grounds of reliability. Delays at the Panama Canal have reduced the on-time performance of all-water container service to the east coast from Asia, voiding one of its chief selling points of all-water service (namely the perceived unreliability of intermodal service from congested west coast ports). Unreliability due to lock delays has also been cited as a limiting factor on the growth of inland barge traffic.

Commoditization of Transportation Services. Transportation and logistics will be increasingly "commoditized" with few differences between providers.

- Price competition will continue to encourage and reward efficiency but significant new efficiencies will be harder to find.

- Service competition will be more important, with the competitive edge going to carriers that can provide a comprehensive network of reliable services rather than those who are merely faster in their given niche. Customers will move closer to "one-stop shopping."

Implications: USACE cost-benefit analyses often rely heavily on understanding of industry transportation and logistics practices. Given the criticality and volatility of the logistics field it will be increasingly necessary for USACE to reality check its understanding and to undertake sensitivity analyses around logistics changes. Customers, in general, will become more demanding and less tolerant of unnecessary cost, delay or unreliability.

Uncertainties: There are no major uncertainties in this field.

2.8.2 Inland Transportation Trends

U.S. Highway Capacity. One of the major drivers of increased logistics costs is highway congestion. Since the 1980s the pace of highway construction has not met the increase in demand. Initially there was an overcapacity situation, but as time past demand has caught up The resulting congestion produces delays and along with higher fuel costs and other factors, drives up freight rates.

The U.S. highway system has begun to feel strained, with larger urban areas looking for congestion relief. Yet there will be no new initiative comparable to the Interstate Highway System and most regions will have to be content with marginal improvements.

- Expansion of the interstate highway system will continue to be slow, with emphasis on relieving bottlenecks and completing missing links. There will be no major national capacity additions. Intermodal connectors will receive limited attention, relying primarily on state and local funds.

- Expansion of toll roads will be concentrated in states with existing systems. Applications in other states (e.g., California) will be limited and isolated.

The highway system and the truckers that use it will increasingly be held responsible for adverse environmental impacts. National diesel emissions standards will be met and tightened with some impact on operating costs; alternative fuels and technologies will emerge for urban and port goods movement.

U.S. Rail Capacity. The railroads are also experiencing capacity constraints. Rail ton miles have increased by approximately 14 percent[12] between 2002 and 2005 and are expected to increase again. In the decades since the Staggers Act deregulated the industry in 1980, the railroads have transformed themselves, increasing ton-miles per route mile by a factor of three (Exhibit 9).

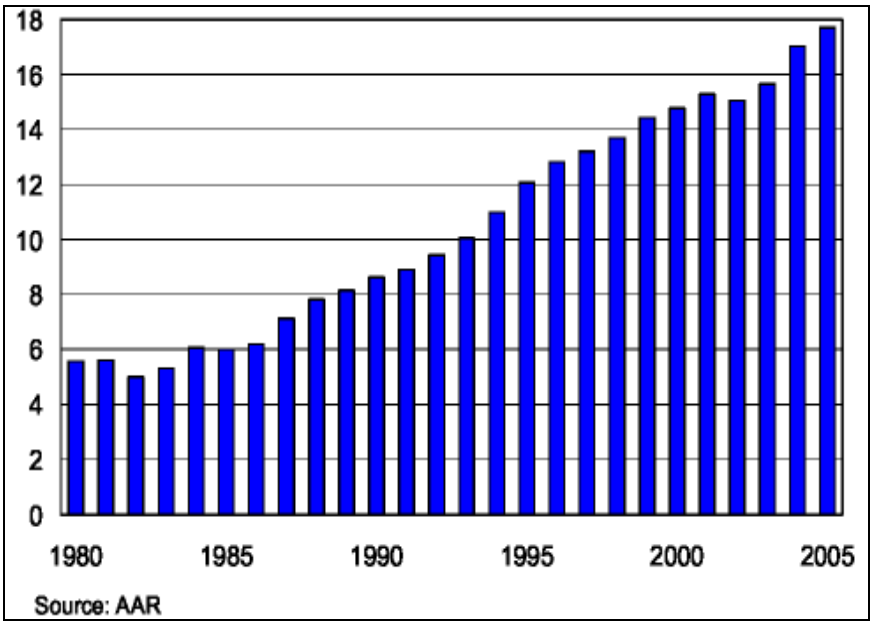


EXHIBIT 9
CLASS 1 RAIL TON-MILES PER ROUTE MILE
(millions)

[12] Source: Bureau of Transportation Statistics (BTS).

Until 2003 all the performance measures were positive. However, in the past two years rates have increased and productivity declined, reflecting the current capacity constraints in the rail industry (Exhibit 10).

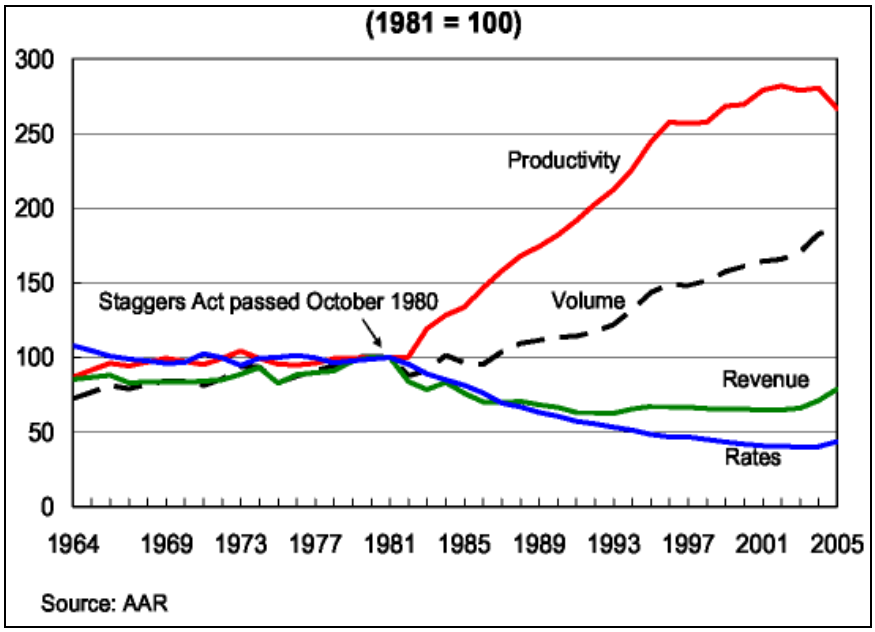


EXHIBIT 10
U.S. RAIL SYSTEM PERFORMANCE

Unlike the publicly provided capacity for highways and waterways, the railroads obtain capital in the private market and have increased capital spending to $ 8.3 billion in 2006 up 21 percent from the previous year.[13]

To balance the desirability of traffic increases with the perceived scarcity of capital North American railroads will continue to add capacity just barely ahead of demand—and sometimes behind demand. Since the 1950s the general trend has been reduction and rationalization of rail capacity to reconcile overbuilt facilities and increased productivity. In the last five years traffic growth has filled much of the North American rail network to near capacity. The railroads are thus in the unfamiliar position of needing not just selective upgrades but widespread capacity increases. This new circumstance has also put the railroads in a position to prioritize freight and raise rates. Most of the long-term contracts signed in the early years of double-stack container service have now come up for renewal. The railroads are taking the opportunity to renew on more favorable terms and at higher rates. The new-found market power has boosted profitability, most notably at Burlington Northern Santa Fe Railroad (BNSF), where intermodal is the leading business source. Although the railroads may be able to better justify investment in intermodal growth they are in no hurry to create excess capacity and dilute their market power. The likeliest trend is therefore strategic capacity investments to accommodate pent-up demand

[13] American Association of Railroads.

rather than building capacity for an uncertain future. From a maritime perspective this trend will tend to keep capacity for intermodal container and bulk export traffic barely ahead of demand. Ports and their customers can generally expect a future of tight rail capacity and stringent requirements for capital investments in advance of demand.

U.S. Pipeline Capacity. The relevant U.S. pipeline system consists of:

- 55,000 miles of crude petroleum trunk lines connecting production areas to refineries (Exhibit 11).
- 95,000 miles of refined product pipelines connecting refineries to distributors (Exhibit 12).
- 278,000 miles of natural gas transmission lines.

Direct interaction between the pipeline system and the marine transportation system is minimal since tank farms and refineries serve as buffer.

One new major pipeline projects is the planned Alaska natural gas pipeline, currently expected to begin operation in 2018. The pipeline is expected to lead to a quadrupling of Alaskan natural gas production between 2005 and 2021. The pipeline will tie Alaskan production into the existing pipeline network, obviating any need for the Liquid Natural Gas (LNG) shipping from Alaska and reducing the need for waterborne LNG imports.

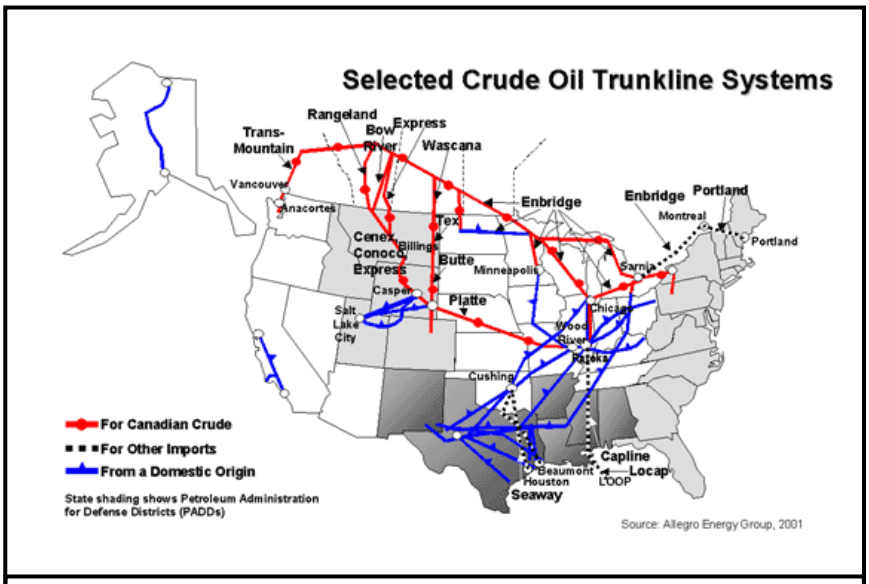


EXHIBIT 11
CRUDE PETROLEUM PIPELINE SYSTEM

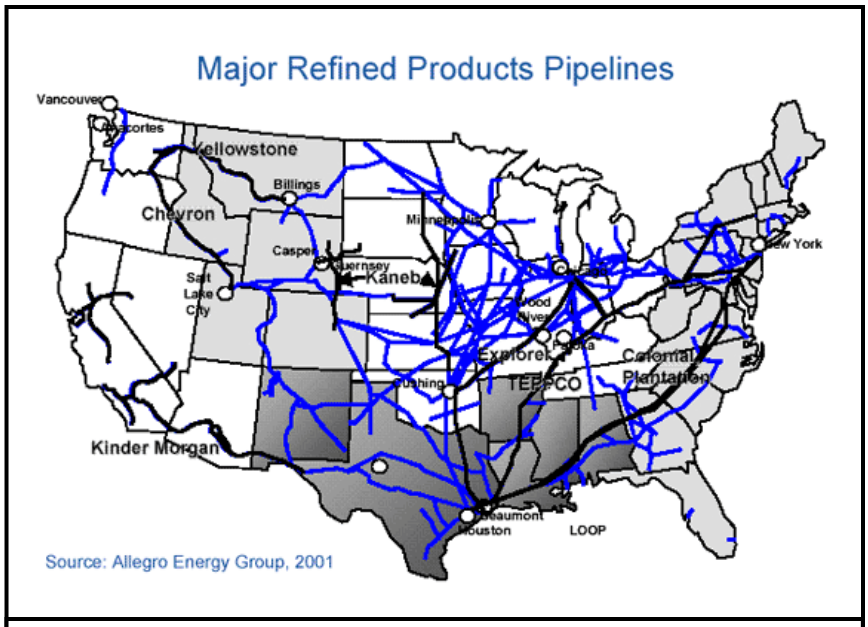
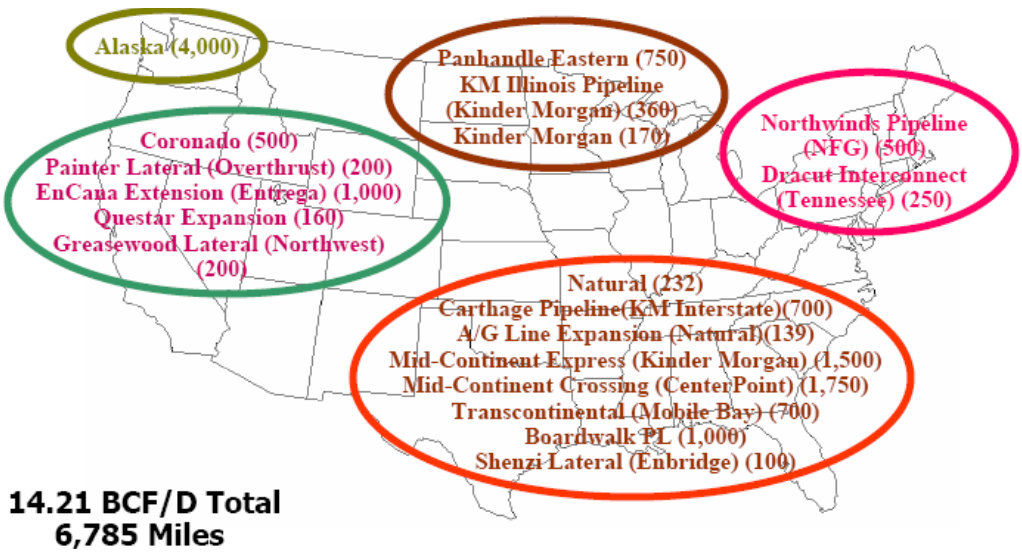


EXHIBIT 12
PETROLEUM PRODUCTS PIPELINE SYSTEM

Exhibit 13 shows the major pipeline projects on the current planning horizon. In general, these pipelines do not directly affect deep-sea shipping. Pipelines do, however, offer competition to the inland waterway system. Pipelines are by far the most efficient means of moving liquid bulk commodities, chiefly petroleum and petroleum products. Once built they will permanently supplant other modes for the commodities and movements they carry. Some of the projects shown in Exhibit 13 may therefore divert cargo from the inland waterway system.



Source: FERC/Office of Energy Projects, November 2006.

EXHIBIT 13
MAJOR PIPELINE PROJECTS ON THE PLANNING HORIZON
(million cubic feet/day)

Implications: Where the inland or coastal waterway systems are alternatives to highway and rail transport constraints on inland capacity should sustain if not expand the need for domestic maritime transportation. The inland modes also serve as a complement to the marine mode, however and it may be difficult to expand inland or deep-sea shipping without landside access and capacity. Tight inland capacity should not therefore, be interpreted as a potential boon for the marine transportation system. Moreover, tight highway and rail capacity will not necessarily justify expansion of port facilities and channel deepening in anticipation of that boon.

Although not expanding rapidly, pipelines have the potential to divert petroleum and petroleum products from the inland waterway system. Case-by-case analysis would be required to ascertain the impacts.

Uncertainties: The ability of the highway and rail system to expand capacity indefinitely is in question.

Construction of new pipelines is politically and environmentally sensitive and may not proceed as planned.

2.9 Impact of Fuel Prices

Expected rises in fuel prices are unlikely to shift much new traffic to the inland waterways.

The overall picture is for fairly stable diesel prices. The most recent Annual Energy Outlook published by the Energy Information Administration anticipates that distillate (diesel) fuel prices will actually decline at an average rate of 0.2 percent annually between 2005 and 2030, leaving the 2030 price 6 percent lower than in 2005. The distillate price is expected to bottom out in around 2015 at a level 15 percent lower than in 2005 and use thereafter at a rate of 0.7 percent annually, implying price increases beyond 2030.

Residual fuel (bunker) prices, however, are expected to rise at a rate of 1.6 percent annually, yielding a 50 percent cost increase by 2030. This increase will disadvantage those maritime operations still using bunker fuel rather than diesel. Bunker fuel oil is currently less than one-third the price of diesel in British Thermal Units (BTU), but will be about half by 2030.

It is generally agreed that waterborne transportation, particularly barging, is more fuel-efficient than rail, which is in turn more fuel efficient than truck. As shown in Exhibit 14 , however, estimates of relative fuel use vary wildly, making any quantified generalization about the impacts of fuel prices impossible.

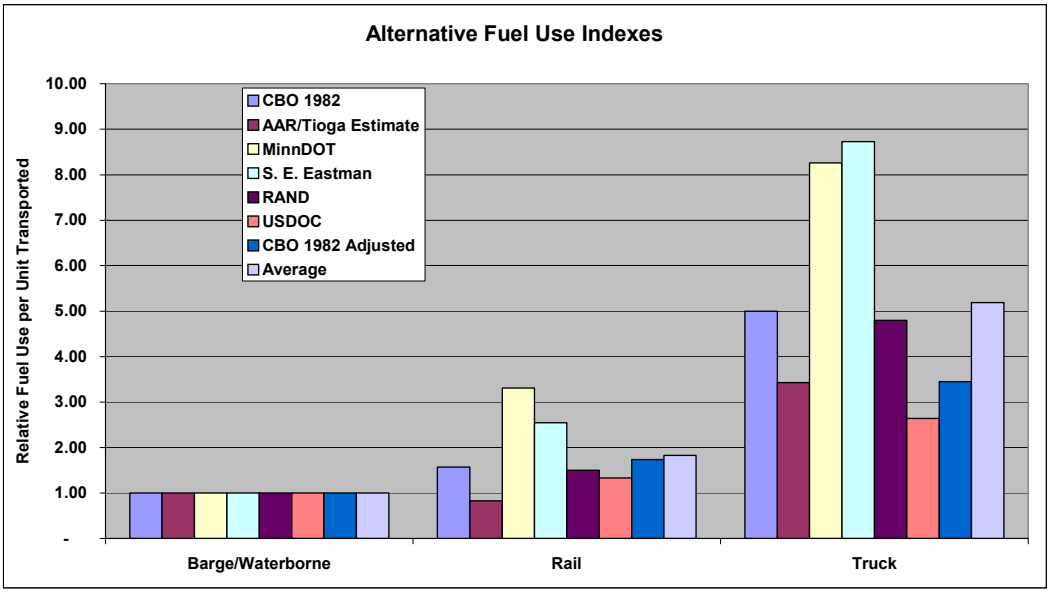


EXHIBIT 14
DIESEL FUEL PRICE INDEXES BY MODE

The estimates in Exhibit 14 were derived from a variety of sources ranging from 1982 to the present and are striking in their disparity. The differences appear to be traceable to assumptions and methodology rather than technology.

- Marine, rail and trucking equipment in use varies significantly in its fuel consumption characteristics. For example, the Congressional Budget Office (CBO) 1982 estimates show overall rail operations as using 57 percent more fuel than barge operations. But unit coal trains as using 12 percent less.

- Estimates differ in accounting for empty return moves, repositioning between loads or upstream barge travel.

- The mileage between two points by barge, rail and truck will always differ and the circuity for any one mode may be substantial. The CBO 1982 adjusted estimates on the chart attempt to adjust for circuity.

These observations suggest that any modal fuel use comparisons must be made on a case by case basis, including the full trip cycle, the actual equipment used and the actual mileages covered.

Using the 1982 CBO estimates and fuel prices from Energy Information Administration (EIA), Exhibit 15 estimates the cost impact of the 2004 to 2005 diesel price rise on an average barge move of 1,500 tons over 476 miles (USACE data). The results show a small additional advantage for barge over rail in general, but also a small additional advantage for unit trains over the barge move. The truck is at a huge additional disadvantage but was never competitive in the first place.

Mode	BTU/Ton-mile*	2004 $/Ton-mile**	2005 $/Ton-mile**	Increase	476-mile trip 1500 tons	Barge Advantage
Barge	420	$ 0.006	$ 0.007	$ 0.002	$ 1,182	$ -
Rail	660	$ 0.009	$ 0.012	$ 0.003	$ 1,857	$ 675
Rail Unit Train	330	$ 0.004	$ 0.006	$ 0.001	$ 928	$ (253)
Truck	2100	$ 0.029	$ 0.037	$ 0.008	$ 5,908	$ 4,726

* Source: CBO, 1982
** Source: EIA, 2006

EXHIBIT 15
COMPETITIVE IMPACT OF FUEL PRICES

Implications: Given the many variabilities in relative fuel use sweeping generalizations about modal advantages are likely to be misleading. Barge transportation is generally conceded to be the most fuel-efficient surface mode but the actual difference will vary widely on a case-by-case basis. Barge is already the least-expensive mode where available. The impact of fuel price changes is unlikely to tip the competitive balance between barge and rail significantly, especially with the relatively stable fuel prices being forecast.

Uncertainties: As noted, actual modal competitive position will vary widely from case to case. Larger-than-anticipated fuel price changes would have a more marked effect.

2.10 Liner Shipping Trends

Trends in deep-sea shipping will mirror economic and logistics trends, with an emphasis on supply chain efficiency tempered by environmental considerations.

2.10.1 Containerized Trade Growth

Since 1980 U.S. containerized trade has grown at an average annual rate of 6.3 percent as shown in Exhibit 16[14].

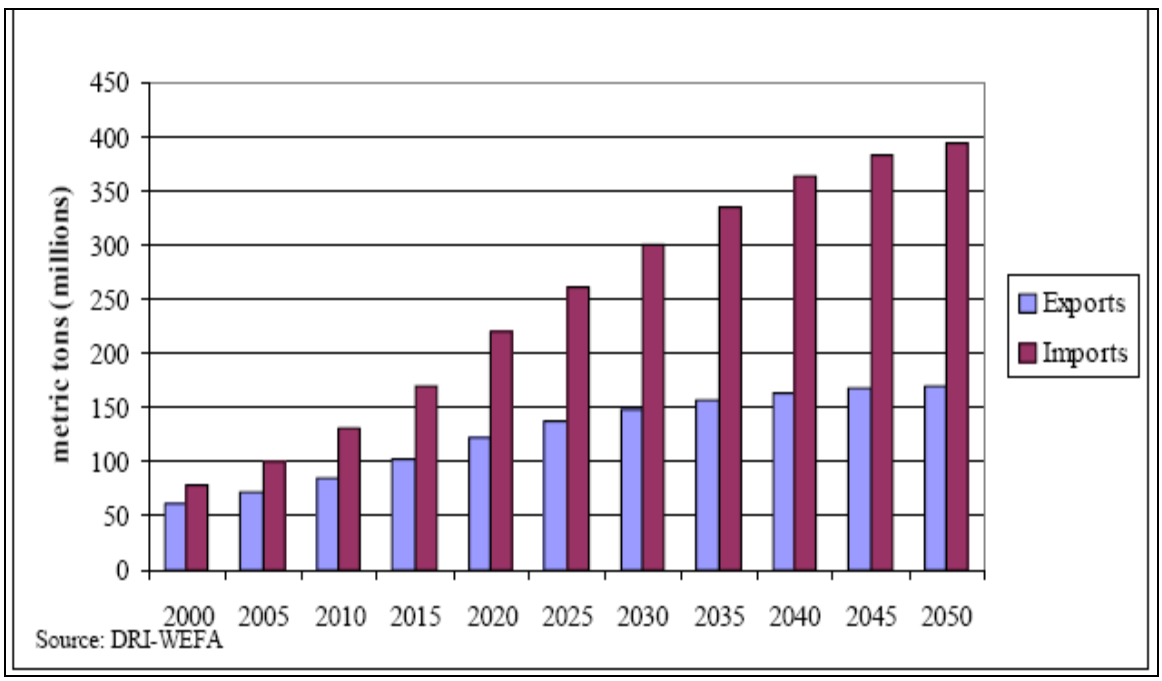


EXHIBIT 16
CONTAINERIZED TRADE GROWTH

As the chart suggests, container trade through Pacific Coast parts has been growing faster, at an average of 67.8 percent annually. Atlantic Coast container trade has grown at 55 percent; Gulf container trade has grown at 5.4 percent.

The near term outlook is for slightly faster growth but returning to similar rates beyond 2010. In broad terms, the growth trends will continue.

[14] *National Dredging Needs Study of U.S. Ports and Harbors*: Update 2000, IWR Report 00-R-04, 2003.

2.10.2 Container Vessels and Operations

Sizes and Drafts. The maximum and average size of container ships will continue to increase. The most recent 2006 new buildings for the Maersk shipping line are 13,000+ TEU, but the upward trend is by no means uniform. A comparison of the 2000 and 2005 container vessel order books (Exhibit 17) reveals that the distribution has shifted upward. Yet over half the vessels on order in 2005 were under 4,000 TEU.

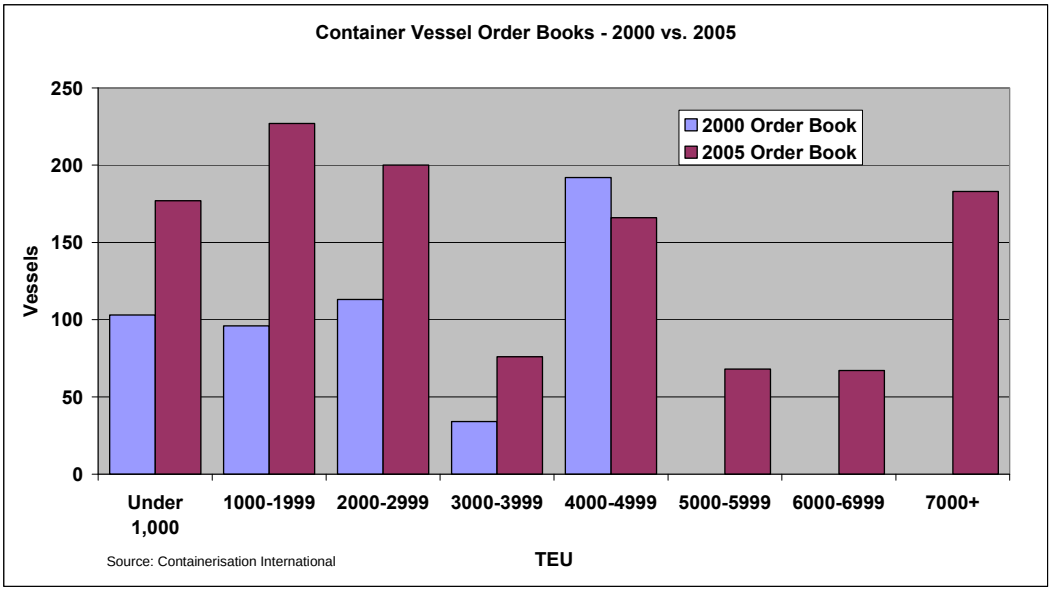


EXHIBIT 17
CONTAINER VESSEL ORDERS

Vessels of less than 4,000 TEU (almost all of which would be able to transit the Panama Canal) accounted for 64 percent of total world slot capacity in October 2005 and 29 percent of the slots on order. As shown in Exhibit 18, the average TEU/vessel actually delivered in each year has risen steadily and is expected to climb further (the 2009 figure is probably exaggerated since larger vessels are ordered farther in advance). Despite the attention paid to the largest vessels, however, the average in 2006 is expected to be just 3,520 TEU—a Panamax size.

The largest container vessel afloat is the Emma Maersk, listed by Maersk at 11,000 TEU but rated at 14,500 TEU by outside analysts. The Emma Maersk is the first of an eight vessel order. The vessels reportedly have a 52-foot draft and are too wide for the proposed new Panama locks.

- CMA/CGM placed orders for eight 11,400 TEU vessels for delivery in 2010.
- ZIM placed orders for four 10,000 TEU vessels for delivery in 2009

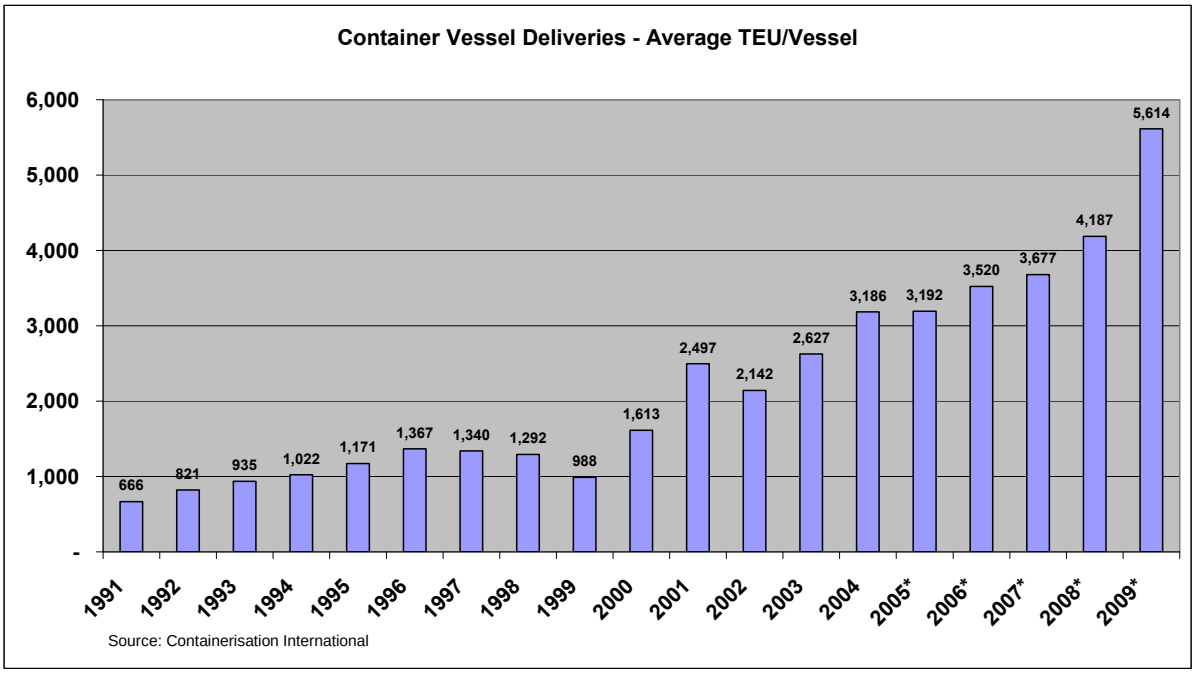


EXHIBIT 18
AVERAGE DELIVERED CONTAINER VESSEL SIZE

As of September 2006, Clarkson Research announced that there were 1,286 container ships of all types on order with an aggregate capacity of 4.65 million TEU, an average of 3,600 TEU per vessel. That is a 52 percent increase in current containership fleet capacity by 2010.

Some observers suggest that container vessel sizes will likely max out at 12,000 TEU for transpacific and transatlantic trades, but will reach 18,000 TEU for the Europe/Asia trade.

Containership Capacity. The growing size of containerships is shifting the relationship between vessel dimensions and capacity in TEU, with potential impacts on berthing and dredging requirements. While some observers previously anticipated that 8,000+ TEU vessels would require 48-foot of draft, longer and wider designs have enabled the vessels to do with less. Some designs for 13,000+ TEU vessels apparently require only 45-foot of draft because they are longer than 8,000 TEU vessels and 21 containers wide rather than 17.

A 2005 study by the Mercator Group for the Port of Long Beach estimated that an 8,000 TEU vessel in the Asia-U.S. West Coast trade reduces vessel costs by $99 per TEU compared to a 4,500 TEU vessel and that a 10,000 TEU vessel produces additional savings of $51 per TEU. With an annual volume approaching 15,000,000 annual TEU in Southern California alone and tight carrier profit margins the attraction of larger ships is obvious.

Mercator's analysis echoes the general comments of others that vessels of up to 18,000 TEU would offer additional savings but at a diminishing rate. In particular, Mercator found that the more costly propulsion systems required by larger vessels do not return incremental net cost

savings until capacity exceeds 14,000 TEU. It is therefore perhaps not coincidental that the new series of vessels begun with the Emma Maersk has been independently rated at 14,000+ TEU.

Exhibit 19 lists twelve representative averages or vessels built between 1968 and 2006. Deadweight tonnage is theoretically a measure of the vessel's lifting capacity. A conservative practice (used publicly by Maersk) is to base capacity on an average weight of 14 metric tons per TEU. That practice would result in the first set of TEU figures in Exhibit 19.

Year	Line	Vessel	Length (m)	Width (m)	Draft (m)	DWT (tonnes)	TEU @ 14 tonnes	Usable TEU	DWT/TEU
Panamax									
1968	Average	1st Generation	180.0	24.0	9.1	15,000	1,071	900	16.7
1969	Average	2nd Generation	220.0	25.0	10.7	29,000	2,071	1,500	19.3
1971	Average	3rd Generation	275.0	32.1	11.8	37,000	2,643	2,300	16.1
1984	USL	Econ-ships	290.0	32.2	10.7	57,800	4,129	4,458	13.0
PostPanamax									
1988	APL	President Adams	275.1	39.4	12.5	54,655	3,904	4,340	12.6
1995	APL	Dubai	300.0	37.1	13.0	62,905	4,493	4,986	12.6
1997	Maersk	Sovereign Maersk	347.0	42.8	14.0	104,886	7,492	8,680	12.1
2001	Hapag Lloyd	Hamburg Express	320.0	42.8	14.5	100,000	7,143	7,179	13.9
2003	OOCL	Shenzhen	323.0	42.8	14.5	99,518	7,108	8,063	12.3
2005	Maersk	Gerd Maersk	367.0	42.8	15.0	115,700	8,264	10,150	11.4
2006	CMA-CGM	Medea	350.0	42.8	14.5	118,000	8,429	9,415	12.5
2006	Maersk	Emma Maersk	397.0	56.0	15.5	156,907	11,208	14,500	10.8

Sources: The Containership: How Big?, presentation by Zia Rizvi; and Containership-Info.net

EXHIBIT 19
REPRESENTATIVE CONTAINERSHIP DESIGNS

Recognizing that many containers move empty and that a realistic average is something less than 14 metric tons, the second set of TEU capacity estimates (labeled "Usable TEU in Exhibit 19) is based on total cellular and deck capacity given permissible stacking practices. On smaller vessels these usable capacities may be smaller than the "14 ton" capacity due to physical space constraints. On larger vessels the usable TEU capacity is up to 29 percent higher than the "14 ton" capacity on the Emma Maersk 3. The difference could be as much as 3000 TEU–the equivalent of an entire third generation vessel.

As Exhibit 19 shows, the ratio of DWT to usable TEU has therefore dropped significantly. The crossover points in Exhibit 19 are

- The USL Econo-ships, designed to maximize loading space within Panamax dimensions; and
- The initial post-Panamax vessels represented by the APL President Adams, which used extra width to gain usable capacity without a commensurate increase in deadweight tonnage.

The chart in Exhibit 20 displays the downward trend in DWT per usable TEU for the vessels in Exhibit 19.

The Mercator study provides the following examples (Exhibit 21).

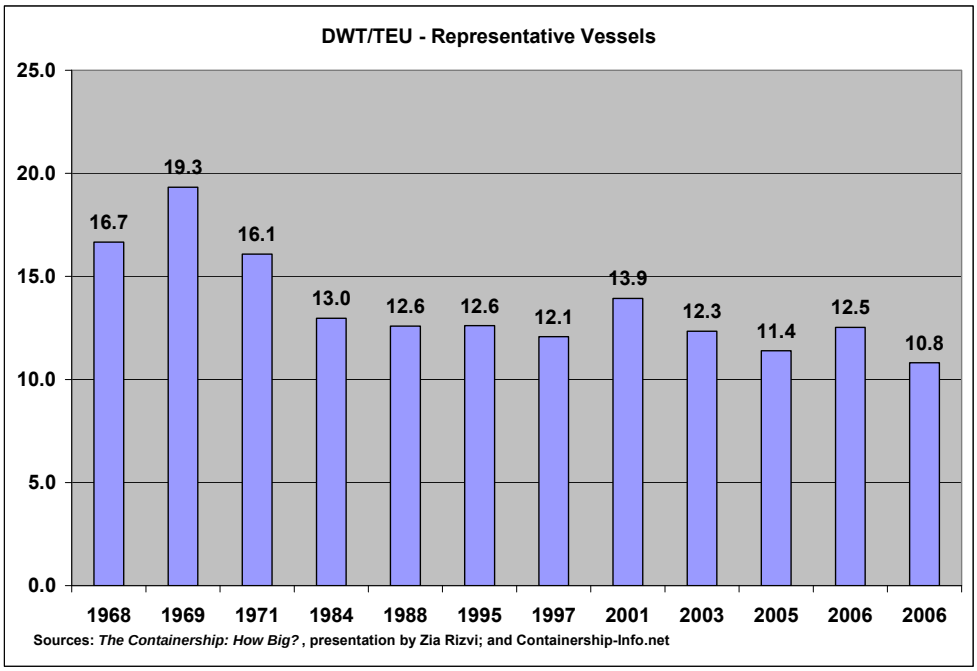


EXHIBIT 20
DEADWEIGHT TONS PER TEU OF REPRESENTATIVE CONTAINERSHIPS

Vessel Capacity (TEU)	3237	5060	5714	8063
Design Draft (feet)	34’	40’	40’	43’
Channel depth	37’	43’	43’	46’

EXHIBIT 21
VESSEL TEU AND DRAFT

Exhibit 22, from a MARAD study, shows the gradual impact on average DWT/TEU as newer, more spacious vessels enter the fleet.

Exhibit 23 shows a collateral impact. Draft does not increase as fast as usable TEU. The logarithmic trend line shown suggests that dredging may not be an indefinite task: current and proposed designs are topping out at about 15.5 meters (50 to 51 feet).

The “post-Panamax” capacity threshold is commonly considered to be about 4000 TEU. As Exhibit 19 demonstrates, the largest Panamax vessels actually reached 4129 TEU while the first post-Panamax vessels were slightly under 4000 TEU.

Deployment and Cascading. The general trend in deployment of new container vessels is well known and has persisted for some time.

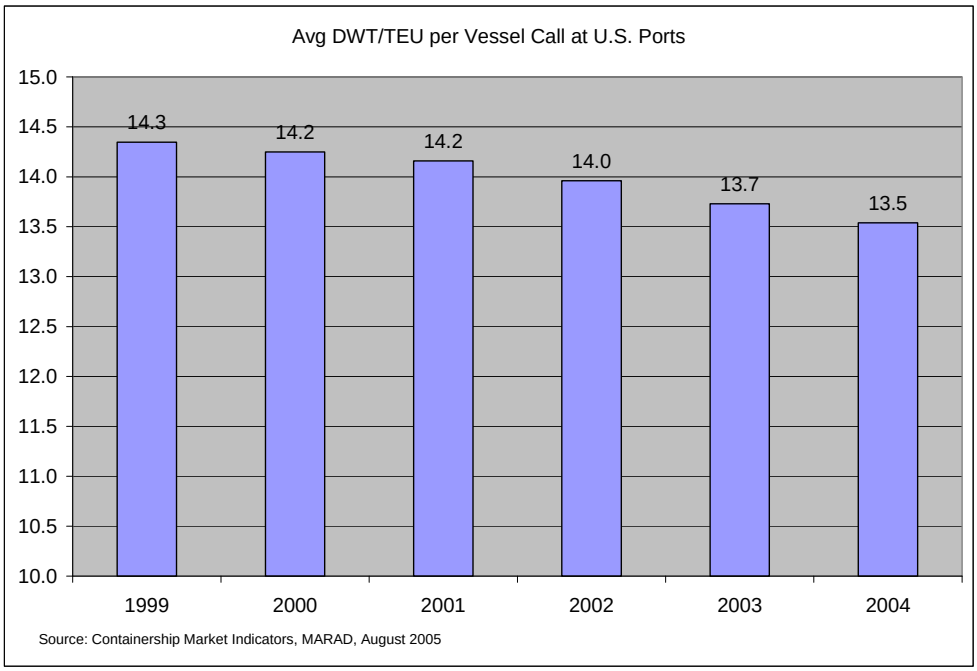


EXHIBIT 22
AVERAGE DWT/TEU AT U.S. PORTS 1999-2004

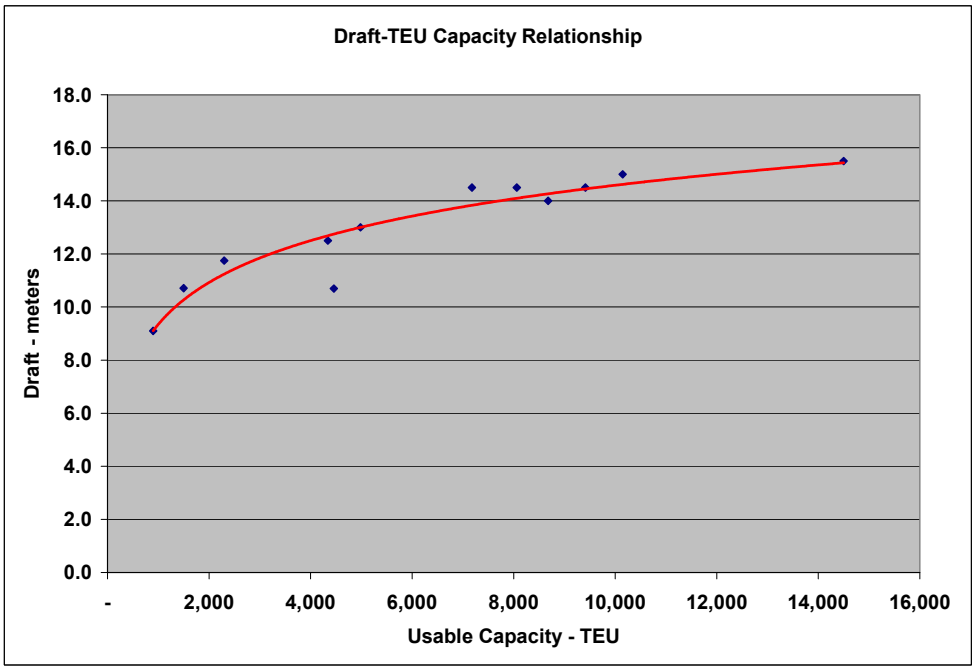


EXHIBIT 23
DRAFT-TEU CAPACITY RELATIONSHIP FOR REPRESENTATIVE VESSEL DESIGNS

- The newest large vessels (currently 10,000+ TEU) are deployed in the Asia-Europe trade where the long voyages can best exploit lower operating costs and scale economies. These vessels can transit the Suez Canal but not the Panama Canal.

- The next-largest vessels (currently 4,000–8,000 TEU) are deployed in the Transpacific, which also receives the former Asia-Europe vessels displaced by larger ships. The Transpacific has the next longest voyages and growth there has regularly absorbed the increased capacity. These "post-Panamax" vessels over 4,000 TEU generally cannot transit the Panama Canal.

- The smallest vessels, less than 3,000 TEU, were typically deployed in smaller trades with shorter voyages, such as the Americas trade, the Africa trades or the Intra-Asia trades. That is still the case and 54 percent of the vessels on order in late 2005 were in this size range. As noted, however, strong growth in the Intra-Asia trade has led carriers to deploy larger new and cascaded vessels of 4,000 TEU or more in that service as well.

- Industry analysts have noted that some carriers have used smaller vessels to start "second string" services to smaller ports. Another option is feeding smaller vessels into the charter market, where they might find their way into other trades (notably the Intra-Asia trade).

Deployment trends are influenced by port and canal limitations and voyage length as well as by trade volume. Drewry Consultants has estimated that the Panama Canal can only absorb 7 more all-water services before running out of capacity. The larger vessels being displaced from the Asia-Europe and Transpacific trades can have drafts of over 40 feet, limiting their deployment at some ports. A weekly service in the Transpacific typically requires a string of 5 ships, but comparable services in the Suez Canal Asia-Europe trade would require 12 ships and a Panama Canal Asia-USEC service would require 8 to 9 ships. Displacing a full string of Asia-Europe vessels can thus supply two or more Transpacific services, but two Transpacific strings must be cascaded to create one Panama service.

Speed. Along with the increase in container vessel size has come an increase in speed. The newest vessels raise the former norm of about 23 knots to 27 knots. The higher speeds facilitate higher productivity on the long Asia-Europe routes through the Suez. Despite rising fuel costs the larger vessels still have better scale economics.

Besides offering faster transit times the faster vessels should allow carriers to operate services with fewer ships. For example, a string between Asia and the East Coast U.S. ports via Panama that currently operate with eight 24-knot vessels is expected to operate with seven 29-knot vessels by late spring of 2007. The faster vessels will offer an 18-day service from Yiantian to New York and attract more cargo from minilandbridge competitors.

Greening. The transpacific and transatlantic fleets will become "greener" (e.g., more environmentally friendly, with cold-ironing capability) under pressure from Southern California and European ports. The strong Southern California efforts to reduce emissions from vessels of all kinds will likely spread to other ports on the West Coast (Oakland, Seattle, Tacoma, Portland) and eventually to much of the nation. The three critical elements of emissions reduction are:

- Use of Ultra Low Sulfur Diesel (ULSD) in place of high-sulfur bunker fuel while in U.S. waters. (The California Air Resources Board [CARB] regulation would require use of ULSD with 24 miles of California ports starting in January 2007.)
- Speed reductions in port and nearby (the Long Beach "Green Flag" program).
- "Cold ironing," use of electric share power instead of main engines while in port.

The program in Southern California has been piecemeal thus far, with growing Green Flag compliance and some retrofitting for ULSD. A major advance was recently achieved with Maersk's commitment to fit 35 vessels to use ULSD in Southern California. The "greening" of the vessel fleet is likely to spread, first in the high-profile Transpacific trade and eventually to other trades. Reduced vessel emissions will help clean up port region air quality but will, ironically, reduce the environmental benefits of navigation projects aimed at facilitating vessel movements. Provisions for "cold ironing" are costly and have been greeted with wariness by other port regions.

Load Centering. Load centering was a widely discussed "trend" in the 1990s that never had much impact. The advent of containerized "megaships" in the 6,000 to 8,000 TEU range was expected by many observers to concentrate cargo in a few coastal "load centers" with truck, rail or vessel feeders to smaller ports. Instead, rapid cargo growth and fleet expansion has led to "megaship" services at multiple ports as major carriers and alliances attempt to provide direct service in every market. The few ports that may have been victims of load centering include Portland, Oregon and Boston, both of which have had trouble holding on to multiple container lines. Load centering as a strategy has had more validity in Europe and Asia where marine feeder services are well developed. In North America any tendency toward "load centering" has been superseded by capacity concerns at the largest ports and expansion in secondary markets.

Implications: Future vessel sizes, drafts and deployments will translate directly into demands for maintenance dredging and channel deepening. Every port would like to handle every ship and project sponsors invariably cite increasing vessel sizes in dredging project justifications.

The container vessel fleet changes slowly despite the attention given to the newest largest vessels, smaller vessels are still being built and deployed.

The Mercator study is the most thorough and analytic treatment of the issue. That study does not foresee 10,000+ TEU vessels with 48-foot drafts arriving in Southern California until 2015 and then only in small numbers. The 10,000 TEU vessels being built and any larger ones to follow will be deployed in the Europe-Asia trade and the 8,000 TEU vessels being used in that trade will cascade into the Transpacific.

Most other ports on the West Coast have or will soon have sufficient draft for 10,000+ TEU vessels. This is particularly true if the added vessel capacity is gained by increasing width at the same or small draft.

From a national perspective, therefore, there does not seem to be a near-term barrier to the scale economies of larger vessels. Moreover, there is no realistic threat of large scale diversions from Southern California ports (and in fact, local communities might even welcome such diversions).

Uncertainties: Very large container vessels are likely to be deployed by no more than a dozen ocean carriers and 12 is too few decision makers to model statistically. There remains the possibility that one or more carriers could deploy very large vessels as a matter of strategic choice, just as U.S. lines introduced the 4,000+ TEU Econo-ships twenty years ago.

To be of any commercial value, however, such a vessel would either need to serve the largest markets (e.g., Southern California or New York/New Jersey) or be devoted to large-scale inland intermodal movements (e.g., through Tacoma, Vancouver or Prince Rupert).

2.10.3 Container Industry Conditions

End of Conference System. The conference system in the liner trades is under attack worldwide, although most prominently in Europe. Widely viewed as an anti-competitive price-fixing system (despite a much more complex reality), what remains of the conference system is likely to progressively collapse under increasing pressure in the next decade. Collapse of the conference system will not lead to chaos in the liner trades, as the actual influence of the conference system has already declined substantially. Collapse of the liner conference system will, however, likely lead to increased consolidation as ocean carriers seek to control more business, provide global services and insulate themselves from competition. The remaining carriers will likely sort themselves out into two large categories: global container carriers that serve all major trades and ports as well as trade-specific carriers who concentrate in one or more specific trades and withdraw from others. The industry is already moving in this direction with Maersk, MSC and the larger alliances as the global carriers and many others as trade-specific carriers. This trend will accelerate as the conference system declines.

Liner Trade Consolidation. The container shipping industry continues to consolidate more business in fewer firms and this trend is expected to continue indefinitely.

As of late 2005, the 10 largest carriers controlled 72 percent of the world container fleet capacity. AP Moller, parent of Maersk Line, will control about 22 percent of world capacity (Exhibit 24). Ten years ago, the top 10 carriers controlled about 35 percent of the capacity.

The overall size and trade coverage of the largest carriers permits them to exploit the scale economies of very large vessels. (It is no coincidence that Maersk, the largest carrier, is acquiring the first 13,000+ TEU ships.) The volume of trade under single control also enables to justify separate all-water and Suez services on an economic scale. Finally, the largest carriers, notably Maersk, has the internal financial strength and cargo volume to participate directly in development of new port terminals.

Alliances and vessel sharing agreements. Other carriers have achieved some of the same goals by forming alliances or vessel sharing agreements (VSAs) in specific trades. Alliances can combine services to achieve the same kind of scale economies and breath of service that Maersk can do by itself. Alliances and vessel sharing agreements have become more common in the Australia – New Zealand and South American trades as a means of rationalizing what had been

Line	2005 Vessel TEU	Vessel TEU on Order	Projected Vessel TEU	Share
Maersk Line	1,523,347	714,184	2,237,531	22%
MSC	736,301	271,316	1,007,617	10%
Evergreen	470,234	152,583	622,817	6%
CMA/CGM	424,494	363,594	788,088	8%
APL	326,291	89,908	416,199	4%
CSCL	317,541	154,160	471,701	5%
COSCO	308,223	220,583	528,806	5%
NYK	292,304	146,600	438,904	4%
Hanjin	291,207	74,365	365,572	4%
MOL	240,391	90,400	330,791	3%
Top 10 Total	**4,930,333**	**2,277,693**	**7,208,026**	**72%**
All Others	1,950,235	826,167	2,776,402	28%
World Total	**6,880,568**	**3,103,860**	**9,984,428**	**100%**

EXHIBIT 24
LINER TRADE CAPACITY SHARES

chaotic competitive conditions. In alliance or vessel sharing agreements, members typically either pool similar vessels on a joint service or trade slot capacity between existing services. Alliance members do not ordinarily interchange or pool containers.

2.10.4 Containerization vs. Break-Bulk Shipping

Refrigerated Trades. Over time, more and more of the refrigerated tonnage is moving in containers. This is a strong trend as the products are shifted from conventional bulk reefer ships into boxes.

- In 1985, 80 percent of the world's refrigerated cargo was still carried in conventional reefer ships.
- In 2005, 57 percent of the reefer cargo volume is carried over the world's oceans in refrigerated containers, while the rest is carried on conventional reefer ships.

Below is a chart, through 2002, of the share of reefer capacity by conventional reefer versus reefer slot capacity on container ships (Exhibit 25).

The updated reefer fleet is shown below, Exhibit 26, based on Clarkson's data. It is clear that the number of bulk reefer ships is declining and so is the capacity (Exhibit 27).

Reefer vessels are being scrapped or converted to other uses in record numbers. The age of the older reefer vessels suggests that scraping will accelerate for the next few years (Exhibit 28).

The source of competition is the container carriers. For example, P&O/Nedlloyd (now Maersk) ordered 7 new reefer container ships and 14,500 integral reefer containers in 2002 for the Europe and North American trades.

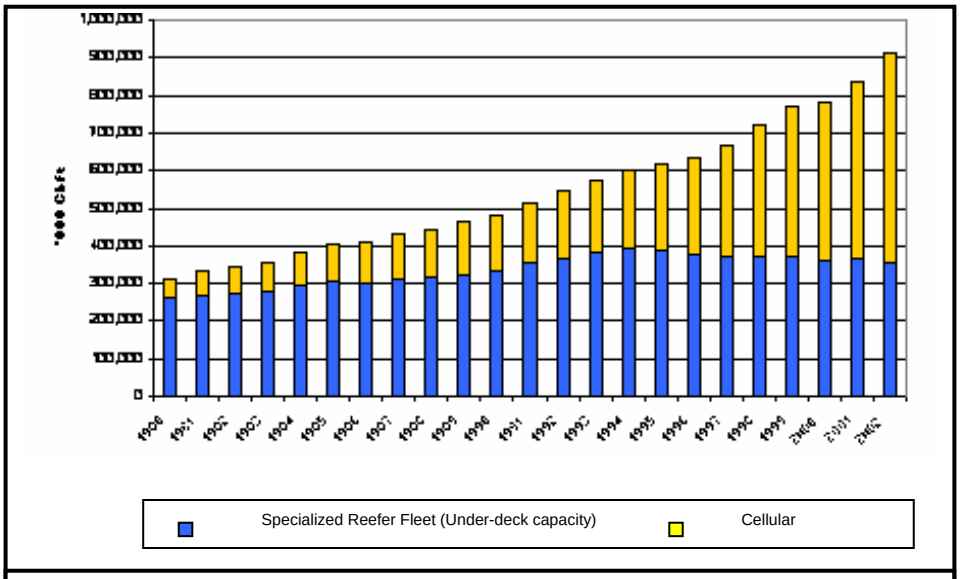


EXHIBIT 25
CONVENTIONAL REEFER FLEET VS. REEFER SLOTS ON CONTAINER VESSELS

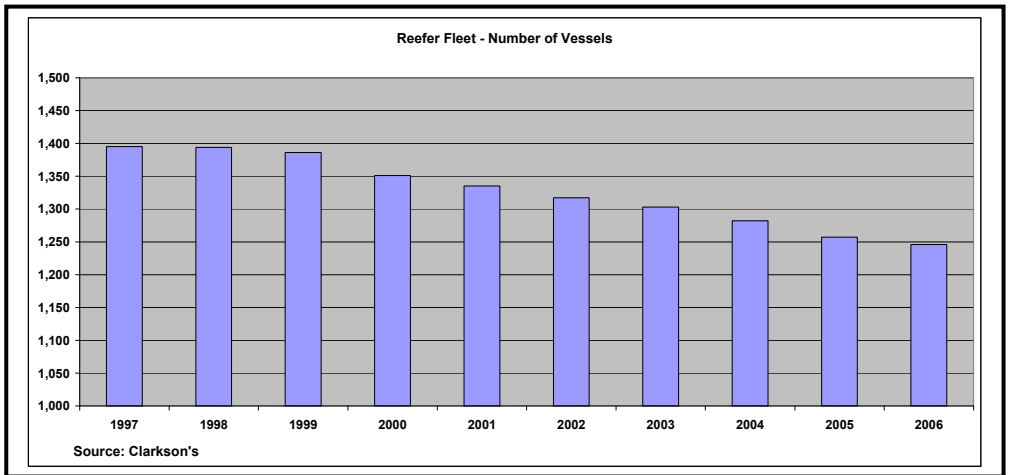


EXHIBIT 26
REEFER VESSEL FLEET

The general outlook (Exhibit 29) from an industry observer indicates further market share shift from conventionals to containers.

While the conventional reefer ship capacity has declined, the container shipping capacity has increased and, therefore, so has the total reefer container capacity. The conventional future reefer fleet, in the face of a market switch to containers, is likely to continue its decline. We expect the number of ships to decline even as capacity grows slightly, since the few new ships being added are at the large end of the size spectrum.

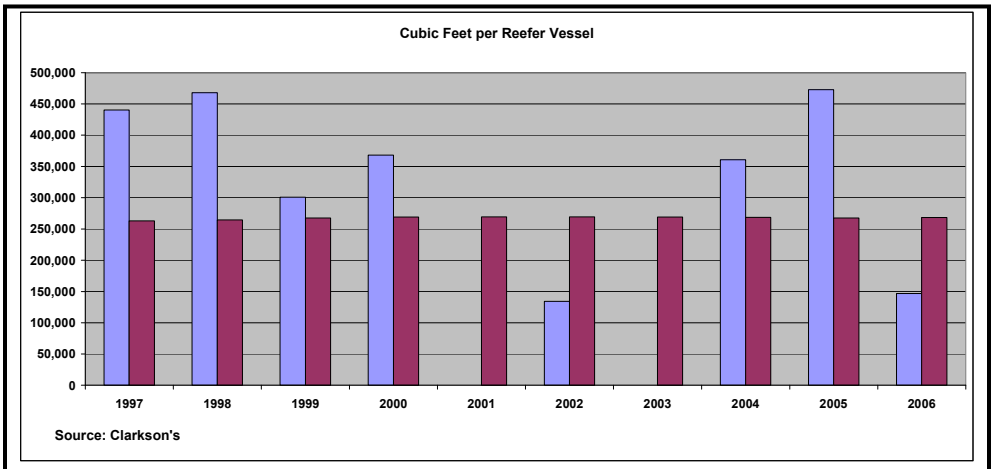


EXHIBIT 27
SIZE OF REEFER SHIPS

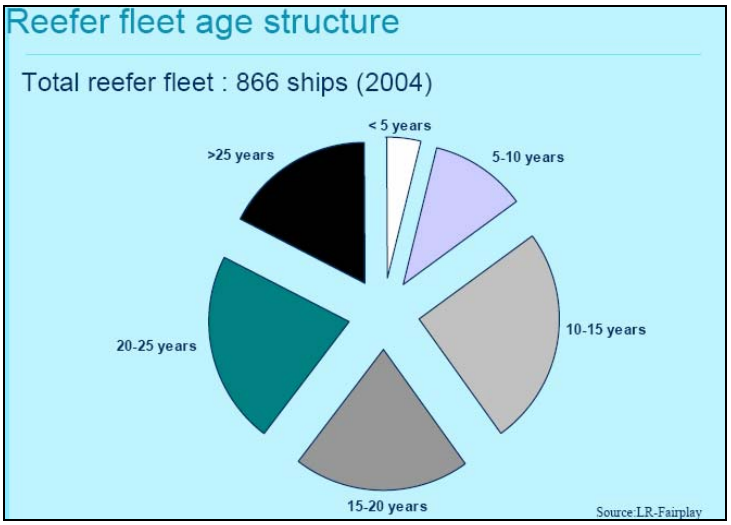


EXHIBIT 28
AGE OF REEFER SHIP FLEET

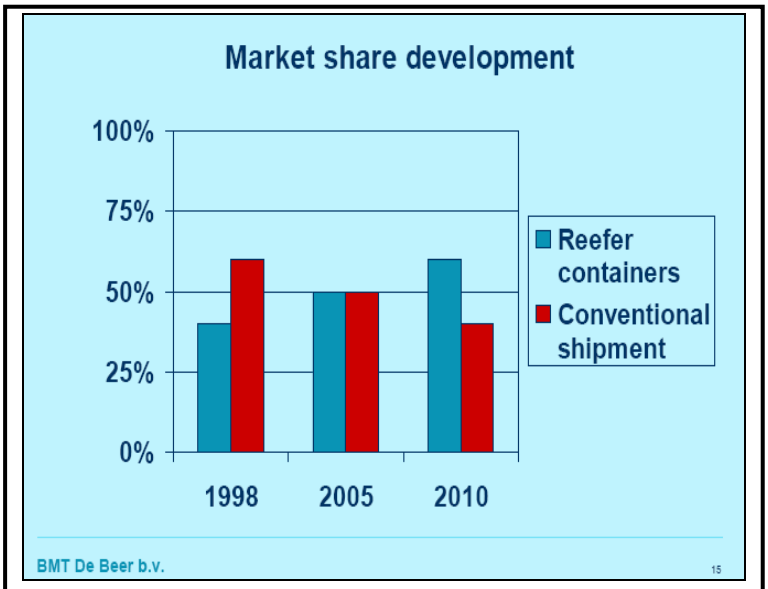


EXHIBIT 29
REFRIGERATED CONTAINERS VS. CONVENTIONAL REEFER SHIPS

2.10.5 Other Break-Bulk Cargoes

The world's merchandise trade is effectively containerized. The remaining break-bulk commodities mostly consist of items that either do not fit in conventional containers or can be more efficiently handled by other means. Over the years the list of such commodities has been shrinking and the remaining break-bulk trades are focused on steel, lumber, machinery, newsprint and project cargoes. The imbalance in major U.S. container trades continues to maintain low export rates and encourage containerization.

As a later section notes, both the break bulk trades and the terminals that handle them can be precarious. Controlled by just a few shippers and consignees and dependent on economic conditions that can fluctuate, these trades can start, flourish and disappear in just a few years.

Implications: The break-bulk sector continues to shrink in terms of commodities carried. Port and channel requirements of break-bulk vessels may be short-lived.

Uncertainties: The USACE projects to accommodate such trades must acknowledge the potential volatility and risk.

2.11 Bulk Shipping Trends

2.11.1 Bulk Trade Growth

Exhibit 30 provides an overview of world seaborne trade. As the chart shows, the major driver in tonnage terms is the petroleum trade. At the other end of the spectrum is the "other dry" trade—containerized cargoes. In between are the bulk trades in grain, coal, iron ore, petroleum products and many other less prominent commodities.

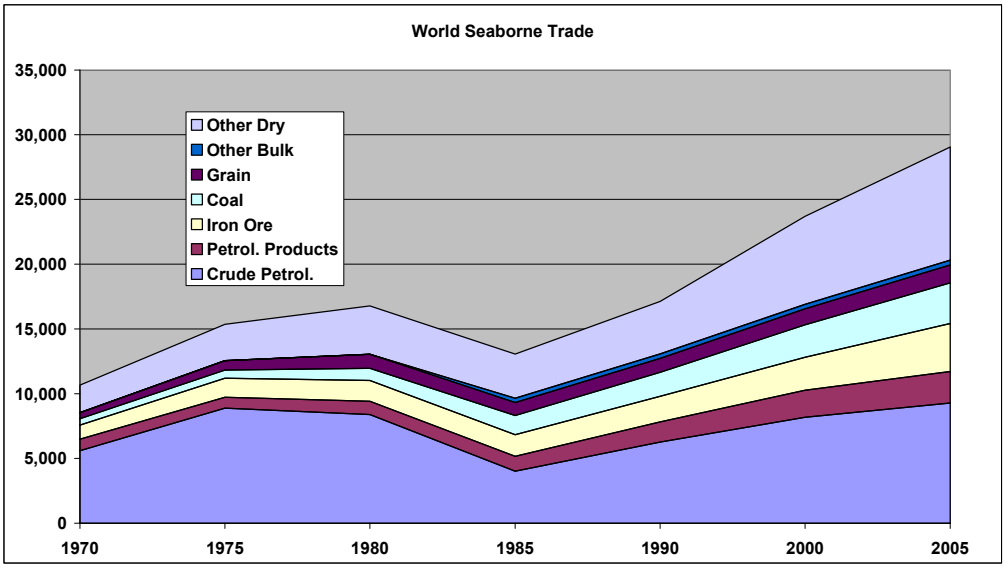


EXHIBIT 30
WORLD SEATRADE GROWTH

U.S. tonnage growth is shown in Exhibit 31.

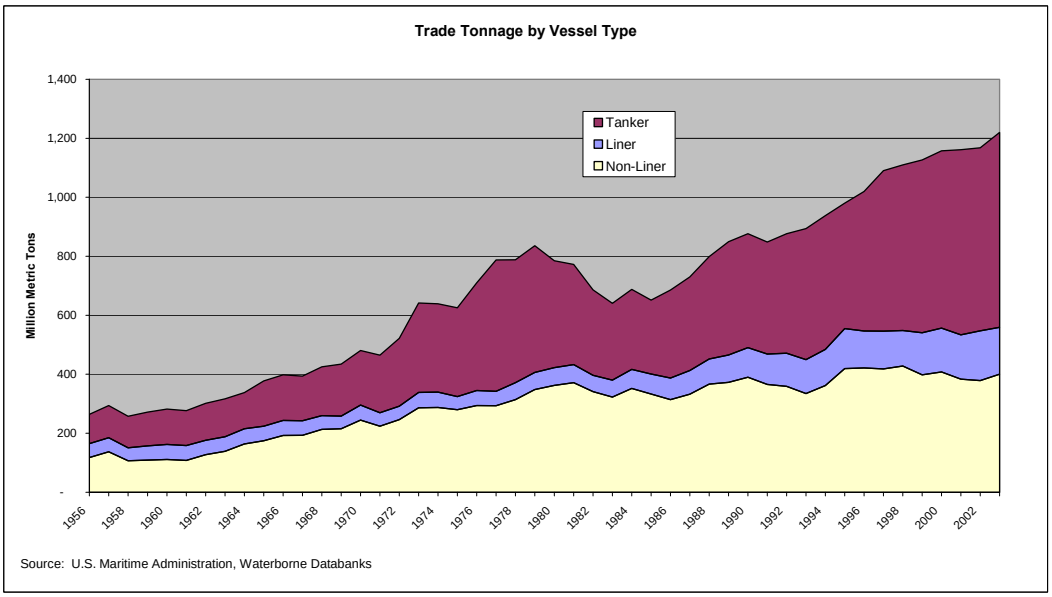


EXHIBIT 31
U.S. TONNAGE GROWTH BY VESSEL TYPE

Tanker tonnage, driven by petroleum imports, has grown at an average of 4.2 percent since 1956. Liner and non-liner trades have both grown at 2.7 percent in tonnage terms over the long

period in Exhibit 31. As noted earlier, the rapid growth in liner trade has occurred in the last three decades, propelled by containerization. The non-petroleum bulk trades are dominated by movements of minerals (coal, ores, gypsum, etc.) and grain. As of the National Dredging Needs Study, the dry bulk trade was expected to grow at about 3.5 percent annually between 2005 and 2050, with enough balance between imports and exports (Exhibit 32)[15].

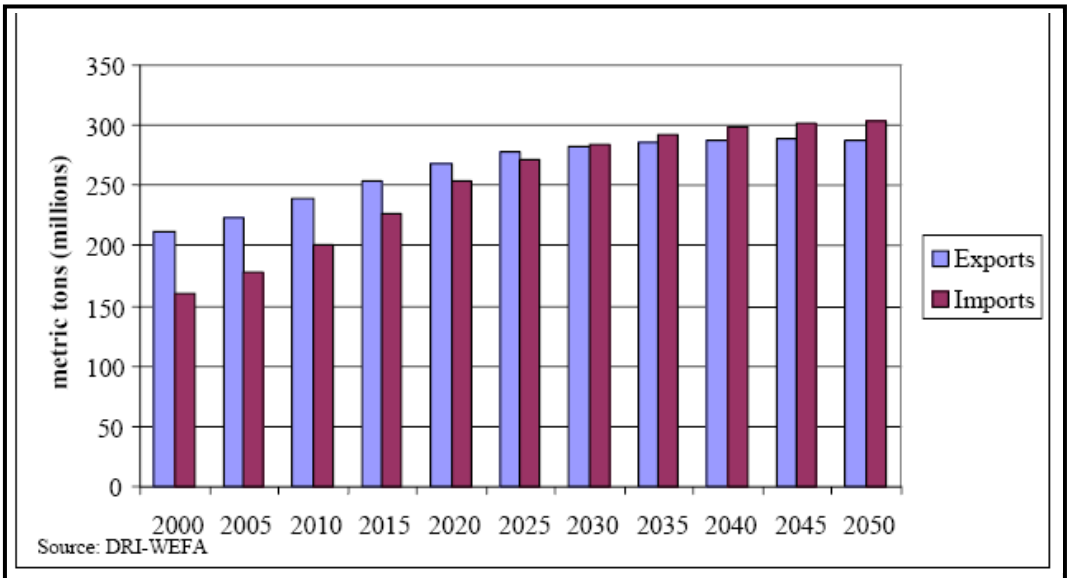


EXHIBIT 32
U.S. DRY BULK TRADE

The National Dredging Needs Study anticipated that tanker trade would peak in 2025 to 2030 and decline slightly to 2050 (Exhibit 33)[16]. The decline was anticipated due to increased fuel efficiency, competition from natural gas, domestic production and other influences.

Implications: The bulk trades lack the strong growth expected in the container trades. Most dry and liquid bulk commodities are handled at specialized private terminals rather than public ports. Marked growth is likely to be localized.

Uncertainties: Specific bulk movements can be volatile, starting and stopping based on currency values and the strategic choices of individual importers and exporters.

[15] *National Dredging Needs Study of U.S. Ports and Harbors*: Update 2000, IWR Report 00-R-04, 2003.
[16] Ibid.

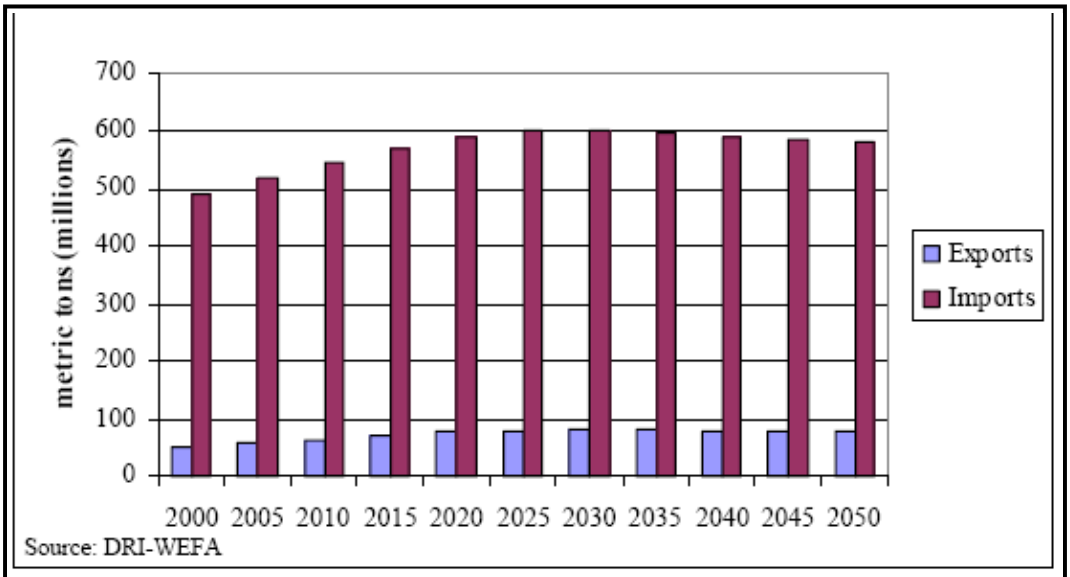


EXHIBIT 33
U.S. TANKER TRADE

2.11.2 Bulk Vessel Fleet

In the bulk vessel fleet, the Supramax and Capesize categories will grow, pending Suez and Panama expansions. The Handysize category will fade, replaced by specialized vessels where needed.

Exhibit 34 shows reported new building contracts for 1996 to 2002.

	Tankers	Bulk Carriers	General Cargo	Container	Total
Year	Avg kDWT	Avg kDWT	Avg kDWT	Avg kDWT	Avg kDWT
1996	50,639	52,583	8,198	23,897	34,013
1997	75,972	63,770	9,033	21,795	48,356
1998	78,293	71,295	7,471	33,567	44,117
1999	81,660	69,173	8,167	42,253	55,726
2000	93,868	58,375	9,937	40,282	56,068
2001	62,291	57,552	8,606	36,467	49,703
2002	53,644	75,633	11,713	46,096	52,965

Source: *Review of Martime Transport, 2006* , UNCTAD

EXHIBIT 34
NEW BUILDING CONTRACTS 1996-2002

There has been general increase in vessel size across the board but the transfer and bulk orders have varied considerably compared to the clear trend in container ships.

Implications: The key issue for USACE is likely to be the draft requirements of Supramax versus Handymax bulk vessels.

Uncertainties: Because bulk vessel deployments are determined by specific commodity movements conditions may vary widely.

2.11.3 Liquid Natural Gas (LNG) Shipping

Escalating demand for natural gas as an economical and relatively "green" fuel is leading to rapid expansion of the LNG shipping sector. The LNG terminals and vessel operations, however, are completely separate from other port and vessel operations. The LNG travels is very costly, specialized ships that are usually built on a project basis to operate between a specific terminal pair. The terminals themselves are almost exclusively offshore and connected to the mainland by pipelines (Exhibit 35).

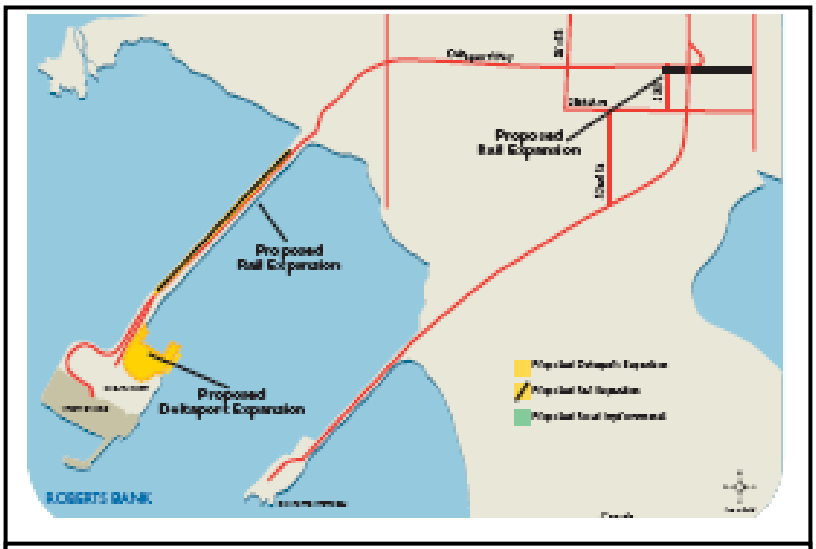


EXHIBIT 35
OFFSHORE LIQUID NATURAL GAS TERMINAL

Exhibit 36 shows the expected growth in imports. Much of the demand is satisfied by pipeline imports from Canada and Mexico and the planned Alaska natural gas pipeline will add North Slope production to that supply.

Exhibit 37 shows the location of current and proposed LNG terminals. The development of offshore LNG terminals is regulated primarily by the Federal Energy Regulatory Commission (FERC) and the Coast Guard.

Implications: LNG shipping is effectively a parallel maritime system disassociated with other commodity and vessel movements or terminals. In that regard, the impact on USACE responsibilities would primarily be in the issue of draft.

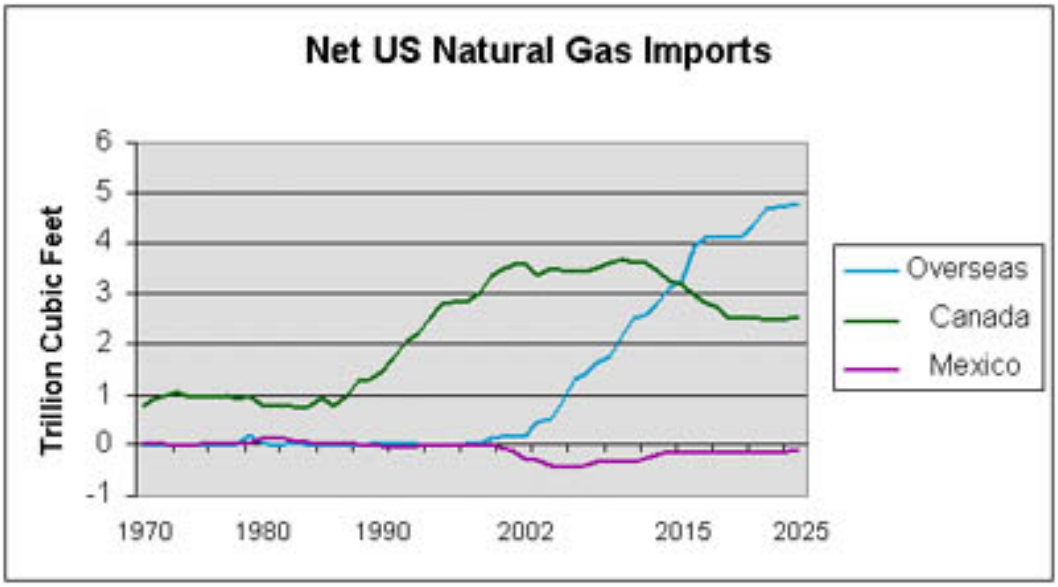


EXHIBIT 36
LIQUID NATURAL GAS IMPORTS

Uncertainties: Industry observers have noted that potential projects are announced frequently and others are cancelled just as frequently. It will be difficult to predict which projects will actually be implemented.

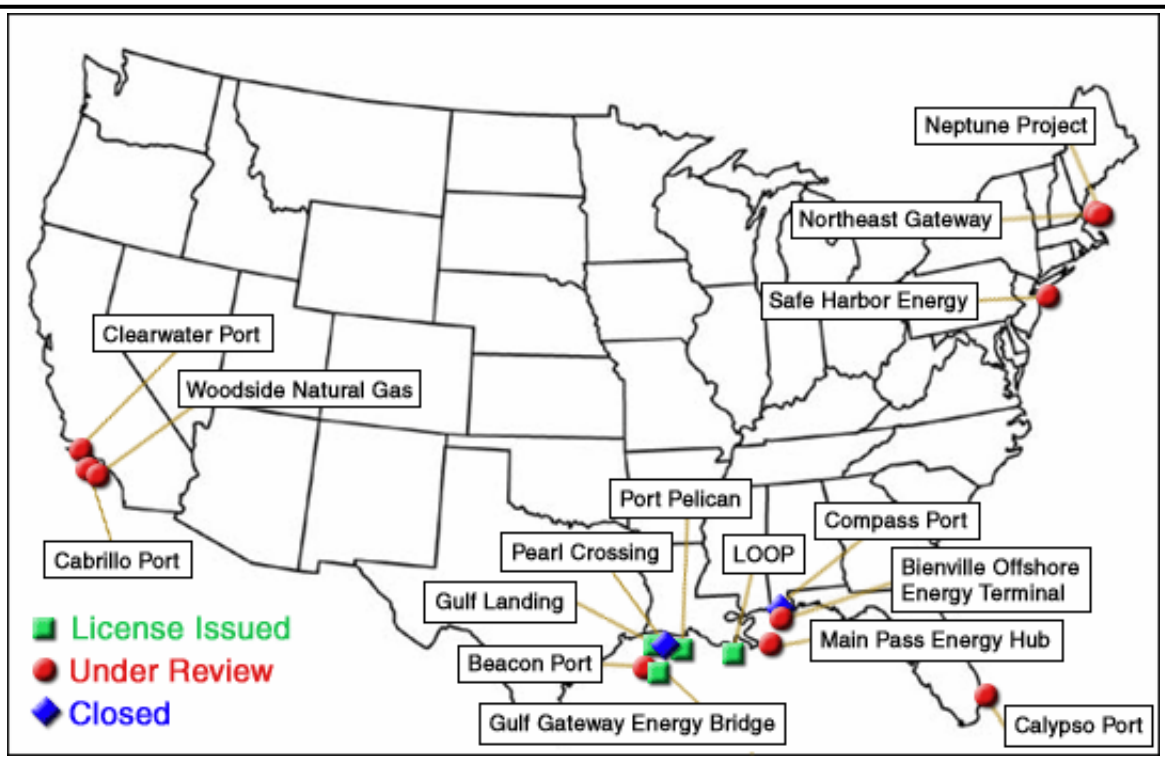


EXHIBIT 37
LIQUID NATURAL GAS PORTS

2.12 Inland and Coastal Waterway Trends

2.12.1 Domestic Shipping Volume

The trend in domestic water ton miles presents a complex story. Over the long term, the trend for domestic water ton miles is down for the coastwise segment reflecting the decline in production of Alaskan crude oil (Exhibit 38). The trend has been relatively flat for the internal and Great Lakes segments. More specifically, in 2004 pre-Katrina, internal volumes were approximately 7 percent below the peak of 1995.

A more detailed review of the Waterborne Commerce tonnage statistics (Exhibit 39) shows that inland commerce was growing in 2004 and 2005 prior to Katrina.[17] This positive trend reflected the overall growth trend in surface freight transportation. Katrina clearly depressed the volume at the end of 2005 and recovery continues well into 2006. Tonnage in 2nd quarter 2006 was still 7 percent below 2nd quarter 2005 but has been trending upward since Katrina. Indications are present, particularly current rate levels and barge construction activity, which indicate that the tight market conditions in the rail and highway modes are now also being experienced in the barge industry.

[17] U.S. Army Corps of Engineers Waterborne Commerce Statistics Center.

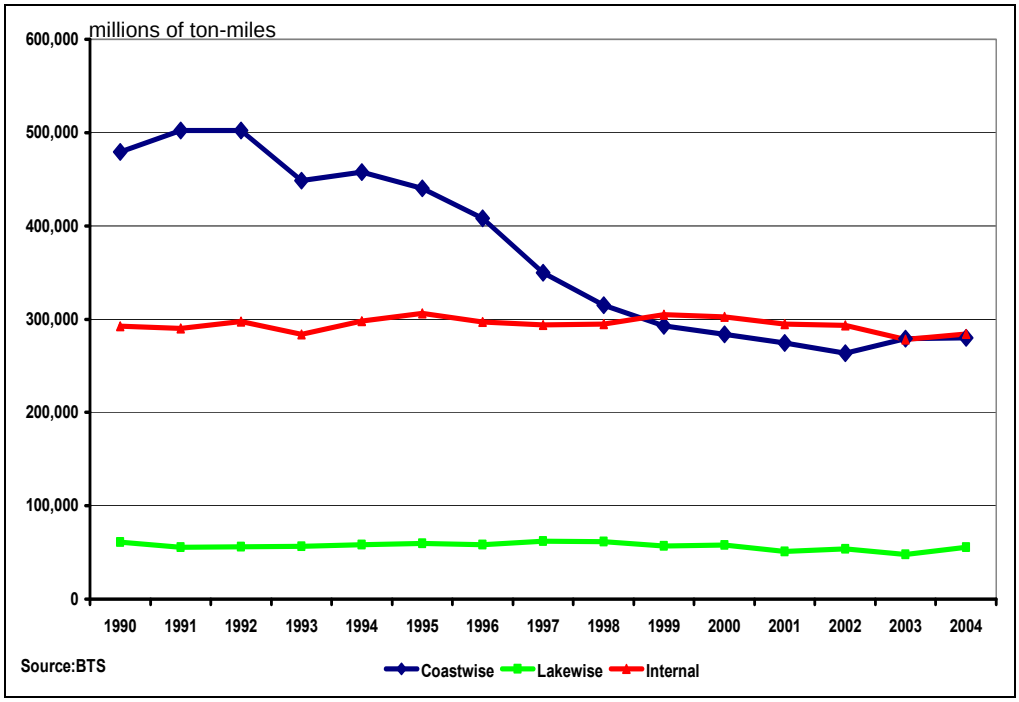


EXHIBIT 38
U.S. DOMESTIC WATERBORNE TON-MILES
(millions)

While transportation activity is cyclical and a downturn in the economy may temporarily relieve some of the upward rate pressure, over the past three decades the economy has grown much faster than publicly funded transportation infrastructure and it seems unlikely that over the long term that capacity concerns will continue. One implication is that demand for the tug and barge service will create a seller's market for indefinite future.

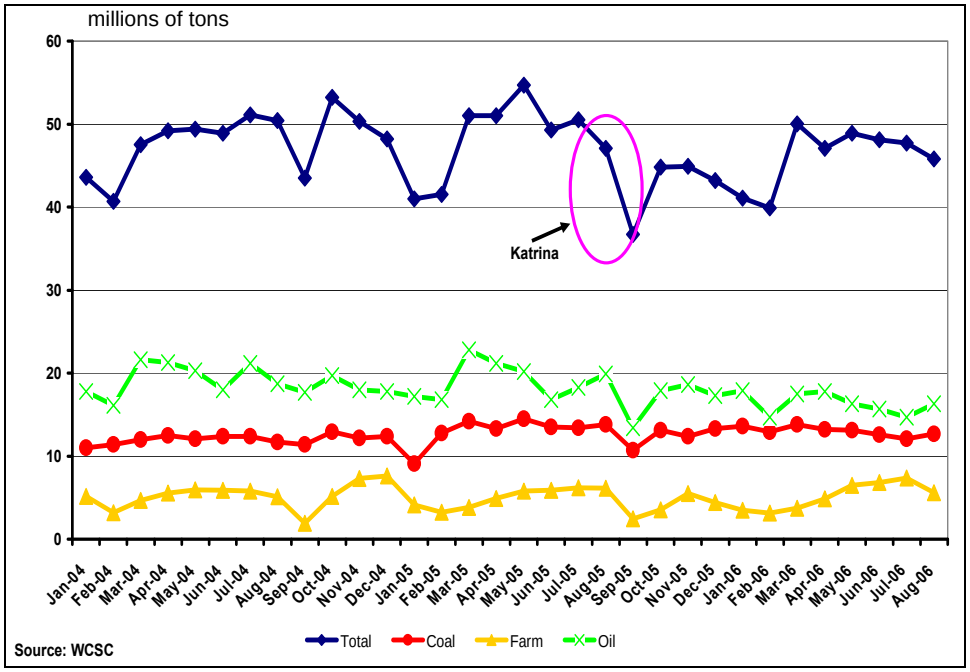


EXHIBIT 39
INTERNAL WATERWAY COMMODITIES
(millions of tons)

2.12.2 Inland Waterway Tonnage and Commodities

From 1985 through 2004 tonnage on U.S. inland and coastal waterways has grown at an average of just 1.4 percent annually. As suggested by the chart in Exhibit 40 and the data in Exhibit 41, that growth took place prior to 1995 and waterway tonnage has been essentially flat since.

Inland waterway tonnage will likely be constrained by the underlying growth of the commodities that make up most of the large business: coal, petroleum and products, grain, steel, chemicals and minerals (Exhibit 42).

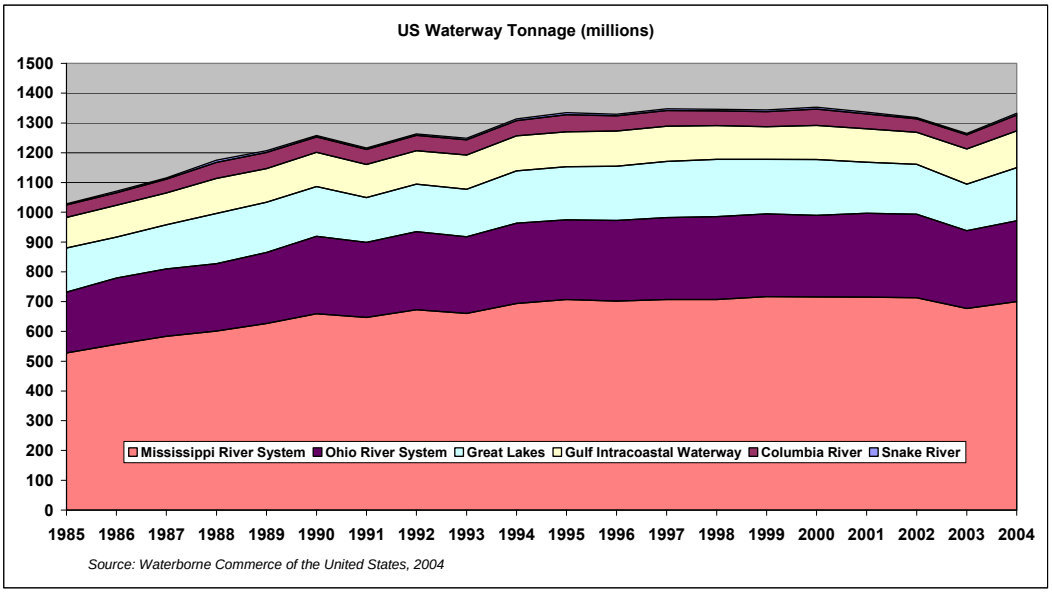


EXHIBIT 40
U.S. WATERWAY TONNAGE BY SYSTEM

U.S. Waterway Tonnage Growth

Waterway	1985	1990	1995	2000	2004	Growth	CAGR
Snake River	4	5	7	7	6	2	2.6%
Columbia River	42	51	57	55	54	11	1.2%
Gulf Intracoastal Waterway	103	115	118	114	123	21	1.0%
Great Lakes	148	167	178	188	178	30	1.0%
Ohio River System	204	260	268	274	272	68	1.5%
Mississippi River System	528	659	707	716	700	172	1.5%
Total	**1,028**	**1,258**	**1,335**	**1,353**	**1,332**	**304**	**1.4%**

Source: Waterborne Commerce of the United States, 2004

EXHIBIT 41
U.S. WATERWAY TONNAGE

2004 Inland Waterway Tonnage (millions of tons)

Commodity	Snake River	Columbia River	Gulf Intracoastal Waterway	Great Lakes	Ohio River System	Mississippi River System	Total	Share
Coal		-	6	43	145	178	373	**28%**
Petro & Prod.	2	8	60	5	17	144	235	**18%**
Chem & Rel. Prod.	0	6	27	2	12	55	101	**8%**
Crude Materials	0	9	22	111	67	126	335	**25%**
Primary Mgf. Goods	0	3	4	12	14	43	76	**6%**
Food & Farm Products	4	26	2	5	17	152	205	**15%**
All Mfg. Equip	0	1	2	-	-	2	5	**0%**
Other	-	0	1	0	0	1	3	**0%**
Total	**6**	**53**	**123**	**179**	**272**	**700**	**1,332**	**100%**

Source: Waterborne Commerce of the United States, 2004

EXHIBIT 42
U.S. WATERWAY COMMODITY TONNAGE

The USACE tracks Coal, Petroleum and Farm tons monthly; these currently make up approximately 75 percent of the total. Over the long term coal is trending up as is the share of "all other" commodities; farm and petroleum products are tracking downward.

The increase in 1985 to 1995 was mostly attributable to increases in coal on the Mississippi and Ohio, petroleum and products on the Mississippi and other crude materials on multiple waterways. The outlook for growth in barge traffic therefore depends on future production and consumption of these commodities in markets served by the inland waterways.

Coal. Since 2002, 26 percent of the tonnage moving on internal U.S. waterways has been coal and coke. Approximately 50 percent of the electricity used in the U.S. is generated by the burning of coal and coal is the lowest cost fossil fuel used in the creation of electricity.[18] The U.S. possesses 275 billion tons of recoverable coal reserves, or about one-fourth of the world's total. U.S. coal reserves are equivalent to four times the oil of Saudi Arabia, 1.3 times the oil of OPEC and equal to all the world's proved oil reserves.[19]

One thousand one hundred thirty-one million tons of coal were produced in the U.S. in 2005 with 430 million tons coming from the Powder River Basin.[20] Powder River Basin coal has much lower sulfur content than Eastern coal and is being used by eastern power plants to meet environmental standards. Two initiatives are working to change the current pattern of distribution of Powder River Coal. First, the current railroads serving the Basin will be seeking higher rates when contracts renew. In 2005 there were major problems with the track bed as coal dust fouled the ballast and caused significant derailments. This translates to higher than anticipated long term maintenance costs. In addition, the long term contracts the railroads entered with the power companies now do not look favorable to the rail companies in the face of escalating rail rates generally. This combination is likely to cause the rail companies to seek significantly higher rates as contracts renew, which in turn may lead eastern utilities to pay for

[18] Edison Electric Institute.
[19] Partners for Affordable Energy.
[20] Energy Information Administration.

the plant modifications necessary to use high sulfur eastern coal.[21] It follows that there may be an increase in eastern coal moving by barge as a result.

The second initiative is that of the Dakota, Minnesota and Eastern (DME) railroad which is attempting to build a new railroad line into the Powder River Basin to provide competition with BNSF and Union Pacific railroads (Exhibit 43). The DME plans to bring the coal to Owatonna, MN where it could be barged to destination. The DME also has the ability to interchange the coal with eastern railroads. A successful DME is likely to keep Powder River Basin coal costs down but provide more tug and barge coal demand on the Upper Mississippi River.

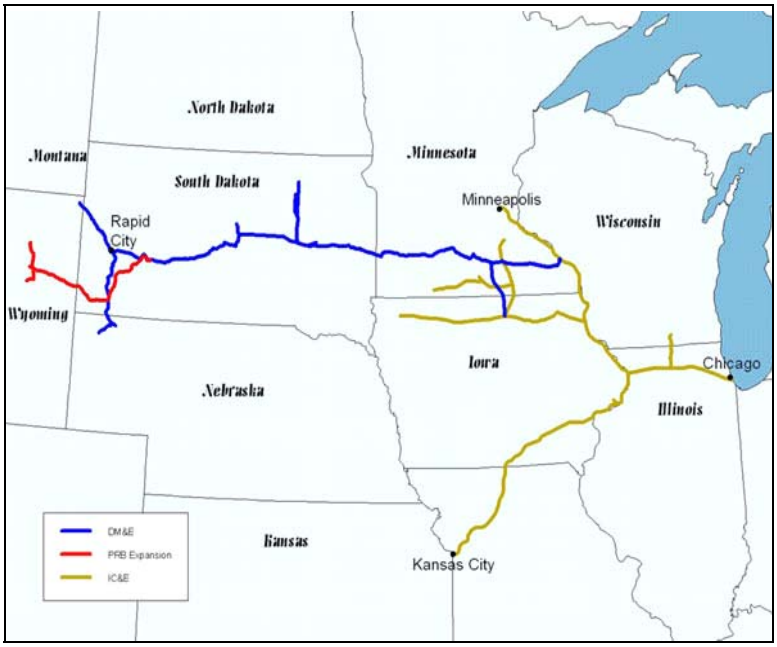


EXHIBIT 43
PROPOSED DME/IC&E RAIL SYSTEM

Petroleum Products. Petroleum has traditionally been the most significant commodity moving in inland waterborne commerce. Since 2002, 39 percent of the tonnage moving on internal U.S. waterways has been petroleum and chemicals. The domestic tank barge industry is composed of approximately 4,000 barges and they account for the transport of millions of tons of cargo annually. Within the U.S., they operate via rivers, lakes, bays and sounds and they run offshore in coastwise trade.

Soaring oil and natural gas prices are leading producers to reopen plugged/abandoned wells once deemed non-productive at previous oil prices. These "new found" sources of domestic oil and natural gas account for 17 percent of the oil and 9 percent of the natural gas produced in the U.S., according to the Interstate Oil and Gas Compact Commission.

[21] Edison Electric Institute.

Any increased demand for tug and barge transportation is likely to be temporary, however, as the domestic oil production by all sources is expected to fall more in the long run.

Grain. The major variable in domestic grain transportation is the amount that will be turned into ethanol. Under the Energy Policy Act of 2005, EPA is responsible for promulgating regulations to ensure that gasoline sold in the U.S. contains a minimum volume of renewable fuel. A national Renewable Fuel Program (also known as the Renewable Fuel Standard Program or RFS) will increase the volume of renewable fuel required to be blended into gasoline, starting with 4.0 billion gallons in calendar year 2006 and nearly doubling to 7.5 billion gallons by 2012.[22] Mixing ethanol with gasoline to produce E15 (15 percent Ethanol) is the most likely way of meeting this standard. Demand for ethanol far exceeds current production capabilities and new plants are being built quickly to meet this demand.

Currently most ethanol is made from corn and 7.5 billion gallons of ethanol would consume roughly a quarter of the U.S. corn crop. Converting all gasoline to E15 would take nearly three times as much corn. The Federal requirement and currently positive economics are likely to generate more corn acreage to be planted and corn yields have shown a long term positive trend. This also means that corn is not the final answer and that ethanol will need to be generated from cellulose, a technology that is currently being developed.

The implications on the river system are important. On one hand, the demand for ethanol can be expected to reduce the amount of corn moving by barge for export. The ethanol plants are typically located near the point of production. On the other hand it is clear that the Mississippi Basin is an emerging source of fuel for the U.S. in competition with imported and domestic petroleum. Currently most of the ethanol moves by rail.

Steel. Steel consumption in the U.S. is rising and is expected to rise further with GDP. The Organization for Economic Cooperation and Development (OECD) expects U.S. steel imports to reach a record 39 million metric tons in 2006. U.S. exports are expected to reach a record of 9 million tons in 2006 due largely to demand in Canada and Mexico that is satisfied by rail rather than water movements. Demand in China and India is driving up world steel consumption. China is becoming the largest exporter but still imports specialty grades.

These observations suggest stability and perhaps moderate growth in U.S. steel shipments, including those on the inland waterways.

Chemicals. Output of the U.S. chemical industry is expected to grow in the 2006 to 2014 period, but foreign competition and other trends may result in some shifts in waterway shipments of chemicals.

The Bureau of Labor Statistics expects some U.S. chemical firms to shift production to developing countries in Asia or Latin America to take advantage of lower development and production costs and serve expanding markets there. The impact on U.S. waterway and deep-sea shipping will depend on whether those U.S. firms transfer production of bulk commodity

[22] U.S. Environmental Protection Agency.

chemicals (such as fertilizer ingredients) that commonly move by ship or barge, or low-volume specialty chemicals that move in tank car or truckload lots.

The Bureau of Labor Statistics expects industry employment to decline in basic chemical manufacturing but rise in the production of cleaning preparations, toiletries, etc. This expected employment shift implies that basic chemical manufacturing is more likely to move overseas or be replaced by foreign producers. Depending on the movement pattern involved, such a shift could reduce inland waterway movements in favor of deep-sea imports.

Minerals. Increasing demand in China and India is expected to increase U.S. production and movement of ores and minerals. Non-metallic mineral production is closely tied to a few major "customer" industries, especially construction (sand, gravel, gypsum, clays, etc.) and agriculture (fertilizers and soil amendments). Strong long-term demand for concrete and other construction materials will support continued production in this sector despite any near-term softening of the housing market.

The U.S. has shifted from being the world's largest exporter of nitrogen fertilizers in the 1980s to becoming the world's leading import in the 1990s. The rising price of natural gas was a major factor as natural gas is the chief source of nitrogen. Lower cost imports have led to the closure of U.S. plants and the U.S. increasingly depends on imports from Trinidad and Tobago, Canada and Russia.

The U.S. also imports about 80 percent of the potash it uses. Most of those imports, however, come by rail from Canada. The U.S. was a major exporter of phosphate fertilizers as recently as 2005, but exports have been declining in the face of increased production in destination countries, notably China.

The chemical tonnage outlook is therefore somewhat less certain than other domestic waterborne commodities.

Implications: The major commodities supporting inland waterway tonnage have mixed outlooks in the long term. None are expected to either grow or decline dramatically and all are subject to outside influences ranging from rail competition to diversion of end uses. USACE will have to periodically monitor commodity projections and evaluate the risks of specific commodity flows drying up.

Uncertainties: Few of the contingencies and outside influences identified above would increase barge traffic on the inland waterways. The risks are therefore on the down side.

2.12.3 Inland Waterways Business Conditions

The U.S. barge industry itself is experiencing variable business conditions that may affect the long-term inland waterways tonnage outlook.

- Poor profits in prior years led to widespread scrapping of older barges and few replacements. The total U.S. fleet of covered barges has reportedly shrunk 12 percent since 2000[23].

- More recent upswings in demand have reportedly pushed up barge rates by 45 percent[24] and filled the order book for new barges.

- Hurricanes Rita and Katrina and the subsequent reconstruction have drawn off a significant part of the barge industry labor force, increasing costs and reducing capacity.

- As a result of reduced capacity and increased demand for movements of steel and other commodities, Mississippi grain movements by barge were reportedly at an all time low in 2005, the product of a decline that began in 2003.[25]

These "boom and bust" conditions are unlikely to contribute to the industry's long-term health.

These reports are entirely consistent with the overall trend in the surface freight industry described above. In addition to the new competition mentioned above that grain faces with other commodities for barge space to move down river, there has also been an increase in imported cargo over New Orleans seeking to move up river, reducing barge cycle times. Strong demand relative to capacity means the tug and barge industry is obtaining higher rates than previously possible and expanding capacity to meet the market opportunity.

Implications: Persistent volatility in the barge industry could diminish tonnage on the inland waterways.

Uncertainties: It is not clear whether the industry will remain volatile or settle down to a new plateau.

2.12.4 Waterway System Funding

The greatest concern of the inland waterways industry appears to be funding maintenance and modernization of infrastructure rather than accommodating growth. The Bureau of Labor Statistics expects that employment in the industry will be affected by "a project decline in vessels operating in the Great Lakes and inland waterways" and mentions the dampening effect of steel imports on Lakes business[26].

Lack of political priority for expansion (or even proper maintenance) of locks and dams on the inland waterway system is a critical trend. The House and Senate passed the Water Resources Development Act of 2006 (WRDA, HR 2864) , but the bill did not become law before Congress adjourned. The June 2005 version of HR 2864 allowed $1.8 billion for seven new 1,200 foot locks on the Upper Mississippi, with the funding to be drawn equally from the General Fund and the Inland Waterways Trust Fund. The bill also earmarks funds for dozens of "small" flood control and restoration projects. Finally, it allowed $1.6 billion for ecological restoration on the Upper

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23 Informa Economics.
24 Darrel Good, University of Illinois Extension.
25 Nick Marcthor, USDA Economist.
26 Bureau of Labor Statistics' Occupational Outlook Handbook.

Mississippi and Illinois Rivers. The last Water Resources Bill was passed in 2000 and opponents sought process changes in the 2006 bill that would have slowed project delivery. Regardless of the outcome, over the long term it is clear that any work on the inland waterway system that increases or maintains capacity for commerce will be difficult and therefore slow to implement.

Implications: That WRDA was sent to conference suggests that some form of the bill will eventually be enacted, given the funding for at least some new locks. WRDA sponsors plan to try again in 2007.

Uncertainties: The timing and final form of the WRDA are uncertain.

2.12.5 Inland Water Levels

Several parties have expressed concern about resent drops in water levels on both the Mississippi and Columbia Rivers. The comments have centered on the impact the reduced water levels are having on the navigable channel. Some suggest the source of the problem is the Corps itself for restricting flow rates to build up lakes and reservoirs while others suggest it is the result of reduced rainfall or a combination of both. The short-term concern is for further reductions in flow, either because of the lack of rainfall or actions by the Corps to hold more water in the system. The longer term concern is that at the current low flowage rates silting is occurring in places that have not been an issue before and that if this continues there will need to be dredging in areas that previously had adequate water flow to prevent silting.

A 2005 IWR study[27] of climate change impacts on the Middle Mississippi focused on water flow changes and economic impacts.

The study found that in the past low-flow events that disrupt barge and river transportation occurred most frequently in December, January and October. The frequency of winter low-flow events has decreased since the 1960s and can be expected to decline further as global warming yields less snow and more rain.

Global warming is likely to change the timing and frequency of both low-flow and flood events in ways that cannot yet be predicted with confidence. The IWR study found that different climate models gave different results.

Some models suggest that the flood season will shift from spring to summer while others do not.

Implications: The uncertainty associated with global warming impacts on inland waterway levels places USACE in something of a dilemma. The Corps has been under pressure to reduce water flow management practices in favor of more natural flow patterns. If changes to those natural flow patterns increase disruptions due to low flow or flood, USACE, will be under pressure to increase water flow management.

[27] Climate Impacts on Inland Waterways. IWR, July 2005.

Uncertainties: The IWR report specifically notes the high degree of uncertainties in climate forecasts and impact models and the difficulty of planning infrastructure investments in such an uncertain future.

2.12.6 Short-Sea Shipping Initiatives

Despite a swell of public sector and industry interest after the 2004 peak season congestion in Southern California no upward trend in short-sea shipping (SSS) has emerged. Efforts to increase inland waterways traffic through SSS or container on barge (COB) initiatives have yet to bear fruit and the real potential of these efforts is open to question. The much-heralded Albany-New York container on barge service initiated as part of the Port Authority of New York and New Jersey's Port Inland Distribution network (PIDN) was recently discontinued.

The four case studies completed for U.S. DOT in August 2006 yielded mixed results with few clear advantages for short-sea shipping over truck or rail intermodal alternatives (Exhibit 44)[28]. "Status quo" short-sea options did not yield a competitive advantage in any of the four cases studied. The "best in class" short-sea options could offer significant cost savings only at substantial transit time penalties. Stakeholders interviewed for the study were concerned over reliability, the high costs of U.S. shipbuilding required under the Jones Act and the adverse impacts of the Harbor Maintenance Tax.

	Truck		Rail Intermodal		Short-Sea Status Quo		Short-Sea "Best in Class"	
	Cost	Time	Cost	Time	Cost	Time	Cost	Time
Gulf/North Atlantic	$1.77	67.5 hrs	$1.06	86 hrs	$1.13	111 hrs	$1.03	111 hrs
South Atlantic/North Atlantic	$1.73	54.5 hrs	$1.09	60.5 hrs	$1.12	70.0 hrs	$1.00	70.0 hrs
South Pacific/North Pacific								
- San Diego/Astoria	$1.58	56.0 hrs	$1.01	62.0 hrs	$1.29	115 hrs	$1.14	115 hrs
- Oakland/Astoria	$1.59	33.0 hrs	$1.35	39.5 hrs	$0.95	68.7 hrs	$0.86	68.7 hrs
- Oakland/San Diego	$1.56	22.0 hrs	$1.90	34.0 hrs	$1.93	55.1 hrs	$1.75	55.1 hrs
Intra-Great Lakes	$1.51	9.5 hrs	N.A.		$1.32	7.5 hrs	$1.24	7.5 hrs

EXHIBIT 44
SHORT-SEA SHIPPING COST COMPARISONS

Short-sea proposals for services linking West Coast ports or serving the inland ports of Stockton and Sacramento have revealed two serious obstacles: the need for massive upfront investment

[28] *Four Corridor Cast Studies of Short-sea Shipping Services*, U.S. DOT, 2006.

in vessels and terminals and the lack of available terminal sites at crowded West Coast container ports.

Exhibit 45 and Exhibit 46[29] make a key point: much of the costs of either short-sea shipping or rail intermodal moves are essentially fixed terminal and drayage costs, with a limited ability for line-haul cost differences to make a decisive difference.

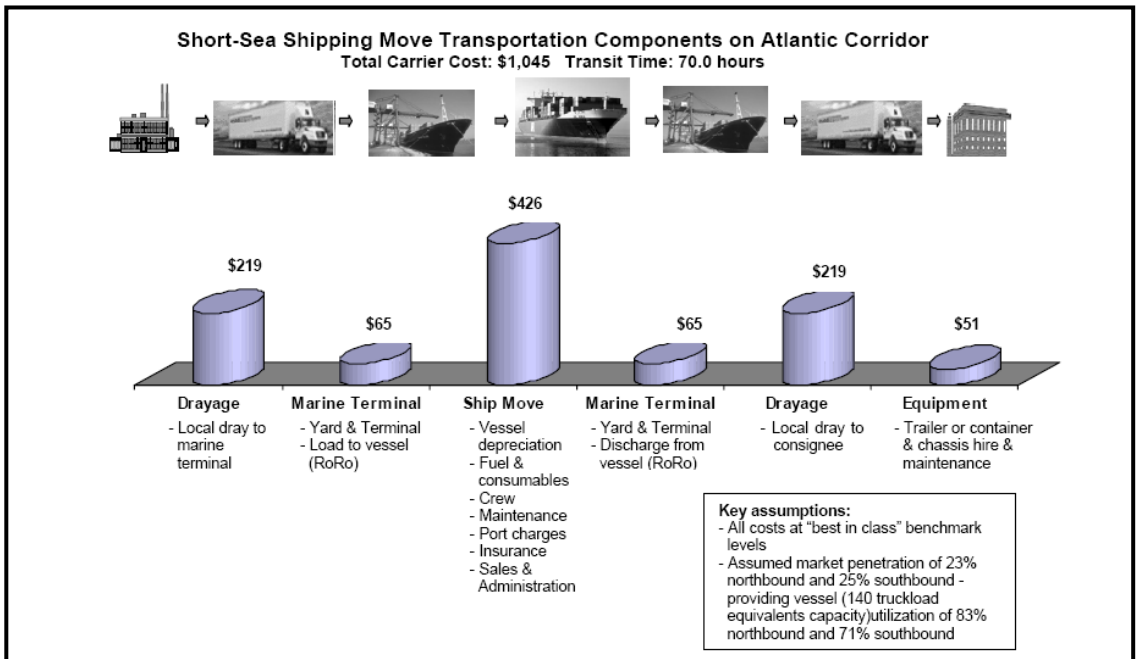


EXHIBIT 45
SHORT-SEA SHIPPING COST COMPONENTS

Indications to date suggest, therefore, that any trend in short-sea shipping will be modest and restricted to a few favorable niches.

The potential market for short sea shipping of non-bulk commodities is significant but risks are apparently too high to warrant private investment and the current administration has not chosen to invest in this industry. While there are many obstacles to be overcome in order to make this concept into reality, the most significant one appears to be the high cost of U.S.-built ships which would be required in this service due to the Jones Act. A report prepared for the USDOT in August 2006 stated:

"Ocean carriers perceived that the high capital cost of U.S.-built ships was the single largest obstacle to successful implementation of domestic coastal short-sea shipping services. Carriers believed that prices

[29] Ibid.

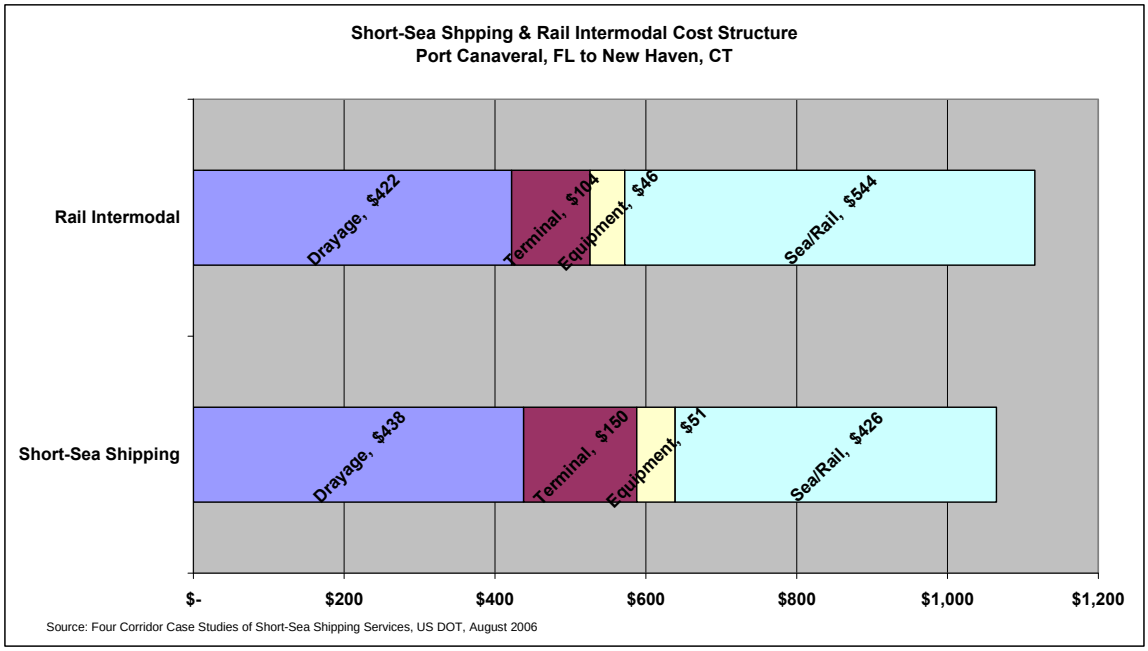


EXHIBIT 46
SHORT-SEA SHIPPING AND RAIL INTERMODAL COST STRUCTURES

from U.S. yards for a container or RoRo vessel were two to three times higher than for an equivalent ship from a foreign yard."[30]

The report also documented other perceived obstacles including:

"Principal among the obstacles noted by ocean carriers interviewed were the high cost of domestically built cargo vessels, high stevedoring costs in U.S. ports and high manning levels for self-propelled vessels engaged in domestic commerce as compared to tug-barge combinations moving an equivalent amount of freight. Other governmental and regulatory hurdles that were mentioned included the additional cost that Harbor Maintenance Tax would apply to shipments moving on a domestic coastal shipping service and the lack of capital financing guarantees for new ship construction through the Title XI program."[31]

Implications: Clearly public policy and the market are not yet aligned in such a manner so as to make short sea shipping for non-bulk commodities feasible at this time. USACE should not expect to see widespread short-sea services.

Uncertainties: It is unclear whether favorable conditions for short-sea shipping will ever emerge.

[30] *Four Corridor Case Studies of Short-Sea Shipping Services, Short-Sea Shipping Business Cases Analysis* Ref #DTOS59-j04-Q-00069, submitted by Global Insight in Association with Reeve & Associates, page 28.
[31] Ibid.

2.12.7 Great Lakes

The Great Lakes and St. Lawrence Seaway together serve as a marine highway for movements of coal, ores, manufactured goods, grain and other cargos. The largest commodity, accounting for more than half the total, is "crude materials"—ores and minerals.

Domestic and U.S.-Canadian tonnage on the Great Lakes themselves has grown at an annual average rate of just 1.0 percent for the last 20 years and shows no prospect for dramatic change in the near future (Exhibit 47).

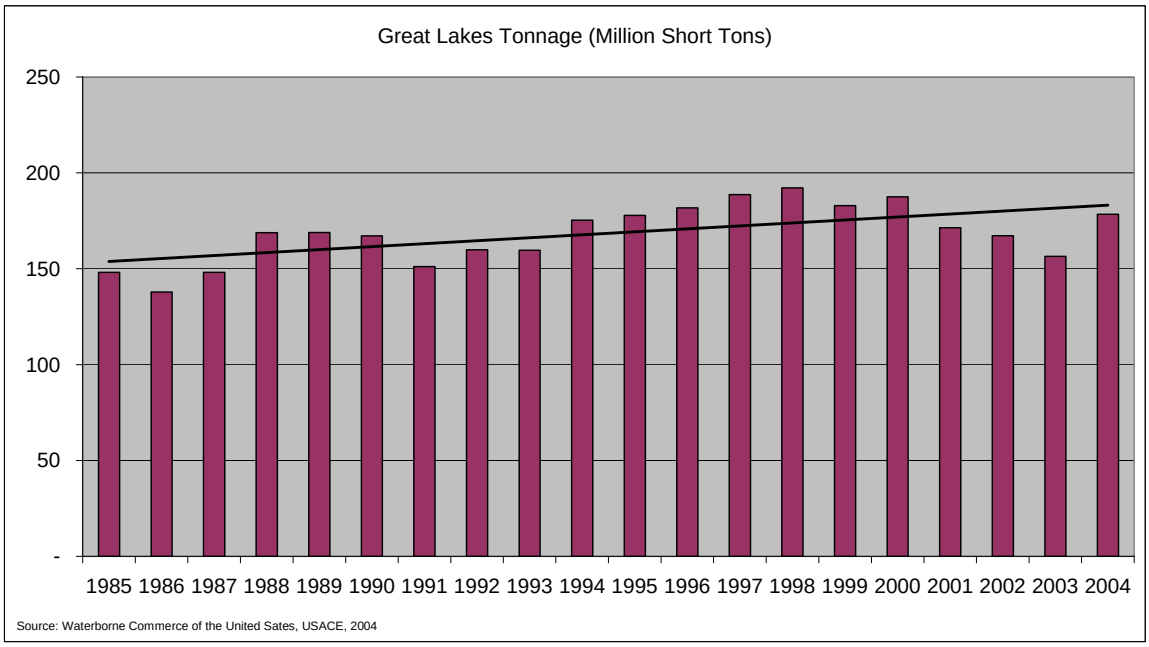


EXHIBIT 47
GREAT LAKES SHIPPING TONNAGE

The St. Lawrence Seaway is limited in two dimensions – physical and temporal. The draft and lock size restrictions prevent most of the world's vessel fleet from entering. The restricted shipping season due to 3 months of winter ice discourages major commitments from customers that expect year-round transportation. The proposed new lock at Sault Ste. Marie would alleviate part of the problem, but the future of that proposal is uncertain.

The Great Lakes Navigation Study, now underway, is intended to address a wide range of issues facing the great Lakes and the St. Lawrence Seaway.

Great Lakes Draft Loss. In common with many deep sea harbors, the Great Lakes ports and channels require periodic maintenance dredging to sustain authorized depth. A 2005 MARAD

survey[32] found that several major Great Lakes ports have sustained significant sedimentation and draft loss due to the long delays in maintenance dredging. The 2004 maximum draft losses range from 12 inches at Stoneport (Presque Isle) to 54 inches at several smaller ports (Exhibit 48).

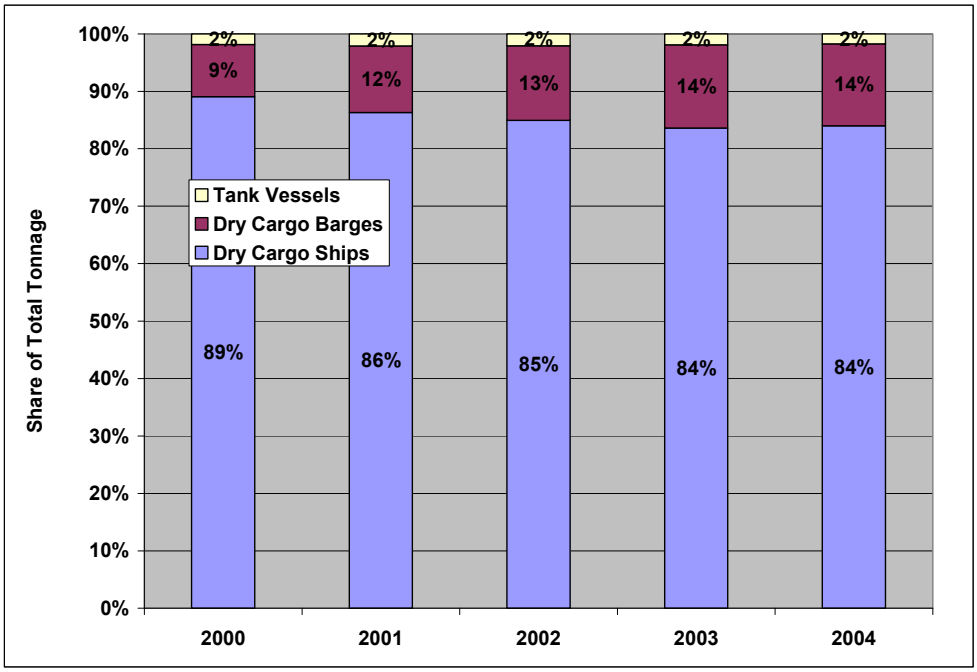
Source: MARAD Industry Survey Series: Great Lakes Operators, 2005

EXHIBIT 48
MAXIMUM REPORTED DRAFT LOSS AT GREAT LAKES PORTS

The survey found that over 75 percent of respondents' voyages over the past five years had been light-loaded due to insufficient depth. The 1000-foot "Poe-sized" lakers that dominate traffic in the Great Lakes lost 267 tons of cargo capacity for each one inch loss of draft. On that basis a 1000-foot laker would lose 4,800 tons of capacity on a voyage to or from Duluth, which is the busiest Great Lakes port.

A small but growing share of Great Lakes tonnage is being handled by Integrated Tug-Barge vessels (ITBs), which typically require less draft (Exhibit 49). Some sources, in noting the recent influx of ITBs, have speculated that the trend reflects carrier strategies for coping with draft loss.

[32] MARAD Industry Survey Series: Great Lakes Operators, 2005.



Source: MARAD Industry Survey Series: Great Lakes Operators, 2005

EXHIBIT 49
GREAT LAKES TONNAGE SHARES BY VESSEL TYPE

Unmet needs for maintenance dredging are in conflict with unmet needs for environmental dredging. Disposal sites for dredging material are reportedly filling up, creating additional uncertainty regarding feasibility and cost. Identification of Great Lakes Areas of Concern (AOCs) and preparation of The Great Lakes Regional Collaboration Strategy in December 2005 resulted in a $20 billion proposed program of environmental dredging and related projects. No new projects were funded.

***Implications*:** Delays in maintenance dredging have created a substantial project backlog on the Great Lakes. The draft loss is beginning to have an impact on aggregate fleet capacity. Moreover, the Great Lakes have very large unfunded competing needs for environmental dredging.

***Uncertainties*:** Given the relatively flat cargo volumes on the Great Lakes, the urgency of dredging is unclear. The introduction of ITBs may also reduce the need for dredging.

New Poe-sized Lock. The other pressing issue for the Great Lakes is the outlook for a second "Poe-sized" lock. The Poe Lock is the only one able to handle the 1,000-foot lakers that together provide about 70 percent of the U.S.'s fleet capacity on the lakes. With only one lock able to handle these vessels the carriers and other stakeholders are concerned that a failure or extended outage of the Poe Lock would seriously disrupt cargo flow on the lakes.

A new Poe-sized lock was approved as far back as 1986, but neither the local nor Federal funding has been forthcoming for the last 20 years. The Lake Carriers Association developed a $400 million cost estimate for the project, including $140 in local funding.

As with other MTS issues, the delay in developing a new Poe-sized lock could eventually produce a crisis. Waiting for a crisis, however, would likely be distinctly counter-productive due to the long lead time required to fund, design, approve and develop a new lock.

***Implications*:** Reliance on a single Poe-sized lock entails risk of significant disruption to Great Lakes shipping and the utilities and steel industry that are the chief customers.

***Uncertainties*:** The nature and magnitude of potential disruption due to failure of the existing Poe lock are uncertain. After such a long delay, issues such as cost and environmental impact will also be uncertain.

2.13 Panama Canal

Perhaps the greatest source of uncertainty and speculation in world shipping is the future of the Panama Canal. The Panama Canal is an option for transpacific cargo destined to the Gulf, Southeast and Northeast. The Panama Canal will likely reach capacity before 2010 and will not have new capacity until 2014 at least.

Status. The capacity of the Panama Canal is limited by width and total throughput.

- The width of the canal limits "Panamax" vessels to a width of 105 feet. Larger "post-Panamax" bulk and container vessels exceed this limit and cannot use the Canal.
- The throughput capacity of the two sets of locks and the narrower parts of the Canal restricts vessel transits to 23 per day.

According to recent studies the canal may be operating at roughly 95 percent of its capacity. At the Panama Canal Authority (ACP) expected growth rate the Canal will reach its throughput capacity somewhere around 2008 or 2009, a finding in agreement with outside studies by Drewry and others. The Canal already has a reservation and waiting system with a rough backlog of 30 vessels at any given time. In August of 2005, a 5-day restriction from 23 to 19 daily transits resulted in a backlog of 91 vessels waiting at either end of the Canal. Delays in transit have also reportedly reduced the on-time performance of all-water Asia-U.S. East Coast container services from 75 percent to 50 percent.

The Canal will reach its throughput limit in the near future, leading to capacity rationalization and higher transit fees. The ACP has already scheduled a series of toll increases through May 2007. There is also a transit slot reservation fee. Slots are currently sold first come, first served. A portion of the transit slots are auctioned off and some very large sums have been paid by frantic vessel owners to get an earlier slot.

Without and until expansion, future allocations of Panama Canal capacity remain speculative. Containerized trade between Asia and U.S. east-west ports now accounts for more than half the containerized cargo through the Canal and is viewed as the major growth driver (Exhibit 50).

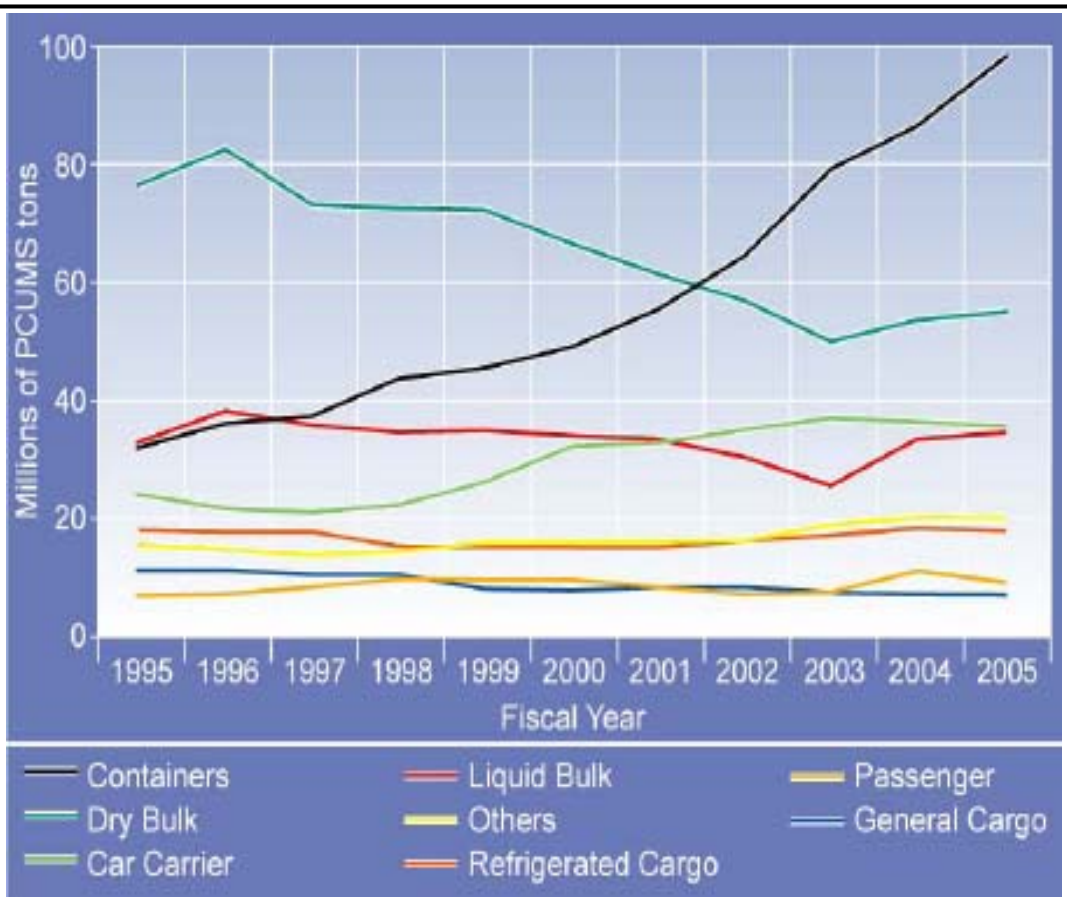


EXHIBIT 50
PANAMA CANAL TONNAGE BY SEGMENT

The all-water route through the Panama Canal has captured a growing share of the Asia-USEC market. Available suggest that as of 2004 the Panama Canal route had about 38 percent of the cargo. There are, however, moderating factors.

- The serious, well-documented Southern California port congestion during the 2004 peak season was not repeated in 2005 or 2006, reducing the impetus to seek all-water routings.
- Ocean carriers have been limited in their ability to expand Panama Canal services by a tight charter market with a shortage of available Panamax ships. This shortage may ease somewhat as vessels are cascaded from the Transpacific, but there are competing uses for those vessels as well.

If canal capacity is maxed out, growth in this trade will be stunted. The ACP might tend to allocate more capacity to container vessels since they generate more revenue per ton than bulk vessels. The ACPs forecasts show expansion of container tonnage at the expense of other vessel types (Exhibit 51). Container tonnage in Exhibit 51 grows at 3 percent without expansion, 6 percent with expansion.

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
Total PCUMS Tons	**279**	**330**	**508**

*Millions of PCUMS tons

EXHIBIT 51
PANAMA CANAL TONNAGE FORECASTS

The Panama Canal is also being used to move cargo between Asia and the Gulf. At least one major importer transships containers at the eats end of the canal onto feeder vessels calling Houston. This movement pattern puts the Panama Canal into competition with Mexican ports trying to capture the same Asia-Gulf or Asia-Southeast cargo flows.

Expansion. The ACP has proposed a major Canal expansion including a third set of parallel locks and selected deepening and widening of existing channels (Exhibit 52). The proposal would effectively double the capacity of the Canal and allow it to handle much larger vessels.

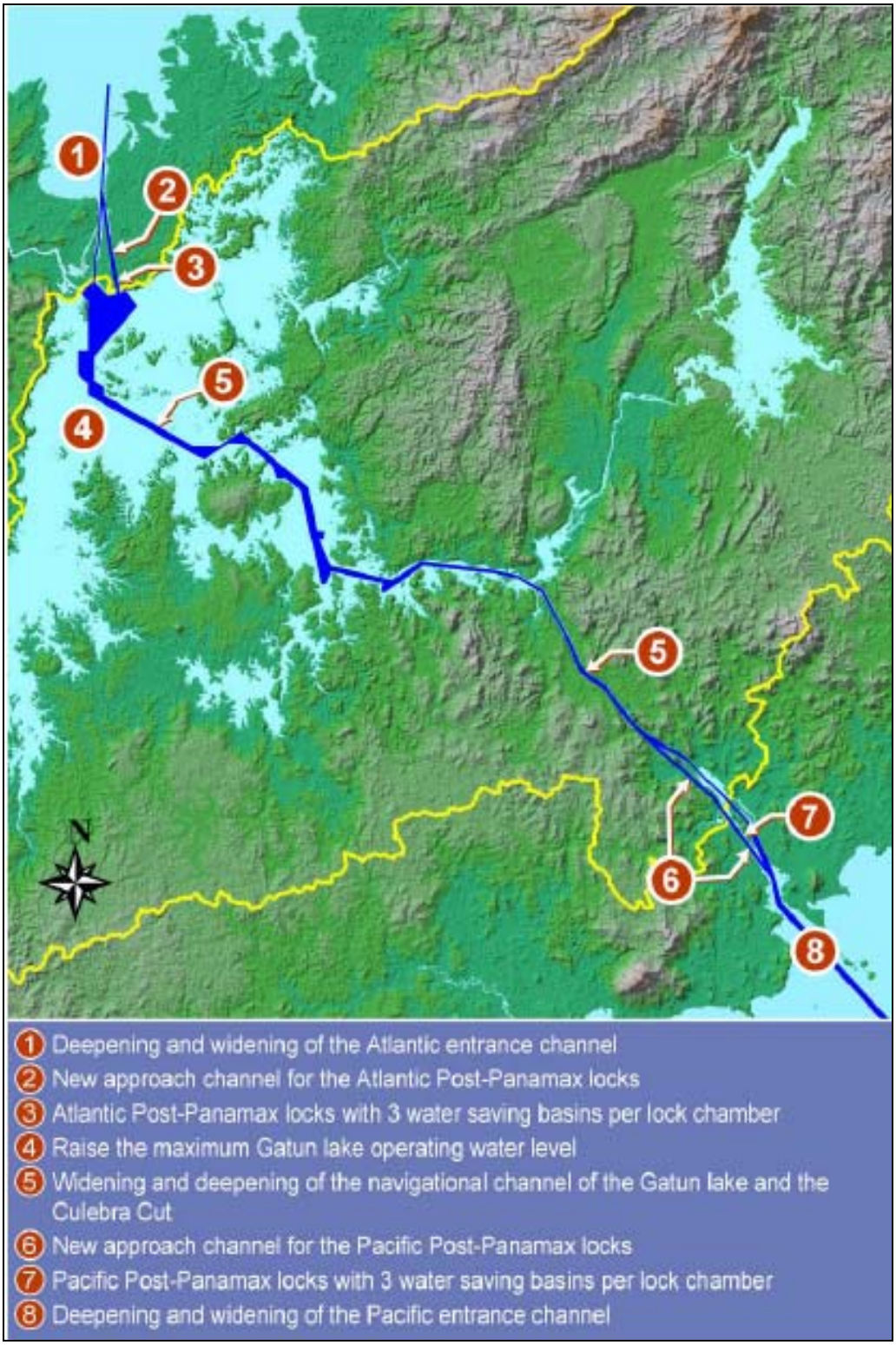


EXHIBIT 52
PANAMA CANAL EXPANSION PROJECT

The cost is estimated at about $5.5 billion with projected completion by 2015 (Exhibit 53). The proposal was approved in a Panamanian national vote on October 22, 2006.

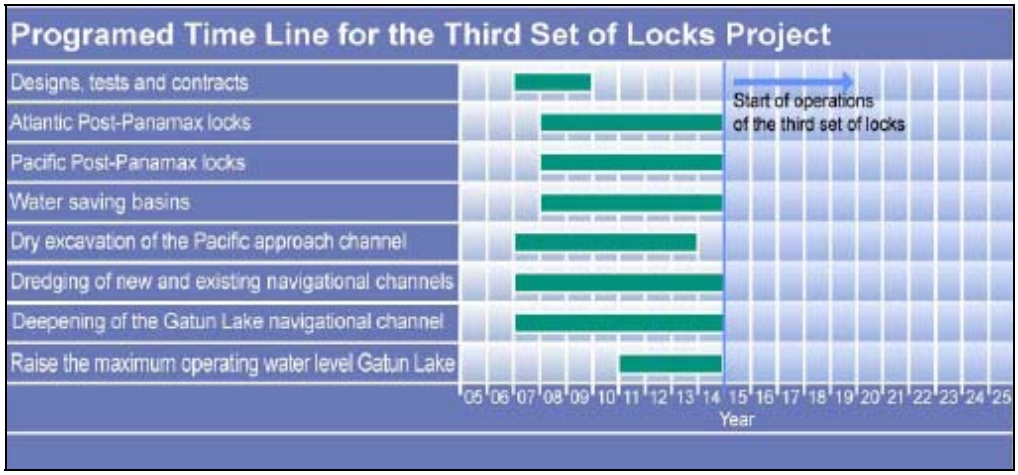


EXHIBIT 53
PANAMA CANAL EXPANSION SCHEDULE

As discussed in later sections, the operational capacity and use of the Panama Canal is linked to draft and dredging requirements at U.S. ports.

Implications: Operations through the Panama Canal will become increasingly congested as it approaches capacity in the next 2 to 3 years. The following scenarios appear possible.

- Operational capacity restrictions, reduced reliability and higher costs due to increased transit fees will blunt cargo growth in the all-water Asia-USEC trade. Mini-landbridge services through the West Coast will regain share.
- The Panama Canal Authority will need to explore operational refinements and bottleneck relief measures while awaiting long-term infrastructure improvements.
- Allocation policies favoring high-revenue container vessels will reduce the available capacity for bulk and break-bulk trades, forcing changes in underlying cargo flows and changes in U.S. port calls.

Uncertainties: The current situation and expansion proposal together raise a number of uncertainties.

- Now that the expansion has been approved, how long will it take the ACP to raise funds and begin construction?
- Projects of this magnitude are rarely completed as scheduled. When will the third set of locks actually open?

- Projects of this magnitude usually exceed their budget, even with contingency reserves. How much will the expansion actually cost and what are the implications for transit fees?
- What happens in the 6 years or more between 2008 to 2009 when the Canal reaches its existing capacity and 2015 or beyond when the third set of locks opens?
- Will U.S. East Coast ports have the draft, crane, berth and inland access capacity needed to take advantage of larger vessels in the Asia-USEC trade?

2.14 Port Trends

2.14.1 Overview

Major U.S. (and Canadian) ports will expand within existing outlines; expansion through fill or on new land will be rare. Major ports will gradually phase out ancillary and non-cargo functions within their borders to focus on major cargo handling capabilities. Ports will operate closer to capacity and will be more vulnerable to disruption.

- Security requirements will raise costs, divert funds and impinge on capacity.
- Port highway connections will remain tight.
- Terminals will take longer and cost more to develop.
- "Efficient marine terminal" concepts will spread, using information to organize operations, minimize dwell and increase throughput and reliability.
- "Agile port" concepts will see very limited application.

2.14.2 Container Port Capacity and Productivity

U.S. container terminals are frequently disparaged for being less "productive" than the leading Asian and European terminals in terms of annual TEU per acre. This criticism has always been misplaced and obscures key facts and trends. U.S. terminal operators and ports have made decisions that minimize operating cost and maximize responsiveness at the expense of space utilization.

- U.S. ports compare very favorably with Asian and European ports in total throughput and cost per TEU, measures more important to the industry than TEU per acre.
- High-productivity terminals tend to be high-cost terminals due to the massive capital investment and substantial labor force required to attain the throughput in limited space. Hong Kong shippers routinely complain about the Terminal Handling Charges (THCs) assessed there to recover high terminal costs.
- Because of the shorter distances to market most Asian container terminals have no significant rail infrastructure to accommodate or serve. Neither Singapore or Hong Kong have rail intermodal terminals either on-dock or off-dock.

- Asian totals are inflated by transshipment volumes, especially at the regional load centers of Singapore and Hong Kong.

U.S. ports have actually demonstrated substantial increases in throughput per acre in recent years as cargo growth has outstripped terminal expansion.

The newest North American container terminals are typically designed to transition between wheeled, mixed and stacked operating methods (Exhibit 54). Centerm in Vancouver recently announced major capital investments to convert to stacked operations with a capacity goal of 11,000 annual TEU per acre, comparable to the leading Asian and European terminals.

	Terminal System	Gate System	Chassis System	Empty Storage	Rail Transfer
Container Port (Oakland, 1970s)	Wheeled	Manual, paper	Individual lines	On-dock	Off-dock
Intermodal Port (Tacoma, 1990s)	Mostly wheeled, some stacked	Manual, paper & computer	Individual lines, some pooling	On-dock, some depots	Mixed on/off-dock
Transition Port (_____, 2000-2010)	Mostly stacked, some wheeled	Semi-automated& paper	Steamship line chassis pools	Mostly depots, some on-dock	Mostly on-dock
Intensive Use Port (_____, 2010+)	Stacked	Automated	Customer or trucker chassis	Off-dock depots	Primarily on-dock

EXHIBIT 54
CONTAINER TERMINAL DESIGN PROGRESSION

With a need to increase overall throughput and limited expansion room, U.S. ports of all types are increasingly pursuing operational refinements, smaller-scale capital improvements and other methods of maximizing productivity of existing terminals.

- Extended gate hours have been implemented at ports in Vancouver, Oakland and Los Angeles/Long Beach (limited to PierPass) and will likely become more common.

- Ports in Tacoma, Vancouver and Los Angeles have improved rail networks to maximize on-dock transfer and reduce dwell times.

- Several ports and terminal operators have implemented new terminal management and gate systems designed to speed transactions and reduce dwell time.

- Appointment systems and virtual container yards are being tried to spread peak period loads and facilitate off-port container interchange and reuse.

The need for more intensive use of limited port lands will lead to continued innovation of this kind.

The Ports of Los Angeles and Long Beach are out of capacity—or are they? It seems to be common wisdom that the two San Pedro Bay ports have reached their limit and face mounting congestion and diversion of cargo to other ports. Much of this thinking is based on the congestion experienced in the peak season of 2004, when vessels waited at anchor and customers did indeed divert cargo to other routes.

Recent trends in Southern California illustrate the difference between the potential for terminal congestion at high container discharge rates and vessel or berth congestion. Despite an influx of larger vessels with 8,000+ TEU becoming common, there was less 2006 peak period congestion at San Pedro Bay than in 2004 or 2005. Observers have noted the berthing efficiencies of fewer larger vessels and attribute some of the congestion reduction to the larger ships. The impact of larger vessels or terminal congestion is mostly an issue of peaking. The use of larger vessels will not ordinarily increase the total cargo handled unless the carrier diverts discretionary cargo from other ports to increase vessel utilization. The use of a larger vessel will, however, ordinarily concentrate more cargo in a single call, stressing the terminal's short-term capacity. The bottleneck could be crane availability, reach, or speed; terminal space and fluidity; or container dwell time (itself affected by rail and truck capacity). Fundamentally, however, one 7,000 TEU vessel call should have the same impact as two 3,500 TEU vessels arriving simultaneously.

The congestion in 2004, however, was mostly due to a shortage of Longshore labor and a rail infrastructure problem combined with unexpected year-to-year growth. More longshoremen were hired, the rail problem was fixed and the 2005 and 2006 peak seasons went smoothly. The San Pedro Bay ports posted a 9 percent volume increase in 2005 and are expecting a 10 percent increase in 2006 when they were supposedly out of capacity.

The recent increases are possible because the Ports of Long Beach and Los Angeles have not reached their true capacity. In fact, they have inherent reserve or latent capacity to grow for several more years. Los Angeles is currently averaging 6,6000 annual TEU per acre and has set a goal of 10,000 TEU per acre by 2025.

The San Pedro Bay ports and U.S. container ports in general are frequently compared with ports in Hong Kong, Singapore, Rotterdam and others on the basis of annual TEU per acre. U.S. ports invariably compare poorly with the Asian giants. This comparison is seriously misleading. U.S. container ports have lower annual TEU per acre not because they make poor use of available space, but because they have more space to handle the available cargo.

"Wheeled" container terminals that park containers on chassis may have lower throughputs per acre, but they also have lower terminal costs and greater responsiveness to customer needs. North American terminal operators have not adapted the more intensive and costly handling methods used in Hong Kong and Singapore (Exhibit 55)[33] because they are neither necessary nor

[33] *Attracting Investments to Seaports – an Introduction*; presentation by Andrew Penfold, Director, Ocean Shipping Consultants, Ltd, European Seaports Conference, Stockholm, June 2006

cost effective. Hong Kong shippers complain bitterly over Terminal Handling Charges (THCs), which are added to ocean freight rates to recover the cost of operating those "productive" terminals. THCs are unknown in North America.

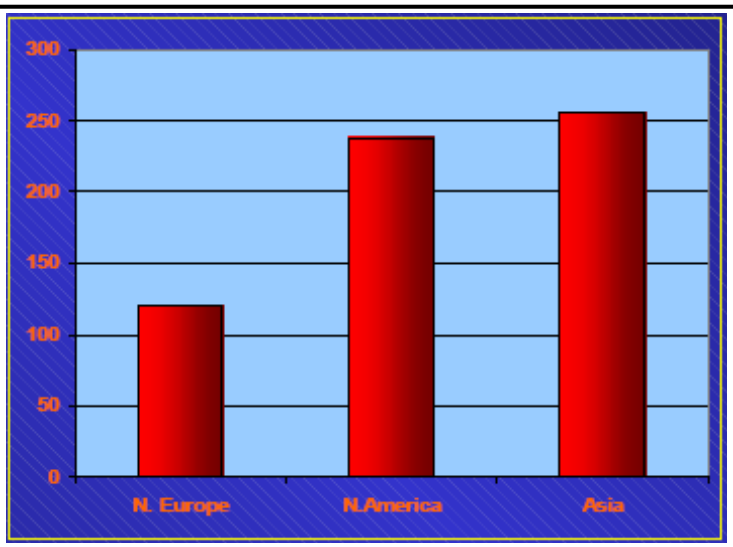


EXHIBIT 55
COMPARATIVE TERMINAL COSTS PER CONTAINER

U.S. container terminals typically incorporate functions that use up space and reduce the apparent throughput per acre.

- Chassis storage. The practice of storing empty chassis on the marine terminal is unique to the U.S., where carrier-provided chassis are a legacy of Malcolm McLean's original container shipping system. Everywhere else chassis are provided by the trucker or the customer and do not take up terminal space for storage.

- Empty container storage. The Hong Kong and Singapore terminals achieve higher throughputs partly by banishing as many empty containers as possible to off-terminal depots. Off-terminal depots are used in the U.S., but many empty containers still take up terminal space.

- On-dock rail transfer. On-dock rail facilities reduce the need for drayage, but the tradeoff is taking up marine terminal space.

An apple-to-apples comparison would subtract the acreage used for chassis storage, empty storage and on-dock rail from the U.S. terminal total before comparing productivity per acre. Berth 4 at the New York Container Terminal now in the design phase, is expected to be able to handle 350,000 to 400,000 lifts per year on 38 acres, the rough equivalent of 8,000+ TEU per acre. A key factor is eliminating chassis storage and stacking instead of parking containers.

Conversion from wheeled to stacked terminals would unquestionably allow U.S. terminals to handle more annual containers per acre. The observations above suggest that operational measures could significantly increase throughout per acre.

- Eliminate empty chassis parking, either by moving chassis off-dock, or preferably, by letting truckers or customers provide chassis.

- Reducing on-terminal storage of empties. Besides taking up space in general, empties have the largest dwell times so they take up the space longer.

- Reducing dwell time for on-dock rail containers. Terminal operators report that containers moving via on-dock rail transfers have longer dwell times.

The U.S. container terminals have ordinarily operated a single daily shift Monday through Friday. Limited hours or limited functions are offered on weekends and early or late gates scheduled only as need to cope with business peaks, late vessels, etc. In contrast, busy terminals in Asia and Europe operate multiple shifts, even if they are not active 24/7.

Measures such as PierPass that increase the utilization of time as well as space have the potential to substantially increase daily and weekly throughput without expanding terminals. The PierPass program was initiated at the San Pedro Bay ports in 2005. Although there were rough spots in the implementation, PierPass shifted roughly 30 percent of the gate transactions to off-peak hours. PierPass is credited with helping avoid congestion in the 2005 and 2006 peak seasons.

The cooperative chassis pool concept was inaugurated by Maher Terminals at the Port of New York/New Jersey in 1995. Carriers at the Maher Terminal contributed their chassis fleets to a commonly managed, commonly used pool. Maher was able to reduce the on-terminal chassis fleet (and the space it occupied) by 25 percent while improving availability and utilization. The Ocean Carrier Equipment Management Association (OCEMA) has taken the lead in establishing co-operative chassis pools. The Hampton Roads Chassis Pool covering the terminals at Norfolk, VA resulted in a 23 percent reduction in chassis inventory. A new cooperative OCEMA pool was recently announced covering the ports of Charleston and Savannah and inland hubs in Atlanta and Charlotte.

Southern California Peaking. A final possibility for increasing average TEU per acre is spreading the annual peak season. Although the Ports of Los Angeles and Long Beach averaged 5,275 TEU per acre for 2005 as a whole, they averaged 537 TEU per acre in the peak month of October – the equivalent of 6,450 annual TEU per acre.

All these considerations suggest that the Port of Los Angeles and Long Beach have substantial latent capability.

The Southern California "peak season" for containerized imports is a perpetual source of concern and speculation. Exhibit 56 shows the inbound TEU counts by month for 2000 to 2005 and 2006 through August. The peak months are highlighted. The same data are shown graphically in Exhibit 57.

A few points are immediately apparent.

- Despite the regular speculation about the peak arriving early, October has been the peak month in every year except 2002 and 2004.

- The 2002 decline in September to November was due to the West Coast work stoppage.

San Pedro Bay Loaded Inbound TEU (peak months highlighted)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
2000	364,586	345,192	359,171	411,986	422,208	414,123	457,595	472,498	429,453	**486,386**	412,452	373,084	412,395
2001	396,230	309,172	402,385	413,298	399,362	435,190	447,137	473,629	487,784	**503,907**	427,993	408,241	425,361
2002	390,922	436,681	390,572	485,979	505,831	528,078	510,429	**562,064**	509,452	416,686	471,034	477,374	473,759
2003	432,867	429,594	473,333	520,097	536,730	505,495	557,871	561,343	548,383	**595,726**	550,594	512,016	518,671
2004	542,560	396,923	570,048	566,989	604,323	601,377	**643,401**	614,342	574,314	635,945	631,572	546,605	577,367
2005	551,220	539,660	465,483	600,014	601,058	629,076	641,935	649,153	664,215	**667,727**	630,155	587,684	602,282
2006	615,552	500,156	623,234	686,232	690,809	700,590	709,782	753,132					659,936

EXHIBIT 56
INBOUND TEU BY MONTH

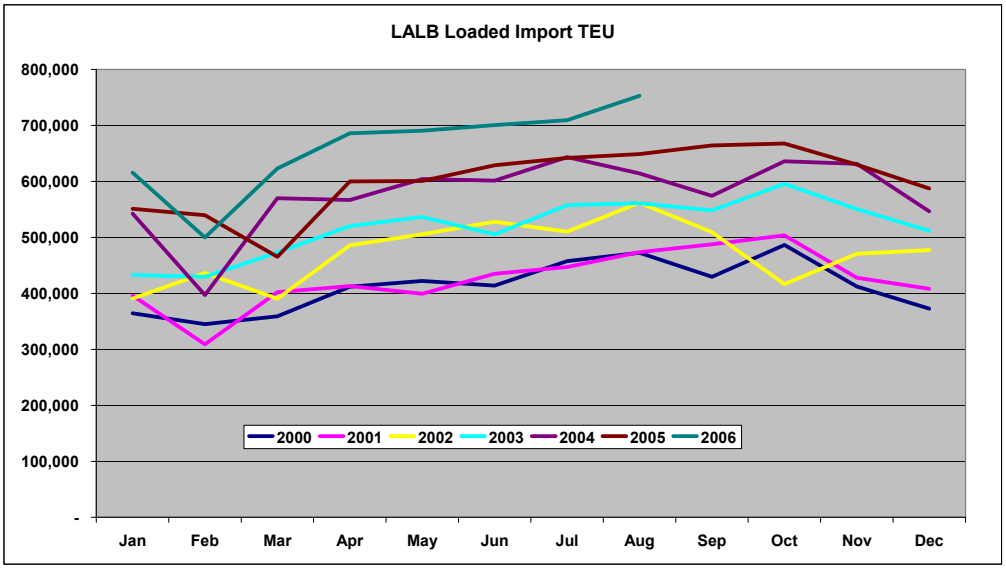


EXHIBIT 57
SAN PEDRO BAY MONTHLY INBOUND TEU

- The flat 2004 peak was likely due to the well-publicized congestion that year and diversion to other ports.
- Exhibit 57 displays another interesting pattern: inbound cargo growth appears distinctly periodic, with strong growth in alternate years. Some correlation with new vessel capacity is possible, as vessel capacity increases also tend to be cyclical.
- The data graphed in Exhibit 58 are normalized – the monthly totals have been divided by the annual monthly average to display peaking patterns.

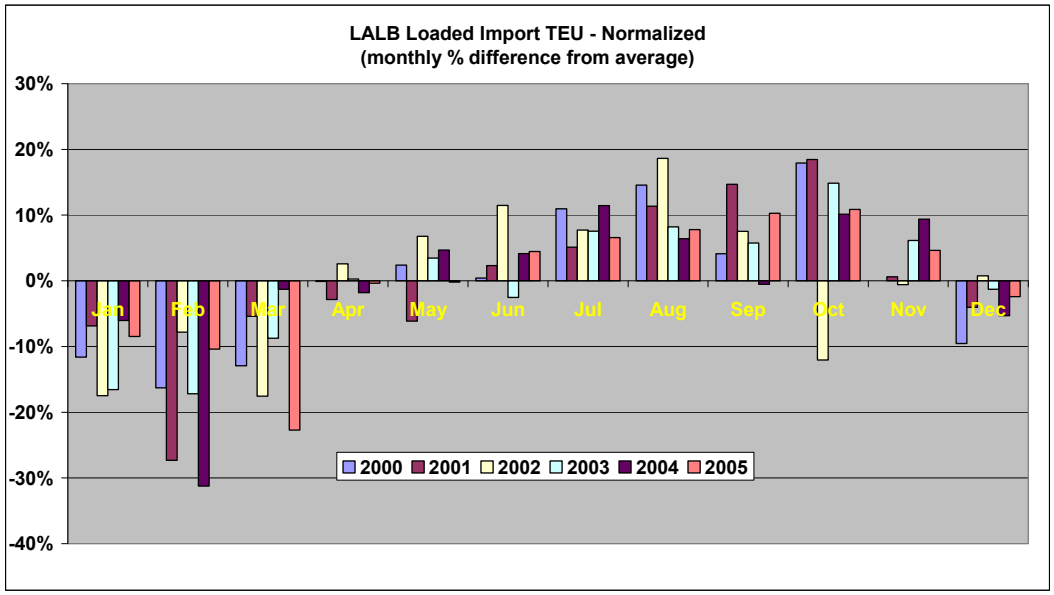


EXHIBIT 58
PEAKING: NORMALIZED MONTHLY INBOUND TEU

- The pattern in the graph is quite clear and changes relatively little from year to year. The data in Exhibit 58 do suggest some softening of the peak. In 2000 to 2001 October was 18 percent above the monthly average but in 2005 (ignoring the "abnormal" 2004) October was just 10 percent above the average. This "softening" is also consistent with the net 2000 to 2005 growth in each month, shown in Exhibit 59. Although the pattern is not completely "anti-peak," it does appear that importers may have shifted some of the traffic away from the October peak and that import growth is stronger in some off-peak months.

2000-2005 San Pedro Bay Inbound TEU Growth by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
00-05 % Δ	51%	56%	30%	46%	42%	52%	40%	37%	55%	37%	53%	58%	46%

EXHIBIT 59
2000-2005 GROWTH BY MONTH

Implications: Were the Ports of Los Angeles and Long Beach really at capacity there would be little point in deepening drafts to handle ever-larger vessels. With apparent latent capacity, expansion of trade at San Pedro Bay is both possible and expected, along with eventual use of larger vessels. The latent capacity at San Pedro Bay also implies that Canadian and Mexican port expansion predicated on "overflow" from congested Southern California ports may be bound for disappointment.

Uncertainties: Successful expansion at San Pedro Bay will require alignment of efforts and coordinated action by multiple parties. Given the sometimes fragility of cooperative industry

efforts and public-private understandings, both the timing of successful expansion and the expansion itself are somewhat uncertain.

2.14.3 Gulf Port Trends

Exhibit 60 shows 2005 tonnage totals for the twelve leading seaport complexes in the U.S. (treating Los Angeles and Long Beach as a single port). Ten of the twelve are Gulf ports. Two factors account for the high tonnages moved through Gulf ports:

- Massive concentrations of crude petroleum, petroleum products, grain, minerals and other heavy bulk cargoes.
- Large domestic cargo shares averaging 42 percent of the total at Gulf ports (and at NY/NJ) versus 18 percent at LA/LB.

The capabilities of the smaller Gulf ports are determined more by their bulk cargoes than by the requirements of container vessels.

	Domestic	Foreign	Total
South Louisiana	117.7	94.6	212.3
Houston	66.6	145.1	211.7
NYNJ	64.3	87.8	152.1
LA/LB	24.6	110.2	134.8
Beaumont	18.8	60.1	78.9
Corpus Christi	23.8	53.8	77.6
New Orleans	32.8	33.1	65.9
Baton Rouge	36.9	22.4	59.3
Texas City	14.4	43.5	57.9
Mobile	26.3	31.4	57.7
Lake Charles	20.6	32.1	52.7
Tampa	29.1	20.1	49.2

Source: Waterborne Commerce Statistics Center

EXHIBIT 60
2005 PORT TONNAGE (MILLIONS OF SHORT TONS)

The Gulf Coast ports are accessed either via dredged ship channels or rivers. Houston's capabilities are dependent on the Houston Ship Channel. The WRDA of 1996 provided for dredging the ship channel to 45 feet, a process completed in 2005. Ongoing dredging is critical as Galveston Bay is naturally only 7–9 feet deep. At present, Houston has 40 feet of draft at its berths, sufficient for the Panamax vessels that tend to call there. Ports such as Gulfport (36 feet), Galveston (49 feet), Freeport (20 feet), Mobile (32 feet) and New Orleans (36 feet) have a mix of draft capabilities. The Ports of New Orleans, Baton Rouge and South Louisiana are all on the Mississippi River. Exhibit 61 shows the channel to Corpus Christi.

Baton Rouge has a 45-foot dredged channel. Beaumont, similarly, is on the Sabine-Neches Ship Channel, dredged to 40 feet. Lake Charles is accessed by the Calcasieu ship channel maintained at 40-feet. Tampa's channel is maintained at 43 feet.

The Gulf container traffic is dominated by Houston, which handled 73 percent of the regional total in 2005. Houston has the Barbours Cut terminal in operation and the Bayport terminal just completed. Container traffic at New Orleans was down by 22 percent over 2004 due largely to disruption by Hurricane Katrina. The Gulf ports carry a larger share of South American, Caribbean and European trades. Gulfport, for example, handles significant volumes of imported South American and Central American bananas. These trades are unlikely to see the introduction of very large containerships in the near future and are therefore unlikely to face the same needs for greater draft that East and West Coast ports face.

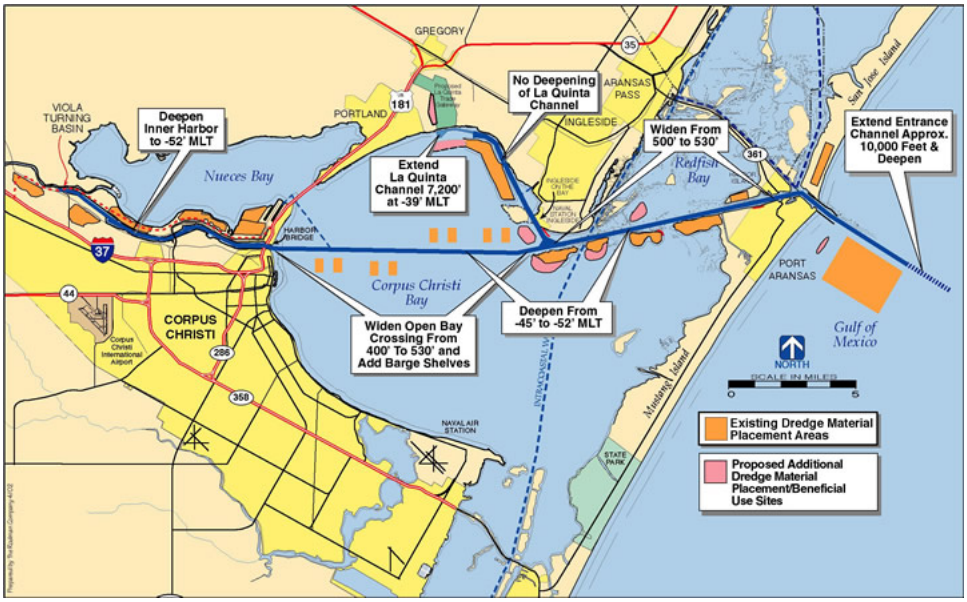


EXHIBIT 61
CORPUS CHRISTI SHIP CHANNEL IMPROVEMENTS

For the immediate future, discussions regarding Gulf ports will be prefaced by discussions of the impacts of Hurricanes Katrina and Rita. Exports through Gulf ports dropped 23 percent immediately after the hurricanes but recovered rapidly. Initially cargoes were diverted: Baton Rouge exports rose 25percent from August to September of 2005. By January 2006, exports through most Gulf ports were at or near pre-hurricane levels. Imports through Gulf ports dropped 11 percent from August to September of 2005. By October, however, imports recovered and passed their pre-Katrina volumes.

The Port of Gulfport was particularly hard-hit by Hurricane Katrina. Container operations were first to resume while break bulk handling of poultry, paper, lumber, etc. took significantly longer to recover. Over 80,000 square feet of warehousing was demolished. Much of this lost space was replaced by May 2006. Gulfport's expansion projects may have been set back by the need for post-hurricane reconstruction. Gulfport plans to complete additional warehousing in two phases, one by November 2007 and the other by mid-2008.

***Implications*:** Hurricanes Katrina and Rita result in large diversions of USACE funds from improvements and maintenance to repair and restoration. In the absence of increased regional funding from Congress, the diversion of resources will delay planned channel improvements.

***Uncertainties*:** The total cost of repair and restoration in the Gulf will not be known for several years. The uncertain future of WRDA in 2007 and beyond adds a second dimension to the uncertainty.

2.15 Growth of Asia-USEC Services

The all-water route through the Panama Canal has captured a growing share of the Asia-USEC market. The estimates shown in Exhibit 62 below suggest that as of 2004 the Panama Canal route had about 23 percent of the cargo.

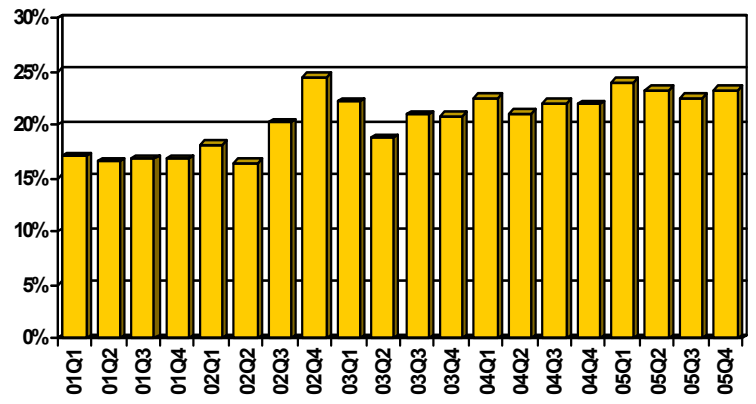


EXHIBIT 62
ASIA-USEC ALL-WATER CARGO SHARES
Sources: Manalytics PIERS, TTX

As 2004 was the year of dramatic congestion in Southern California, it is likely that the all-water share grew further in 2005 as customers sought alternatives to mini-landbridge service. There are, however, moderating factors.

- The serious, well-documented Southern California port congestion during the 2004 peak season was not repeated in 2005 or 2006, reducing the impetus to seek all-water routings.
- Ocean carriers have been limited in their ability to expand Panama Canal services by a tight charter market with a shortage of available Panamax ships. This shortage may ease somewhat as vessels are cascaded from the Transpacific, but there are competing uses for those vessels as well.
- The Panama Canal has limited room for growth. Panama Canal Authority forecasts anticipate 3 percent growth in container traffic through 2025 without capacity expansion and 6 percent with additional capacity.
- East Coast ports may need to increase capacity (draft, berths, cranes) to handle hoped-for increases of container-business in larger vessels.

Implications: Growth in all-water Asia-USEC services will likely slow in the next few years as the Panama Canal reaches capacity, tolls rise and reliability declines.

Uncertainties: Future congestion in Southern California or a change in Panama Canal transit slot allocation could allow additional Asia-USEC cargo growth.

2.15.1 Canadian Container Port Competition

The Prince Rupert Port Authority, Canadian National (CN) and Maher Terminals are developing Fairview Container Terminal in Prince Rupert BC (Exhibit 63). The terminal is being developed in two phases with construction on Phase I underway to be completed in the third quarter 2007 and Phase II scheduled for 2010. Phase I is a 500,000 TEU terminal. Throughput capacity at the completion of Phase II will be 2 million TEU annually. Water depth berth-side is 52 feet at the completion of Phase II, as it will be at the single berth for Phase I. Prince Rupert has a transit time advantage of 1,000 to 1,200 nautical miles over the Ports of Los Angeles and Long Beach depending on Asian Port. Initially, the U.S. inland destinations will be limited to Chicago and Memphis while in Canada the markets of Winnipeg, Toronto and Montreal are planned for service.

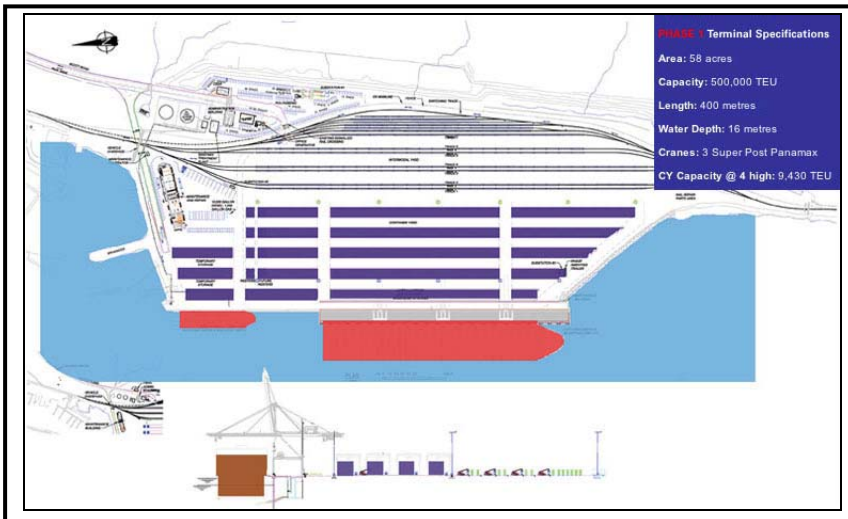


EXHIBIT 63
PRINCE RUPERT TERMINAL PLAN PHASE I

The long-delayed expansion of Deltaport in British Columbia finally obtained environmental clearance in November 2006. The project would increase Deltaport's capacity from 900,000 to 1.3 million annual TEU at completion in 2009.

Exhibit 64[34] shows results from a survey of why customers would shift to Canadian ports.

[34] *Industry Survey Series: Mainstream Container Services*, MARAD, 2003.

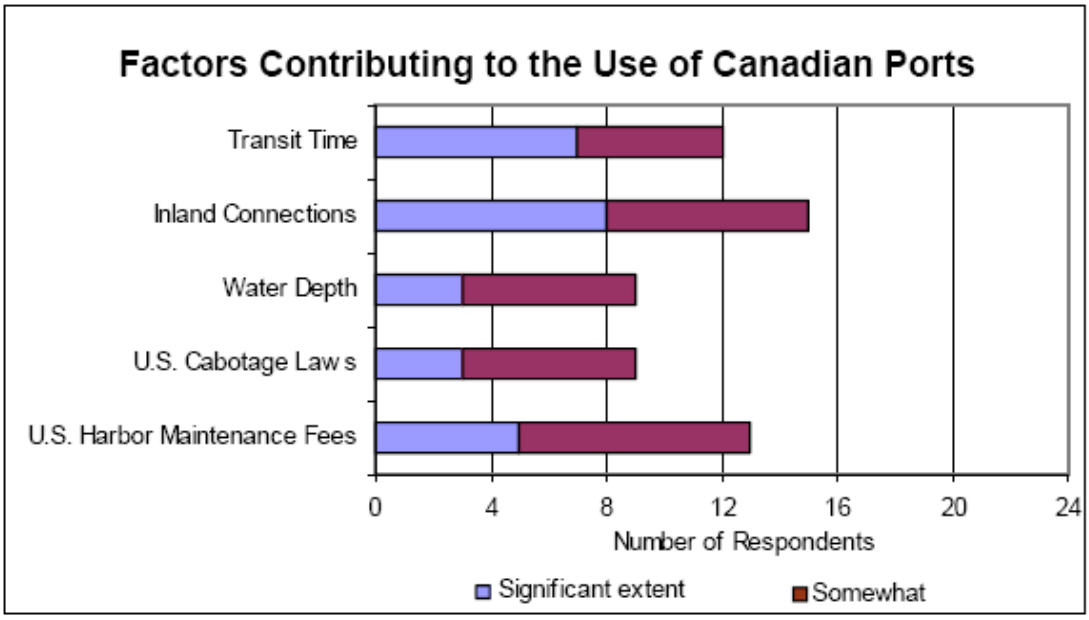


EXHIBIT 64
USAGE OF CANADIAN PORTS

Implications: The Canadian ports in British Columbia are well-positioned to compete for traffic to the U.S. upper Midwest and east. Prince Rupert and the expanded Deltaport terminal will be marketing their capacity in that trade and will likely divert some intermodal traffic from Seattle and Tacoma. New growth services through the B.C. ports may also take some intermodal pressure off of the Ports of Los Angeles and Long Beach and Oakland.

Uncertainties: The big question facing the B.C. ports is whether they can take existing traffic from the Ports of Los Angeles and Long Beach or simply attract a share of the growth. In this regard they are in the same position as Seattle, Tacoma and Oakland.

2.15.2 Mexican Container Port Competition

Today there are two West Coast Pacific Mexican ports with ocean carrier service to/from Asia: Lazaro Cardenas and Manzanillo (Exhibit 65). Both are southwest of Mexico City and their primary market is Mexico's major population and production centers. Both currently have limited direct sailings from Asian ports. All of the carriers except Maersk call on the Mexican ports as part of their Asia/North American service that includes USWC ports before stopping in any Mexican port. Maersk serves the Mexican ports as part of an Asian/Central American route that does not call at USWC ports.

Manzanillo, the more fully developed port, dominates Mexican container traffic on the West Coast (Exhibit 66). SSA Marine and Hutchinson Whampoa are the primary stevedoring companies. Ferrocarril Mexicano, S.A. de C.V. (Ferromex) provides rail service.

Lazaro Cardenas is being promoted as an alternative to Southern California as a North American intermodal gateway. At Lazaro Cardenas, Kansas City Southern de Mexico (KCSM)

EXHIBIT 65
MEXICAN WEST COAST PORTS

provides rail service. KCSM is now a sister company to the Kansas City Southern Railroad and the combination has recently announced through container service to the U.S. with 6th day delivery to Jackson, MS and 7th day to Atlanta. Under the right circumstances, these times can be competitive with rail moves from Southern California. Current Hong Kong/Atlanta service is 24 days through Los Angeles and the new service over Lazaro Cardenas is planned at 25 days. It will be price competitive with the service via Los Angeles.

Lazaro Cárdenas has existing capacity and space for additional traffic. Hutchinson has plans to expand the operation through the development of an additional 210 acres. It serves most major population centers in Mexico with direct rail service provided by KCSM. It does not have frequent direct sailings from multiple ports in the Far East or large capacity ships making the port calls. There is daily intermodal service on mixed freight trains to Mexico City with connecting service on local service trains through to U.S. destinations. Lazaro Cardenas faces several difficulties.

PORT	2005	2004	2003	2002	2001
Manzanillo	873,976	830,777	709,209	638,597	458,472
Lazaro Cardenas	132,479	43,445	1,646	134	0
Ensenada	75,101	39,202	46,332	53,142	26,016
Mazatlan	17,419	15,954	16,394	12,900	18,315
Guaymas	5	16	36	33	0
Topolobampo	-	-	-	-	-

Source: Secretaría de Comunicaciones y Transportes, AAPA

EXHIBIT 66
MEXICAN WEST COAST CONTAINER VOLUMES (TEU)

- First, extra time and miles are incurred on the Far East end of the container shipment as a result of the limited options for port selection because of limited service to Lazaro Cardenas. This incremental activity (cost and time) in China is due to the presence of far more direct sailings from multiple Far East ports to all other U.S. West Coast ports. Also, it has increased sailing times, at least 2 days, as compared to California ports.

- Second, it would take a major commitment by underlying customers to provide sufficient volumes in the lane to support a carrier's investment of resources to provide direct calls, more frequent sailings and/or larger ships.

- Third, the lack of rail alternatives is a negative for some importers. At U.S. West Coast ports there is the option of Union Pacific or BNSF while at Lazaro Cardenas the only railroad is KCSM.

The Port of Ensenada has also been advanced as a potential competitor to Southern California. Competitive inland rail service does not exist at Ensenada and is not likely to be developed in the foreseeable future. The likeliest service pattern for U.S.-bound trade would be to truck the containers to the existing rail service in Southern California, thereby adding time and cost relative to service via the San Pedro Bay ports. Instead, Ensenada is more likely to serve the Mexican maquilladora industry.

There is the prospect of a new port on the West Coast of Baja California at an undeveloped site known as Punta Colonet, on the Pacific at Cabo Colonet. There is currently no reliable rail service that connects to the U.S. railroads from this port.

There are container-on-barge services from Manzanillo to smaller ports closer to the U.S. on the east coast of the Gulf of California, e.g., Guaymas and Topolobampo. Guyamas has historically been an export port for mineral production. Topolobampo is a mineral, general cargo and cabotage port. Beyond rail service to the U.S. Mexico border at Nogales would be by the same Ferromex service as originates at Manzanillo. Most critically, these ports would both require transpacific vessel to sail up the Gulf of California, adding time and cost.

Implications: Despite the attention paid to these potential as alternatives to the port of Los Angeles/Long Beach, the main functions of the principal west coast Mexican container ports will be to serve Mexico's own foreign trade. The recent rapid growth at Manzanillo, Ensenada and Lazaro Cardenas is rooted in expansion of Mexican trade, not in diverting traffic from Southern California.

Of the potential U.S. sectors the Gulf and Southeast markets offer the best opportunities for the Mexican ports. In that market they are perhaps positioned as well to substitute for the Panama Canal as they are to substitute for the port of Los Angeles/Long Beach. As the Panama Canal reaches capacity in the next few years, the Mexican Ports may have a larger role as a relief valve for the Canal.

Uncertainties: Of the Mexican port development proposals Lazaro Cardenas is the only established operation. Punta Colonet may or may not be developed. Ensenada may or may not expand to serve the U.S. and Guaymas may or may not evolve from a mineral and agricultural port to a significant container port. The size, nature and timing of developments at other ports are highly uncertain.

The rail issues add a second layer of uncertainty. Manzanillo and Lazaro Cardenas have bad rail service to inland Mexican markets and Lazaro Cardenas also has links to U.S. markets. Guaymas and Topolobampo have rail connections, but those routes are circuitous and poorly positioned to reach U.S. destinations. Ensenada and Punta Colonet lack rail connections. A major rail construction initiative may not be likely, but could alter the competitive positions of the Mexican ports.

The greatest overall uncertainty is whether one or more Mexican ports could divert a significant amount of year-round traffic from the port of Los Angeles/Long Beach instead of acting as a peak season safety valve. If so, there would be reduced expansion pressure at the port of Los Angeles/Long Beach and a possible postponement of dredging or filling projects.

2.15.3 Terminal Development and Leasing Trends

Although casually attributed to environmental requirements, terminal development timelines are stretching out for several reasons.

- Environmental requirements will continue to consume time and resources. Experience gained in meeting previous requirements may be offset by progressively stricter regulations. The surprise factor is gone, however, and ports plan for the required environmental reviews and clearances.

- Community concerns over congestion, noise and emissions are becoming increasingly virulent, without the structured process of environmental review. Increased tension has emerged between port and city authorities in several regions. Less-structured impediments can present greater problems and less predictable outcomes.

- The sheer scale and technical sophistication of terminal developments and engineering requires more time and funding that simply paving more space and ordering new cranes. Building terminals on reclaimed or marginal sites will cost more and take longer.

- The increasing political sensitivity of world trade and attendant security concerns has recently led to national political interference and delay in the cases of the COSCO terminal in Long Beach and DP World's purchase of P&O terminals.

- On the West Coast in particular, communities are increasingly divided on the desirability of more trade and port activity if much of that trade appears to benefit other regions.

There is a perceptible trend toward shorter terminal leases at container ports to give both ports and carriers increased flexibility. In Southern California, terminal lease negotiations have become a tool to encourage (or even enforce) emissions reductions and other "green" initiatives. This trend is likely to result in more frequent terminal turnover and rebuilding, especially coupled with the need to maximize capacity within existing port outlines.

As ports have greater difficulty developing and financing new terminals and ocean carriers grow in size, there is an emerging trend towards terminal development by carriers or joint ventures. In the U.S., examples include the new Maersk terminal at Portsmouth, Virginia and the Joint Maersk-CMA/CGM terminal proposed for Mobile, Alabama. Both of these examples are in secondary markets outside the major existing container ports. This trend may lead to diversification of the U.S. container port business and additional aggregate capacity.

Triple bottom line. The port industry has begun referring to the "triple bottom line" (Exhibit 67), which includes environmental and social acceptability as well as financial or economic success. The same concept is also embodied as E3: Environment, Economics and Equity, the "sustainability trinity (Exhibit 67)." Institutionalization of this concept across the port industry should lead to smoother, if still lengthy, project development processes.

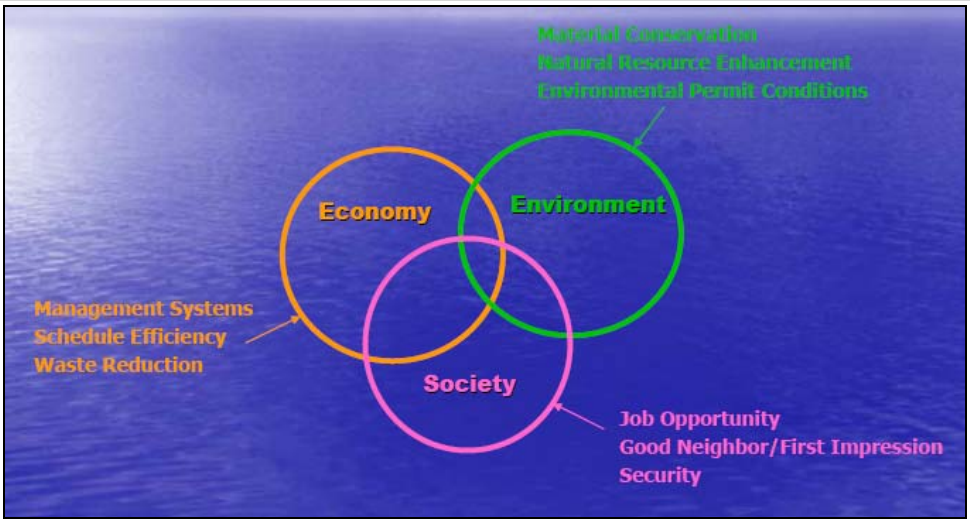


EXHIBIT 67
TRIPLE BOTTOM LINE FOR PORTS

Implications: Every discernable trend is lengthening the time required for expansion of Port infrastructure, including USACE projects.

Uncertainties: Uncertainty itself is at the core of this trend. It is possible that development timelines will continue to increase indefinitely.

2.15.4 Port Consolidation and Coordination

Port consolidation and cooperation are frequently proposed in states such as Washington and California with major competing ports and no single state port authority. Consolidation is typically proposed as an antidote for what critics see as "wasteful" competition between ports (but which shippers and carriers regard as "healthy" competition). Claims are also made for potential efficiency improvements that might better be termed rationalization benefits.

- Cooperation is most often proposed by smaller ports with precarious market shares. For instance, when Tacoma was a distant second to Seattle the cooperation proposals came from Tacoma; as Tacoma gained market share at Seattle's expense, it was Seattle that was interested in cooperation.

- Cooperation or alliance is also attractive to large, space-constrained ports paired with smaller ports that have expansion room. The recently announced merger of Vancouver with the Fraser River Ports is one example (after most of Fraser River's container business went to Vancouver); the alliance between the ports of Oakland and Sacramento is another.

- Cooperation under pressure is a noticeable trend in Southern California. Despite their longstanding commercial rivalry Long Beach and Los Angeles have responded to intense community and regional pressure with extensive cooperation on planning, traffic and environmental issues.

Although there are thus multiple reasons advanced for cooperation or consolidation between ports, there may be limited scope for actual combinations. Many states already have single port authorities. In regions such as the Columbia River or San Francisco Bay the ports tend to be specialists with their own niches. Under those circumstances the benefits of consolidation are limited.

Implications: USACE is likely to see additional coordination between regional ports and consolidation in limited circumstances. Either coordination or consolidation offer a means of rationalizing conflicting demands for dredging priority and potential duplication of capacity and infrastructure.

Uncertainties: Port coordination may take place under pressure and may dissolve when the pressure lets up.

2.15.5 Break Bulk Terminals

"Break-bulk" cargoes are what remains of maritime trade that is neither handled in bulk or containerized, or driven off ro-ro vessels. Major break-bulk commodities include lumber, steel and newsprint. "Project cargoes" include movements of assembled machinery, heavy lift items, outsized shipments and other one-time or short-term cargo flows usually handled in the same

terminal as break-bulk trade. Project cargoes tend to be associated with nearby construction or industrial projects. Examples include partially completed transit cars, prefabricated bridge components, refinery vessels, windmill components and power plant turbines.

Break-bulk and project cargoes are commonly handled at "general cargo" terminals, often at smaller regional ports. These terminals typically consist of paved wharves or aprons with fixed or mobile cranes and multi-purpose transit sheds.

General cargo terminals capable of handling breakbulk and project cargoes may become a rarity. The range of breakbulk commodities has been steadily narrowed through progressive containerization of the commodities themselves and of the port at which they move. The existing break-bulk cargoes at a given port are likely to be controlled by just a few shippers and consignees (often just one). The future of both the cargo and the terminal often depends on the fortunes and strategies of a very few stakeholders. Closure of an adjacent steel plant, completion of a new bridge, or a tariff change can eliminate an entire cargo flow overnight.

Although there are many general cargo terminals in the U.S. there are often just one or two serving a region.

Implications: For large container ports under pressure to increase capacity, the question is whether the lower productivity of general cargo terminals can justify their continued existence. Oakland, for example, has closed out all non-containerized operations. For smaller ports such as Sacramento, the issue can be one of survival when major customers depart.

Uncertainties: The volatility of break-bulk and project translates directly into uncertainty for dredging and navigation projects. The perceived need for dredging at a general cargo terminal may rest on the requirements or preferences of a handful of customers whose own future is precarious. Besides the inherent uncertainty, it becomes difficult in such circumstances to distinguish broad NED benefits from private benefits to a few major customers. The uncertainty can be particularly acute for terminals handling project cargoes. Project cargoes tend to be linked to regional public or private infrastructure initiatives and can dry up for months or years at a time, jeopardizing the financial health of the terminal and port.

Section 3
Major Interdependent Issues

3.1 Interdependent Issues

The interrelationships and circularity of trade and transportation linkages make it difficult to portray simple cause-and-effect relationships or make simple predictions – the answer to almost any question is "it depends." A few interlocked themes connect many of the marine transportation system trends discussed previously.

Growing vessel size. While both bulk and container vessel sizes are growing, the major dredging needs appear to be associated with very large container ships and the ports they might use. The uncertainty is in the number and deployment of vessels requiring 50+ feet of draft, which exceeds that available at many U.S. container ports.

Future of the Panama Canal. Plans to add a third set of wider locks to the Panama Canal were recently approved by the Panama electorate. Timely expansion, however, is not guaranteed. In the meantime the Panama Canal is becoming congested and more expensive. There are multiple possible outcomes depending on which vessels continue to use the Panama Canal for which routes.

Southern California Port Capacity. The complex and interrelated discussions of U.S., Canadian and Mexican container ports come down to a pair of key questions.

- When, if ever, will growth at the ports of Los Angeles/Long Beach plateau?
- If and when the ports of Los Angeles/Long Beach plateaus, where will the growth go?

The answer to the first question depends on the ability of the two ports, their terminal operators and the two railroads to wring additional productivity out of existing or revamped facilities. The answer to the second question involves a competitive assessment of other West Coast ports and non-West Coast alternatives.

East Coast Container Port Competition. East Coast container port competition is not a mirror image of the West Coast. East Coast deployments and cargo volumes depend much more on Panama and Suez Canal routings and the growth of exports from the Indian subcontinent. In addition, the larger number of ports spreads rail investment and resources more thinly.

Indian Export Growth. It is widely agreed that the long-term growth of exports from India and adjacent economies will eventually result in expanded container traffic through the Suez Canal to the U.S. East Coast. The chief uncertainty is how much and when. A second source of uncertainties is whether Indian exports will supplant Chinese exports and constrain Chinese growth, or grow in parallel with Chinese exports and add to the U.S. import total.

Together, these factors will interlock to determine the long-term dredging and navigation needs of the major U.S. ports.

3.2 Container Port Competition and Dredging Needs

The draft requirements of container ports and the public justification of dredging depend on:

- The volume of containerized trade at those ports;
- The draft requirements of the vessels;
- The total resource costs with and without dredging (the difference being roughly equivalent to NED benefits); and
- The cost of dredging itself (outside the scope of this paper).

The volume of containerized trade at any given East Coast container port depends on:

- The growth of containerized trade that it can serve; and
- The port's share of local, regional and national markets.

The growth of containerized trade depends on:

- World and US economic growth;
- Regional US import demand;
- Relative currency values; and
- Trade restrictions or freedom.

Market share is the focus of port competition. Ports compete in several ways.

- Ports, in their roles as landlords and sometimes as operators, are continually attempting to build new container terminals and improve existing terminals to increase both capacity and efficiency.
- Ports have recently focused on improving rail access and connections, both on-dock and near-dock.
- Ports negotiate favorable contract terms such as volume thresholds and wharfage/dockage charges.
- Ports assist carriers in market development and in securing ancillary port services to make it easier to do business at their port.
- Ports also compete to locate new importers and exporters in the service areas ("hinterlands"), just as cities and regions compete for new employers and industries.

Ports are continually striving to improve their competitive position as first one, then the others increase capacity, improve performance and in general "ratchet up" the level of competition. Most of their activity is focused on landside improvements, but channel depths are also viewed as a competitive issue.

Ports are intensely competitive and will continue to compete vigorously for the foreseeable future.

- Ports compete first for carrier tenants. This competition is mostly regional, as all major carriers typically serve all regions. For example, the Ports of Seattle, Tacoma and Portland compete for carrier tenants in the Pacific Northwest.

- Second, ports compete for vessel calls from their tenants. Each major steamship line or alliance maintains multiple transpacific and transatlantic services and each port would like to be included in as many services as possible. This competition is inter-regional, since carriers usually call at only one port in each region. Alliance members, however, may spread their calls between one or more ports in a region based on the prior port associations of the alliance members.

- Ports compete for local and regional cargo, both imports and exports. Ports in the same region compete for local cargo, while ports in adjacent regional compete for regional cargo. For example, Baltimore and Norfolk compete with each other for cargo moving to and from the mid-Atlantic region and both compete with New York/New Jersey for Ohio Valley intermodal cargo.

- Port compete in tiers. The largest container ports compete nationally and internationally for discretionary cargo flows and for industrial developments in their hinterlands. Smaller ports, particularly bulk and break-bulk ports, compete regionally for commodity flows and terminal locations.

Exhibit 68 shows the major population clusters whose cargo flows the container ports are seeking to capture.

The need for channel deepening and related improvements is driven by the expected need to accommodate an influx of larger vessels with deeper draft. Every port would like the capability to handle larger vessels and fears potential cargo diversions to other ports. Every vessel operator would like to realize the economies of larger ships and the revenues from greater cargo volumes. The cost and environmental consequences of dredging, however, will force USACE to be increasingly selective about channel deepening projects.

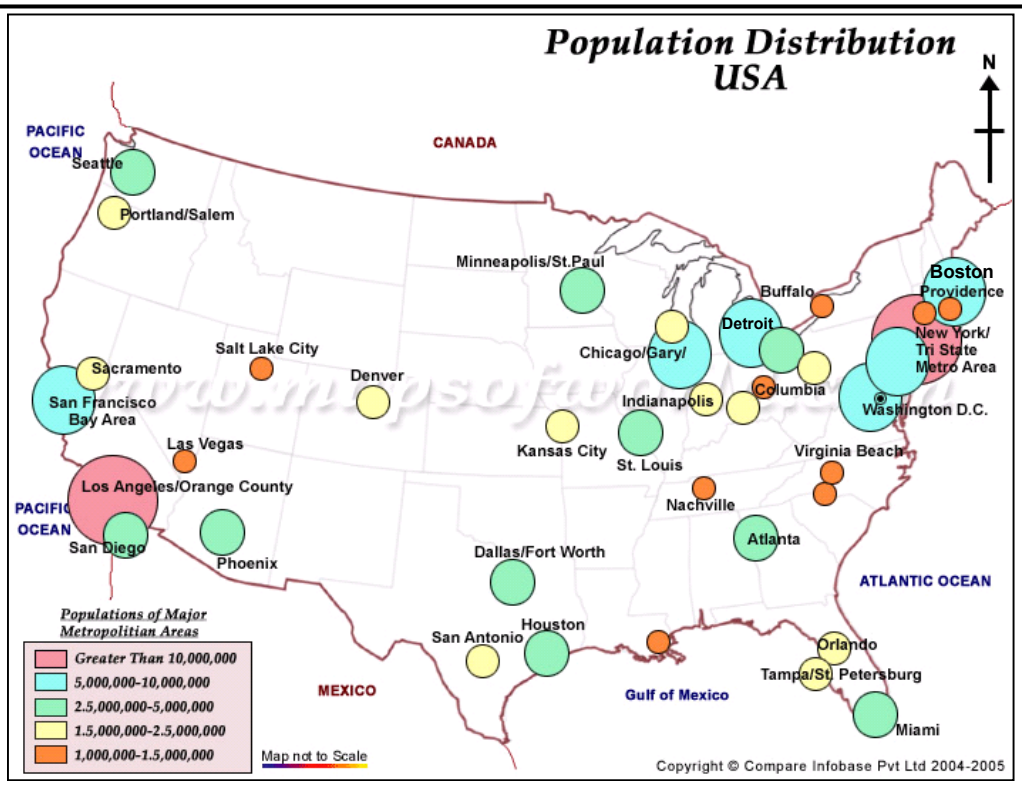


EXHIBIT 68
U.S. POPULATION DISTRIBUTION

3.3 West Coast

Every West Coast U.S., Canadian and Mexican port has expansion plans designed to increase market share and competitive position. The outcome of this competition combined with the influx of very large container ships will determine the long-term need for West Coast port dredging.

Many industry observers interpreted the 2004 peak season congestion as a sign that the ports of Los Angeles/Long Beach had reached capacity. Yet the two ports handled additional traffic in 2005 and 2006 without comparable problems. As the preceding chapter points out the San Pedro Bay ports have substantial latent capacity within their existing outlines and also have some room to expand physically.

Large-scale expansion of port facilities through fill or pre-emption of other land uses is impossible in the present or foreseeable political and environmental context. It is likewise inconceivable that the railroads serving the ports will have new rights-of-way. The issue, therefore, is whether the San Pedro Bay ports and their partners can make the multiple incremental improvements necessary to achieve higher throughput in existing and available space. That issue is more political and institutional than it is technical or financial.

Most West Coast intermodal cargo is inherently discretionary because it can move through any West Coast port at comparable service and cost levels. West Coast ports compete for discretionary cargo moving to and from the territory east of the Rockies (Exhibit 69). This cargo can and is shifted between ports with very little notice, since both major railroads serve all West Coast ports and are more concerned about keeping the traffic on their lines than about which port is used.

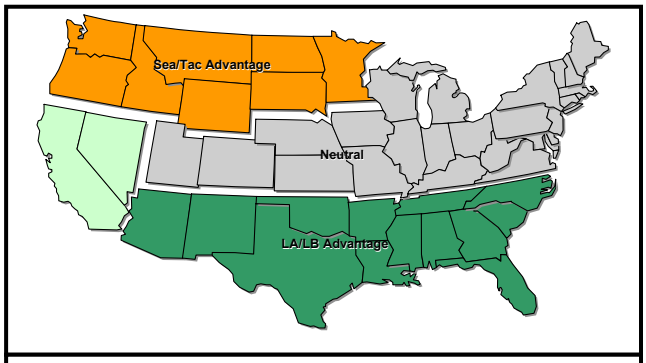


EXHIBIT 69
WEST COAST PORTS INTER-REGIONAL COMPETITION

On a shipment from Asia to Chicago and points beyond the cost differences between the Ports of Los Angeles, Long Beach, Oakland, Seattle, Tacoma and Vancouver are small. Carrier and customer port choice are influenced by service frequency and other logistic considerations besides cost. This observation implies that the national economic consequences of one port being unable to handle the largest vessels would be relatively small (and the National Economic Development benefits of dredging to allow that port to accept larger vessels would be small as well). If no West Coast port could handle the largest vessels the nation as a whole would incur unnecessary shipping costs.

Only if the ports of Los Angeles/Long Beach can sustain growing container trade will there eventually be a regular need to handle very large container ships there. Most San Pedro Bay terminals have a 40-feet berth depth, sufficient for most vessels of up to 8000–9000 TEU. Some terminals have drafts up to 50 feet, barely sufficient for the Emma Maersk under restricted operating conditions. If the ports of Los Angeles/Long Beach plateaus in the near future, there would be little point in carriers attempting to serve San Pedro with larger vessels only to see the containers delayed in the terminals.

If San Pedro Bay can sustain another decade or so of trade growth, carriers may find it advantageous to serve the ports of Los Angeles/Long Beach with larger vessels cascaded from the Asia-Europe trade or built for the purpose. If so, there would be a demand for dredging San Pedro Bay channels and berths to perhaps 53 feet (50 feet of draft and 3 feet of underkeel clearance).

Volumes at LA/LB are high enough justify shuttle voyages, so the ability of other West Coast ports to take the larger vessels would b not be a limitation.

The answer to the diversion question is more complex and is related to the East Coast issue below. The general sentiment among importers is that the ports of Los Angeles/Long Beach remains the gateway of choice for Asian goods. Southern California is an enormous consumer market and will draw first-call container vessel services under any circumstances. As long as the ports and their inland links have the capacity to handle inland cargo as well, Southern California will remain a preferred intermodal gateway The question then becomes one of next-best alternative.

The full range of alternatives to San Pedro Bay includes:

- The U.S. ports of Oakland, Seattle, Tacoma and (to a lesser extent) Portland;
- The British Columbia ports of Vancouver (including Deltaport) and Prince Rupert;
- The Mexican port of Lazaro Cardenas (and perhaps others); and
- All-water service via the Panama Canal. (The Suez Canal routing option depends on growth of Indian exports and is not included in this discussion.)

Oakland. The Port of Oakland has reserve terminal capacity to handle intermodal traffic diverted from the ports of Los Angeles/Long Beach and is counting on intermodal growth to fill those terminals. Oakland also has plans to expand intermodal rail terminal capacity. Oakland's limitation is rail line haul capacity. The BNSF route is already busy and connects with BNSFs San Pedro Bay route. When asked at the 2006 Transpacific Maritime Conference, more than one ocean carrier representative stated that large-scale cargo shifts to Oakland would only be practical once Union Pacific's Central Corridor route over Donner Pass was cleared for double-stack cars and double track was restored. Oakland has promoted these improvements as part of California's Goods Movement Action plan and they may also receive consideration for funding through California's recently approved infrastructure bonds. Oakland's aggressive dredging program provides 50-feet drafts at the newer terminals, with 50 feet eventually planned for all of major terminals, allowing Oakland to take vessels with up to 47-feet of draft.

Seattle. Seattle faces many of the same problems as Los Angeles and Long Beach. Tightly constrained by urban development and an environmentally sensitive populace, the Port of Seattle is focusing on optimizing productivity within existing terminal space. The multiple Pacific Northwest rail routes offer expansion room for intermodal cargo although Seattle's on-dock and near-dock rail yards are approaching their limits. Seattle's major terminals have 50-feet of draft, allowing them to handle larger vessels.

Tacoma. Of the West Coast ports Tacoma is perhaps best positioned to absorb diverted intermodal cargo from San Pedro Bay in the near term. With recently opened and rebuilt terminals and space for at least one more, Tacoma has a clear expansion path. Tacoma's on-dock rail yards are busy but not yet congested, although there are growing pains in rail access routes and support trackage. Draft at Tacoma varies from 45 feet to 50 feet.

Portland. Portland has struggled to maintain multiple carrier calls at its container terminal. Over the last several years some carriers have dropped their Portland calls and others have started new Portland services. When complete, the Lower Columbia River Dredging project will provide 43 feet of draft – not enough for the largest container ships but enough to allow expanded trade. As an intermodal diversion option, Portland's biggest limitation is its location 100+ miles up the Columbia River.

Vancouver. The Vancouver, B.C. port complex is pursuing an aggressive expansion program in anticipation of growth from both existing and diverted traffic. The Deltaport Third Berth project is scheduled to be complete in 2008. Vancouver is also attempting to ease trucking problems through extended gate hours (not unlike the ports of Los Angeles/Long Beach) and other

operational improvements. Finally, Vancouver is upgrading and expanding its Centerm and Vanterm operations on Brainard Inlet. Deltaport has 52 feet of draft while Vanterm has 50 feet and Centerm 40 feet to 53 feet. When expansion plans are complete, Vancouver will be a competitor for diverted the ports of Los Angeles/Long Beach traffic.

Prince Rupert. The Prince Rupert project is entirely dependent on intermodal traffic with no local market. Although the project is promising, it must prove itself in operation. Draft there is greater than 53 feet, allowing Prince Rupert to handle any container vessel being contemplated. If carriers choose to deploy 15,000 to 18,000 TEU vessels in the transpacific, Prince Rupert can take them. Under a scenario where very large vessels are used for intermodal cargo, Prince Rupert would be a logical call. If local and intermodal cargoes must be combined to fill the largest vessels, Prince Rupert will not be a candidate.

Panama. The Panama Canal is an option for cargo destined to the Gulf, Southeast and Northeast. The Panama Canal will likely reach capacity before the ports of Los Angeles/Long Beach plateaus and will not have new capacity until 2014 at least. U.S. importers will need a viable solution before the Panama Canal expansion is complete.

Mexico. In Mexico, Lazaro Cardenas can offer limited relief capacity but does not have the combined rail and port capability to offer a large-scale alternative to the ports of Los Angeles/Long Beach in the near future. Given that most of the capacity at Lazaro Cardenas will likely be used for Mexican trade, the residual capacity for U.S. trade is less than one years' growth at the ports of Los Angeles/Long Beach. Manzanillo is even more dedicated to Mexican trade and lacks a competitive rail route to U.S. markets. As alternatives to the ports of Los Angeles/Long Beach, the ports of Ensenada, Punta Colonet and Guaymas must be regarded as speculative.

The considerations above suggest the following answers to the key questions on West Coast container port competition.

- The ports of Los Angeles/Long Beach will plateau when the ports, terminal operators and railroads are no longer able to make incremental productivity improvements. The limit is political and institutional, not technical.

- When and if the ports of Los Angeles/Long Beach plateau, the overflow traffic would probably go first to Tacoma and then to either Vancouver/Deltaport or Oakland, depending on which is ready first. Most likely, the overflow traffic would be split among the three ports, with potential changes in vessel rotation and deployments. Prince Rupert, if successful, would be a fourth alternative. The Panama Canal and the Mexican Ports are more distant alternatives.

Implications: The more successful the ports of Los Angeles/Long Beach are in sustaining growth, the more likely they will require additional dredging. In the unlikely case that they plateau before the carriers are ready to put in 10,000+ TEU vessels, the need to dredge there could be postponed indefinitely.

Oakland is being dredged to 50 feet and is unlikely to require further dredging in the near future. Tacoma's Blair Waterway was recently dredged to 51 feet and is likely sufficient for the foreseeable future.

The issue comes down to timing.

- By 2008, Oakland's dredging program, Deltaport's expansion and Prince Rupert's development should all be complete, providing multiple alternatives to the ports of Los Angeles/Long Beach.
- By 2010 the Panama Canal will likely be out of capacity, eliminating it as an option for additional diversions.
- By 2010, Prince Rupert will have either proven itself or not and Oakland will likely have additional rail capacity.
- In 2014, the new Panama Canal locks are planned to open.
- In 2015, the Mercator study expects 10,000 to 12,000 TEU vessels to start calling the ports of Los Angeles/Long Beach. Only a few terminals can handle them.
- In 2020 Mercator forecasts 11 weekly calls by 10,000 to 12,000 TEU vessels at the ports of Los Angeles/Long Beach implying need to dredge at least some of the terminals to provide a uniform 50 feet of draft or more.

Uncertainties: As noted above there are multiple uncertainties in this scenario.

- The ability of the ports of Los Angeles/Long Beach to make incremental productivity improvements within existing and available space.
- The ability of Oakland and Vancouver to add capacity as scheduled.
- The ability of Prince Rupert to attract substantial trade that might otherwise have used the ports of Los Angeles/Long Beach.
- The ability of the Panama Canal Authority to handle growing traffic and build a third set of locks on schedule.
- The actual development pattern of Mexican ports and Mexican trade versus the "aspirational" plans being publicized.

3.4 East Coast

Container port competition on the East Coast is, if anything, more intense than on the West Coast. There are more ports, they are closer together and there is less total cargo to fight over. Each port's market share with and without dredging depends on:

- Competition with other East Coast ports for local and regional trade;
- Competition with West Coast ports for regional and national trade; and

- Ocean carrier routing and capacity deployment practices

East Coast ports are seeing diversions from the West Coast (e.g., the ports of Los Angeles/Long Beach) as a major component of their growth potential. Competition with West Coast ports depends on:

- West Coast trade volumes, peaking and capacity;
- Intermodal rail capacity and efficiency;
- Capacity and performance of all-water Panama Canal services from Asia; and
- Importer/exporter location preferences.

This last point is particularly significant for ports such as Charleston and Savannah that have been aggressively promoting the development of nearby distribution centers in the wake of the 2004 West Coast congestion. Once invested in supply chain facilities on the East Coast, importers are far less likely to concentrate all of their business back in Southern California.

Both the draft of the vessels serving East Coast ports and the capacity and performance of all-water services depend on:

- Sizes of vessels in current and future fleets;
- Carrier deployment of vessels cascaded from Europe-Asia and Transpacific trades; and
- Successful expansion of the Panama Canal.

East Coast ports are generally served by smaller vessels than those that ply the transpacific trades, but have nonetheless found their cargo growth constrained by draft restrictions. Carriers and alliances have introduced larger vessels in the transatlantic, Australia-New Zealand and Asia all-water trades, both as newbuilds and as cascades from the transpacific.

- **New York/New Jersey**. As the population distribution shown previously in Exhibit 68 suggests, the ports of New York/New Jersey is a "must" call for steamship lines serving the East Coast. Available draft at most of the ports of New York/New Jersey terminals ranges from 40 feet to 42 feet, with the Maher terminal having 46 feet and the Port Newark terminal reporting 52 feet.

- **Philadelphia**. The Delaware River ports are seeking greater draft, primarily to handle petroleum traffic but also to bring larger container, reefer and break bulk vessels into Philadelphia., which presently has 40 feet of draft.

- **Baltimore**. The Baltimore terminals have 42 feet of draft.

- **Norfolk**. The VPA terminals at Norfolk have 41 feet to 45 feet of draft, enabling those terminals to take the larger vessels now in the transatlantic trade.

- **Charleston**. The terminals at Charleston have 45 feet of draft as a result of the deepening project completed in 2004. Charleston is marketing its ability to take larger vessels.

- **Savannah**. Savannah has 42 feet of draft.

These channel and berth depths are barely adequate at present and in some cases larger vessels "ride the tides" to maximize use of the available draft.

The transatlantic and South American trades have not seen the same influxes of large new vessels as the Europe-Asia and transpacific trades and are unlikely to see major sizes increases in the foreseeable future. There are three scenarios that could bring larger vessels to the East Coast ports.

Larger vessels transiting the current Panama Canal locks in the Asia-USEC trade. As noted in the Panama discussion the Canal is becoming congested and may be out of capacity for more transits by 2008 to 2010. If container ship operators want to increase capacity, they will have to either maximize the vessel dimensions or supplant other kinds of vessel transits. Maximum Canal vessel draft is 39.5 feet, which requires 43 feet of water to provide 3 feet of underkeel clearance. Maximizing vessel size and draft through the Canal could disadvantage ports such as New York/New Jersey and Philadelphia which have just 40 feet of draft in some locations.

Larger vessels transiting new Panama Canal locks. The new set of locks is designed to provide 52 feet of draft, allowing vessels larger than can be accommodated at East Coast ports. Exhibit 70 shows the claimed depths and planned improvements. The ports of New York/New Jersey and Norfolk (Virginia) would be able to handle the largest vessels if the improvements listed are implemented.

Larger vessels in Suez Canal services. A major shift in the Asian manufacturing and exporting "centroid" to the Indian Subcontinent could conceivably result in the deployment of larger (10,000+ TEU) vessels in the Suez Canal routes to the U.S. East Coast, as opposed to the 4800 TEU (APL) or 5500 TEU (Grand Alliance) vessel now used that route.. To fill such vessels, however, East Coast ports would also have to handle intermodal cargo for the rest of the nation. The East Coast ports may find that intermodal rail capacity, rather than draft, becomes a limiting factor.

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

EXHIBIT 70
EAST COAST PORTS AND POST-PANAMAX VESSELS

Section 4
Roles and Responsibilities

4.1 Future Project Approval Requirements

Historically, roles and responsibilities for dredging, navigation aids, harbor improvements and waterways have been spelled out by legislation and regulation. The laws and regulations still exist and still technically control roles and responsibilities, but in practice major projects increasingly require complex coalitions of agencies with shared responsibilities.

Longstanding budget shortages at many levels mean that the agencies with responsibility may or may not have the required funding or manpower to discharge those responsibilities. With a backlog of vital work to be accomplished, influence shifts to the organizations with the resources to do the job. While influence has always followed funding, the recent scarcity of funds has strengthened the tendency. Process management may become more critical to project delivery than technical skills.

There appears also to be a trend toward more elaborate multi-organizational funding when the size of the project exceeds the capabilities of any one agency and sponsor. A harbor dredging project, for example, may rely on multiple local sponsors to augment USACE funding. Some Southern California port emissions reduction programs have been jointly funded by the ports and regional government.

The growing complexity of harbor and waterway projects is a second reason for the trend toward larger coalitions. No single agency can handle all of the technical, economic, environmental, governmental and social issues raised by dredging a major river. The expanded scope and authority of local and regional environmental and planning agencies also requires that they be made part of the process. No one agency can act in isolation.

All these points suggest that USACEs direct control of the projects it undertakes is declining and that USACEs ability to control the process will continue to erode. USACE has always partnered with local sponsors, but the role of the local sponsors is expanding.

- With its own budget limited, USACE relies more on local sponsors and partner agencies to perform or fund major portions of the project analysis and documentation and surrenders more control of the timeline.

- Environmental considerations are increasingly handled by negotiation rather than design. Neither the pace of the negotiations nor their outcome is under USACE control, despite USACEs major role in environmental issues.

- USACE projects have always been subject to political influence; the power of that influence increases when budgets are tight.

Project delivery timelines will likely stretch further. The Corps will have to spend more if its resources in the project approval process and less on project delivery.

These changes to the project delivery process have resulted from Federal, state and local laws and regulations; court decisions; and local activism. None of these forces appear to be diminishing. There are not, however, commensurate forces working to increase USACEs resources or authority to meet those new requirements. USACE is not unique in that respect, as escalating responsibilities have outstripped resources on many government levels and in many jurisdictions.

Despite periodic calls for streamlining the project approval process there appears to be little chance for reversing this trend. Much of the blame for long, expensive approval processes is placed on "environmentalists." Yet in many cases the "environmentalists" are Federal, state and local agencies. These agencies have been given the authority and the mandate to protect the public and the environment from unnecessary harm and would be negligent if they were less than diligent in their scrutiny of USACE projects.

In the most contentious environment, namely California, the approval process itself is the governing factor since technical input and funding together are still not enough to get the project built.

With resources falling short of MTS needs, there has long been an incentive for sponsors to exaggerate the need for their project, its potential benefits and its urgency. There have been efforts to have legislators legitimize benefits that would not be counted under USACE guidelines to increase the chances of approval.

The proclivity for posturing versus documenting more modest but legitimate needs may have increased as improved knowledge of affected ecosystems ratchets up the estimates of environmental impact. Project opponents are no less prone to exaggerate their own case. There is a real risk of approving and implementing projects that are not actually cost-beneficial, or of abandoning projects that could have delivered net public benefits after mitigation.

At the core of the problem is a decline in public trust paralleled by increased knowledge of adverse consequences. For a century or more USACE and other government entities built projects with minimal regard to the externalities since labeled "environmental." Influential segments of the public no longer trust that government agencies will adequately protect the environment. Antipathy toward foreign trade and commerce in general leads many members of the public to oppose projects that would cause even minor environmental impacts. This is especially apparent in port projects but also contributed to the demise of WRDA in 2006.

4.2 Shifting Roles

Federal Role. Although remaining the official project leads, Federal agencies such as USACE will no longer dominate the project initiation, approval and delivery process. Federal approval processes have institutionalized crucial roles for local, regional and state agencies as well as local stakeholders of all kinds. This open door is unlikely to close. Federal agencies will need to be more visibly and functionally responsive to both local sponsors and local opponents to deliver projects.

State Role. The state role in water and port project delivery will continue to vary with state budgets and governance patterns. In many states port authorities are state agencies, with

significant budgets for development projects, significant coordinating functions and mandates to promote trade and employment. In such cases the state port authorities will emerge as full project partners with USACE as opposed to just local sponsors. In states where port authorities are local or city departments the state government itself is likely to play a much smaller role. The state role is also expanding where Goods Movement plans or Freight Plans have been developed that encompass port and waterway issues.

Regional Government Role. The role of regional planning agencies has been significantly expanded by the ISTEA/TEA21/SAFETEA-LU series of highway and multimodal funding bills. Such legislation has reinforced a trend of using metropolitan planning organizations (MPOs) and other designated regional agencies as conduits for Federal and State transportation funding. Earmarks for regional projects appear to account for a growing part of total Federal spending. The funding is commonly tied to development of metropolitan transportation plans (MTPs) and metropolitan transportation improvement plans (MTIPs). The largest regional government roles, however, have been in highways and transit, with much less activity in ports and waterways. This may change as regions recognize the important and impact of ports and waterways and the need to integrate their planning and development.

Local Role. There has been a very limited role for municipal governments in USACE projects outside of instances where ports are municipal entities. Any participation shortfall by local government, however, has been more than made up by the ability of local stakeholders to create ad hoc interest groups around specific projects. "Citizens For _____" and "Citizens Against _____ "or their equivalents are becoming nearly ubiquitous and strongly influence the project approval agenda. There is a key distinction between government agencies on any level and ad hoc interest groups: government agencies have well-defined responsibilities and processes, while interest groups do not. The increased influence of ad hoc interest groups will mean longer, less predictable project approval processes.

Private Sector Role. The decreased ability of USACE, ports, FHWA and other public agencies to fund, approve and complete projects in a timely fashion is creating both an incentive and a power vacuum. If the above observations about the changing nature of project approvals are correct, the private sector role might increase for several reasons.

- As private sector organizations such as international steamship lines and marine terminal operators increase in size and scope their ability to finance and benefit from port and waterway projects increases as well.
- Private sector stakeholders are given increased legitimacy by procedural outreach requirements.
- Private sector organizations can often move faster and with less public input than USACE or other government entities.
- Trade and freight facilities such as inland logistics parks and marine container terminals are beginning to attract the interest of institutional investors.

Implications: USACE will likely have an indefinite future backlog of meritorious and perhaps economically cost-beneficial projects. Funding may be less of a constraint than approval, since

the difficulty of approving projects has kept many organizations from spending the available funds. The critical steps for future project delivery will likely be:

- Alignment with local and regional plans and priorities;
- Coalition building to combine and coordinate resources; and
- Consensus building and education on environmental impacts and mitigations.

Uncertainties: The project approval landscape and roles described above can vary considerably by project and locality. More sweeping changes could come with legislative or regulatory change.

4.3 A Pro-Active Environmental Role

The USACE is becoming increasingly proficient at managing the environmental reviews and analysis that now must accompany every significant project in the maritime sphere. The USACE role, however, has been essentially reactive, with attention to environmental issues occasioned by the perceived need for infrastructure projects.

On the horizon is a potential opportunity or need for USACE to become proactive and to encourage or solicit projects that *improve* the marine shipping environment rather than just mitigating impacts. By doing so, USACE might set the stage for future benign expansion rather than simply mitigating the harm from new projects. As implied earlier, USACE and the maritime shipping industry have a 100-year legacy of environmental impacts. No one has a public mandate to clean them up.

Such an approach would be in tune with new demands from Southern California Pacific Northwest communities for environmental improvement as a condition of project approval, not mere mitigation. In other words, communities around the ports are demanding that existing environmental impacts be reduced before new projects can be considered.

The USACE has long considered itself a guardian of the nation's water resources. By extension, USACE could—and perhaps should—become the guardian of the marine shipping environment. The U.S. Coast Guard has always had some protective role, but USCG has focused more on incident prevention and response. The notion of a paradigm shift may be a cliché, but it is appropriate in this context.

Pragmatically, USACE may need to get "out-in-front" of the environmental issues if it entertains any hope of efficiently discharging its traditional responsibilities for infrastructure development, dredging, etc. At a minimum, project proposals that cannot pass environmental review or whose environmental mitigation costs (including the cost of the review process) tip the benefit/cost ratio the wrong way should be identified and abandoned as quickly as possible. By being its own harshest critic the Corps may be able to concentrate limited resources on the best projects.

In the long run, USACE may need to become environmentally proactive to control its own destiny and to fulfill its historic mission. The efforts being put into beneficial uses of dredge material can be seen as an initial step.

It may become appropriate to define a class of environmental projects undertaken either on USACEs initiative or in response to local requests.

4.4 Public/Private Partnership Potential

A prime field of interest for public-private partnerships has been transportation infrastructure such as toll roads or port terminals where a combination of up-front capital contributions and user fees might attract private investment. This is one field where the maritime transportation industry has diverged from the broader freight industry as a whole.

- As a national trend cutting across the transportation industry trend toward public-private partnerships have hardly materialized and show few signs sign of real significance. The generalized concept of "public-private partnerships" has been a public initiative, promulgated by public agencies faced with persistent funding shortfalls. Private sector initiatives to partner with the public sector have been rare and will likely remain so.

- Within the port industry, however, examples of public-private cooperation predate the broader "partnership" trend and will likely gain momentum despite the limited success elsewhere.

The Alameda Corridor is cited as a successful public-private partnership and illustrates the circumstances under which public-private cooperation might work.

- The former Southern Pacific rail line to the San Pedro Bay ports was sold to a joint powers authority, which obtained Federal funding and sold bonds to finance construction.

- The railroads agreed to a fee structure for using the Alameda Corridor.

Note that the railroads did not invest or bear risk: they use the publicly funded facility and pay user fees. In this sense there is a narrow band of "partnership." This approach has not been extended to toll roads or other facilities used by a broad range of operators. For one thing, there is no comparable mechanism to obtain user commitments to fees or traffic volumes.

Transportation infrastructure projects are generally unattractive to private sector investors for several reasons that will likely limit the scope of public-private partnerships.

- Long, uncertain development times due to regulatory, environmental and political factors.
- Inability to secure contractual commitments from users.

The potential for public private partnerships has been widely discussed in the context of rail capacity, but there have been few examples of working partnerships to date. The two most prominent recent examples are the CREATE project and the Heartland Corridor.

- The Chicago Region Environmental and Transportation Efficiency (CREATE) project is a proposed package of 29 Chicago area initiatives designed to expedite rail movements, reduce highway congestion and improve passenger rail service. The entire package has a price tag of roughly $1.5 billion but was funded in SAFETEA-LU at $100 million. Funding from the railroads, the state and the City of Chicago will bring first phase funding up to

$330 million. The funding is so much lower than the request, however, that the CREATE coalition will be strained to prioritize projects.

- The Heartland Corridor project is designed to improve rail capacity and operations over NS trackage between Hampton Roads, VA and Columbus, OH. The project was funded at $95 million in SAFETEA-LU.

These two examples may be the forerunners of many public-private partnerships to come, or they may turn out to be the high point of a concept that fades with time. Solving public transportation capacity problems is rarely good private sector business.

- User fee revenues projections are generally unreliable and do not provide sufficient justification for private investment.
- Public agencies can often borrow money at lower rates than private investors.
- The development time and capital recovery periods for transportation infrastructure projects are typically much longer than private sector investment horizons.

With almost all the push coming from the public side, public-private partnerships are unlikely to become as common as the public sector would like. Much of the push has come from Congestion Management and Air Quality (CMAQ) programs and similar initiatives with large-scale funding. The partnerships may fade when the money runs out.

Joint-venturing between port authorities and terminal operators, however, has taken hold in seaport terminal development. This trend is attributable to:

- Emergence of large, global marine terminal operators who can finance and sustain multiyear development efforts and profit from the outcome.
- Customers (ocean carriers) who can make long-term commitments to capacity being developed. (Sometimes these are the parent companies to the terminal developers.)
- Unambiguous long-term demand with known economics.

There have recently been several new examples of public-private partnerships in port development.

- The Ontario Teachers' Pension Plan recently agreed to purchase marine container terminals in New York/New Jersey (New York Container Terminal and Global Terminal) and Vancouver (Deltaport and Vanterm). As noted by the Plan's investment arm, the terminal acquisition "…has little vulnerability to market or economic vagaries and features a very attractive growth profile." (NY Times, Nov. 25, 2006)
- A leading Indian entrepreneur has expressed interest in taking over development of the proposed Vizhinjam transshipment terminal after the Chinese consortium that won an earlier bidding round was eliminated on the basis of security concerns.

- APM Terminals, Maersk's terminal operating arm of Maersk, purchased a 65 percent controlling interest in the NordFrance container terminal at Dunkirk.
- A subsidiary of Australia's Macquarie Bank is acquiring Hallenn, the major container terminal at Halifax.

J.P. Morgan recently dropped its interest in a new container terminal north of the current Port of Richmond, CA. The potential site faced a multitude of environmental obstacles and would be at odds with the Bay Conservation and Development Commission's Seaport Plan. J.P Morgan, however, is not part of the marine transportation system and cannot either commit cargo or directly benefit from operating efficiencies.

Implications: Public-private partnerships are viable in the port industry and their importance will likely increase. They will not be a major source of transportation infrastructure funding in other sectors, but will likely see niche applications.

Uncertainties: The lack of experience with public-private partnerships leads to doubts over where and when they might succeed.

4.5 National Policy Outlook

At any given moment the *de facto* national policy towards ports, waterways and USACE responsibilities is the sum of Federal government laws, regulations, procedures, funding and attitudes toward the subject. While there have been a number of policy-related reports and analyses, there is no current integrated national policy document. The ports and waterways share this problem with other fields in which official national policies are outdated, ineffective, or simply lacking.

The USACE, the ports and the waterways have functioned at their present level for a long time without a coherent national policy. Success in "muddling through," however, tends to postpone the difficult but perhaps necessary process of developing a national policy. USACEs internal policies and procedures go a long way toward filling the policy vacuum on the project level. These policies, however, do not set national priorities or deal with tradeoffs between USACE goals and the goals of other agencies.

The policy vacuum is perhaps nowhere more apparent than in the unsuccessful attempts to pass a new Water Resources Development Act. WRDA would both establish the direction for water resources development activity and provide the resources to implement the implicit policy choices.

One result of the national policy vacuum is that local and regional policies and funds will define the project landscape. The Golden Rule is often parodied as "he who has the gold makes the rules" – an apt description of policy making in the absence of Federal participation.

Given the magnitude and complexity of other problems facing the Federal government, it is not surprising that a system that can muddle through indefinitely such as the ports and waterways, will not receive priority for either attention or funding. Infrastructure's durability can be its

own worst enemy when it permits postponement of maintenance, improvement, or replacement.

A national policy should not be envisioned as a cure-all. Two agencies that agree on the need for a national policy may not agree at all on the content of that policy. Too often, the easiest policies to adopt are superficial and ineffectual, while strong, effective policies meet prolonged opposition from one faction or another.

While no national port and waterway crisis appears on the horizon, it would be unfortunate if the Federal government waits until a crisis to act. Besides the cost of letting a system slip into disrepair, reacting to a crisis is not the preferred method of making public policy.

The Maritime Transportation System is a crucial part of the national economy by any measure. The trends, implications and uncertainties cited in this report often imply a need for Federal action. There are also opportunities for USACE to take a proactive role in improving and protecting the maritime and waterway environment. It would indeed be unfortunate if the needs went unmet, the action delayed and the opportunities ignored while the nation waits for a crisis.

Section 5
Bibliography

5.1 Key Sources

The subject of marine transportation is both very broad and very volatile, making it difficult to capture definitive information in a single source or even a series of sources. The documents below cover large parts of the system and the issues it faces while recognizing the inherent interdependencies. Most importantly, they have extensive discussions of cause and effect and of issues and priorities, that transcend the currency of the data they contain

An Assessment of the U.S. Marine Transportation System. A Report to Congress. MARAD, September 1999

This very ambitious report covers the entire marine transportation system from multiple viewpoints, including recreational and passenger uses. While specific are now dated, the major issues addressed have persisted. This report also describes some of the interlocking responsibilities of government agencies.

Climate Variability and Change with Implications for Transportation; National Research Council/National Academy of Science, September 2006.

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Short-sea shipping by vessel or barge is a topic of considerable current interest. The U.S. DOT report developed by Global Insight explores the underlying logistics and economics of short-sea shipping in real-world comparisons with other modes. This head-to-head comparison in actual cargo markets distinguishes this study from a number of papers and reports that cite the theoretical advantages of short-sea shipping without real-world applications.

Intermodal Recommendations to Secretary Norman Y. Mineta. A Report sponsored by the Marine Transportation System National Advisory Council, September 2005.

The Marine Transportation System National Advisory Council developed this report and the recommendations it contains to reflect combined public and private sector viewpoints across a wide range of issues facing the system. It remains very current in most respects and highlights a number of the critical tradeoffs facing policy makers.

National Dredging Needs Study of U.S. Ports and Harbors: Update 2000, IWR Report 00-R004, 2003.

This study contains extensive forecasts and analysis of multiple shipping sectors and trades, as well as a detailed analytic approach to future dredging requirements. The report also includes

an insightful discussion of growing vessel sizes and trade requirements that can be balanced against the competitive desires of regional ports.

National Marine Container Transportation System, A Call to Action. Waterfront Coalition. May 2005

This white paper makes an eloquent case for Federal action, policy decisions and funding to meet the nation's marine transpiration requirements. The Waterfront Coalition is primarily an organization of importers and this white paper provides a unique private sector viewpoint.

Proposal for the Expansion of the Panama Canal – Third Set of Locks Project, Panama Canal Authority. April 2006

The proposed expansion of the Panama Canal is a pivotal issue in world shipping and in the future of U.S. ports. This overview from the Panama Canal Authority provides a description of both the proposed expansion program and the world shipping context.

Report of Congress on the Performance of Ports and the Intermodal System. U.S. Department of Transportation Maritime Administration. June 2005

Mobilization for war in the Persian Gulf strained the capabilities of the U.S. ports and the intermodal system that connects them to inland points. While ports themselves often take a competitive stance, the nations relies on the functioning of the system as a whole. This report is valuable for its analytic rather than descriptive approach and its focus on capacity bottlenecks and shortfalls.

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IWR Future Directions

IWR's Future Directions program activities include the identification of emerging water challenges and opportunities and the tactical engagement of USACE senior leaders on these issues. Such critical thinking is seen as an essential prerequisite to strategy development and planning.

IWR employs a variety of approaches to encourage strategic thinking, including the development of Water Resources Outlook papers and the conduct of topic specific provocation sessions with senior leaders.

Other tools IWR has recently developed to engage senior leaders strategically are the Castle Forum and the Lunch Roundtable. The Castle Forum is an off-site event where senior leaders and external thought leaders can engage in out-of-the-box thinking regarding subjects not usually addressed by them. The Lunch Roundtable brings in water experts from outside the Corps to provide different perspectives on issues familiar to senior leaders.

Future Directions activities include:

- Water Resources Outlook papers
- Post-Katrina Studies
- Interagency Performance Evaluation Task Force (IPET)
- Planning Framework for Coastal Louisiana
- Hurricane Protection Decision Chronology
- Twelve Actions for Change
- Louisiana Coastal Protection and Restoration (LACPR)
- National Shoreline Management Study
- Strategic Planning
- Policy Development
- Other activities headed by the USACE Chief Economist

For more information about the Future Directions program, contact:

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