Marine Terminal Management Training Program
Jacksonville, FL

Trends in Container Terminal Design

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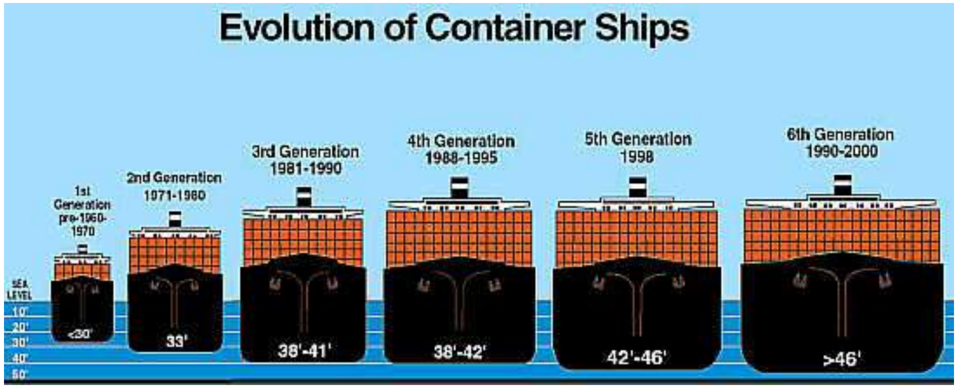
Introduction

- Container terminal design trend
- Factors driving the trend
- Planning and engineering of a terminal
  - Number of berths, water depth
  - Land usage
  - Site elevation
  - Infrastructure



Container terminal design trend
North America

Historically operating at low density and high labor cost

Due to growing environmental concerns pressure to operate with

- Fewer air emissions
- Higher density

Automation has been slow but growing

- Perceived inefficiency of the first systems
- Resistance of organized labor
- Capital cost of implementation

Container terminal design trend
North America

APMT Terminal in Norfolk, VA leading the trend

- ASCs with manual shuttle carriers
- 50% increase in avg QC productivity
- Ports America Concession at Port of Oakland with similar scheme

Strong interest in hybrid RTGs

- Reduce pollution
- Increase fuel savings
- Battery and flywheel-based

Tandem 40 Quay Cranes arrived in Deltaport, Vancouver

Container terminal design trend
Asia

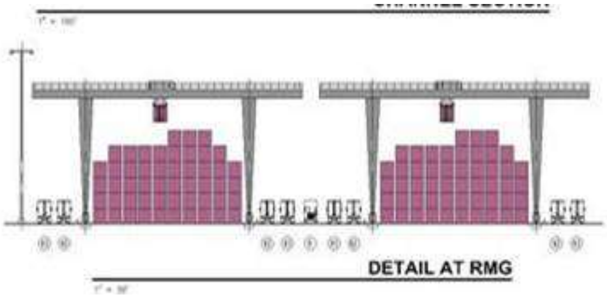
High density, low labor cost (RTG + tractors)

Low but growing environmental concern

Trending towards semi-automation

- Overhead bridge crane system at Singapore
- Automated RTGs – Toshima terminal in Japan
- Double cantilever RMGs at Pusan and Shanghai

Early adapters of Tandem-40 cranes



Container terminal design trend
Europe

Medium density, high labor cost (straddle carrier based)

High environmental concerns

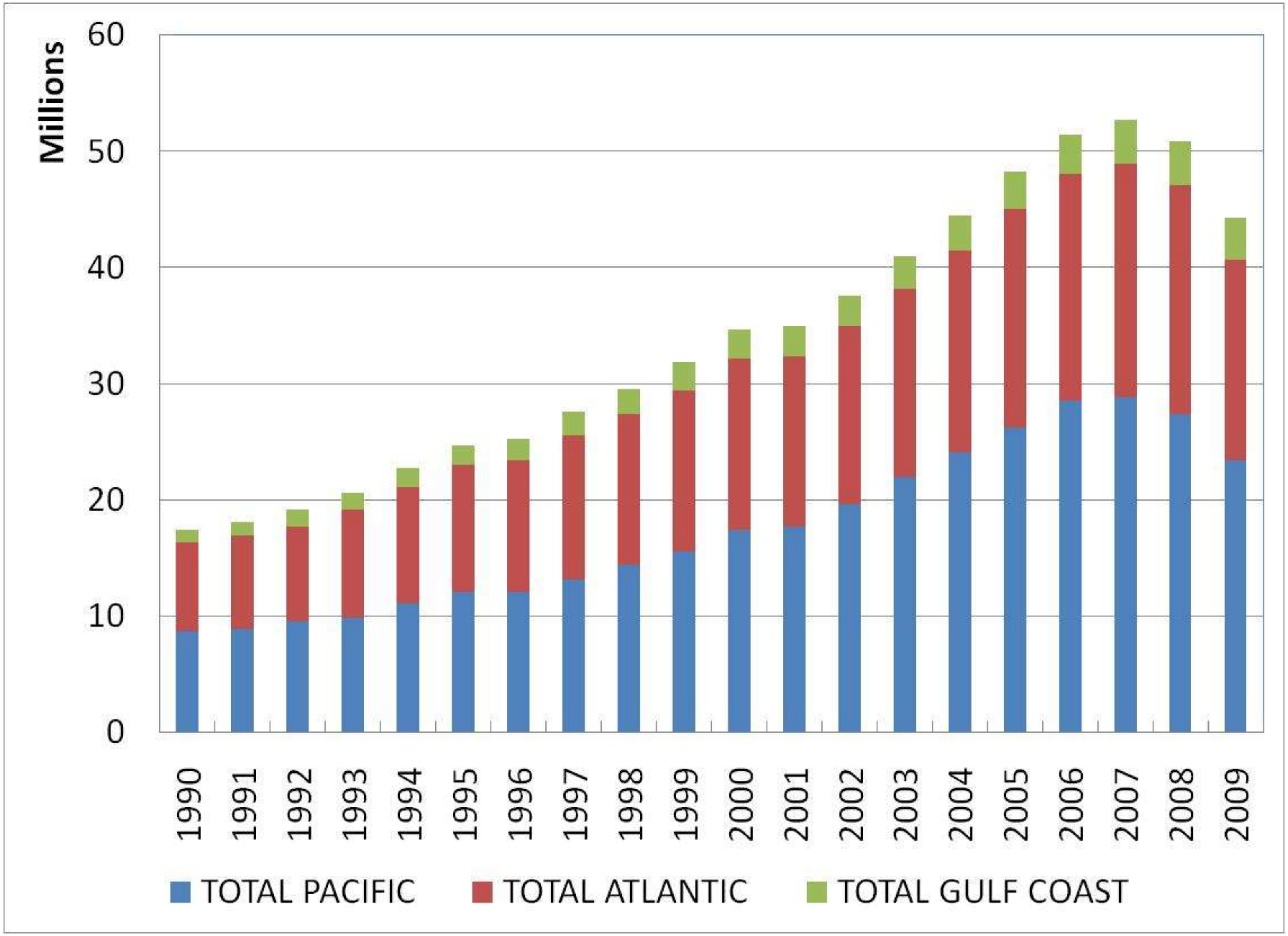
Moderately strong union

Pioneer of highly automated terminals

- Robotic AGVs + ASCs
- Dual hoist cranes (2nd hoist automated)

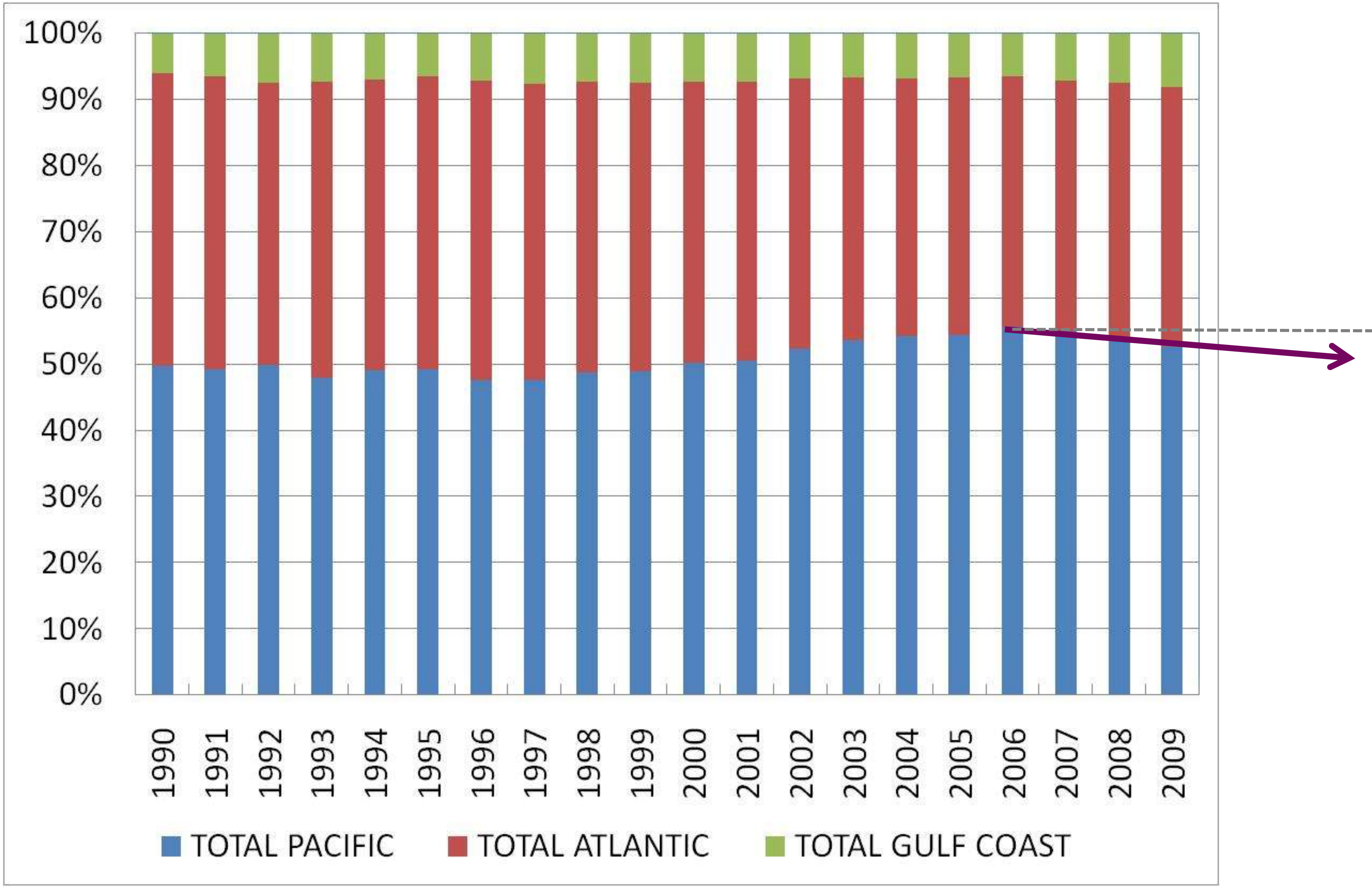
Factors Driving the Container Terminal Design

North America Container Port Traffic (TEUs)

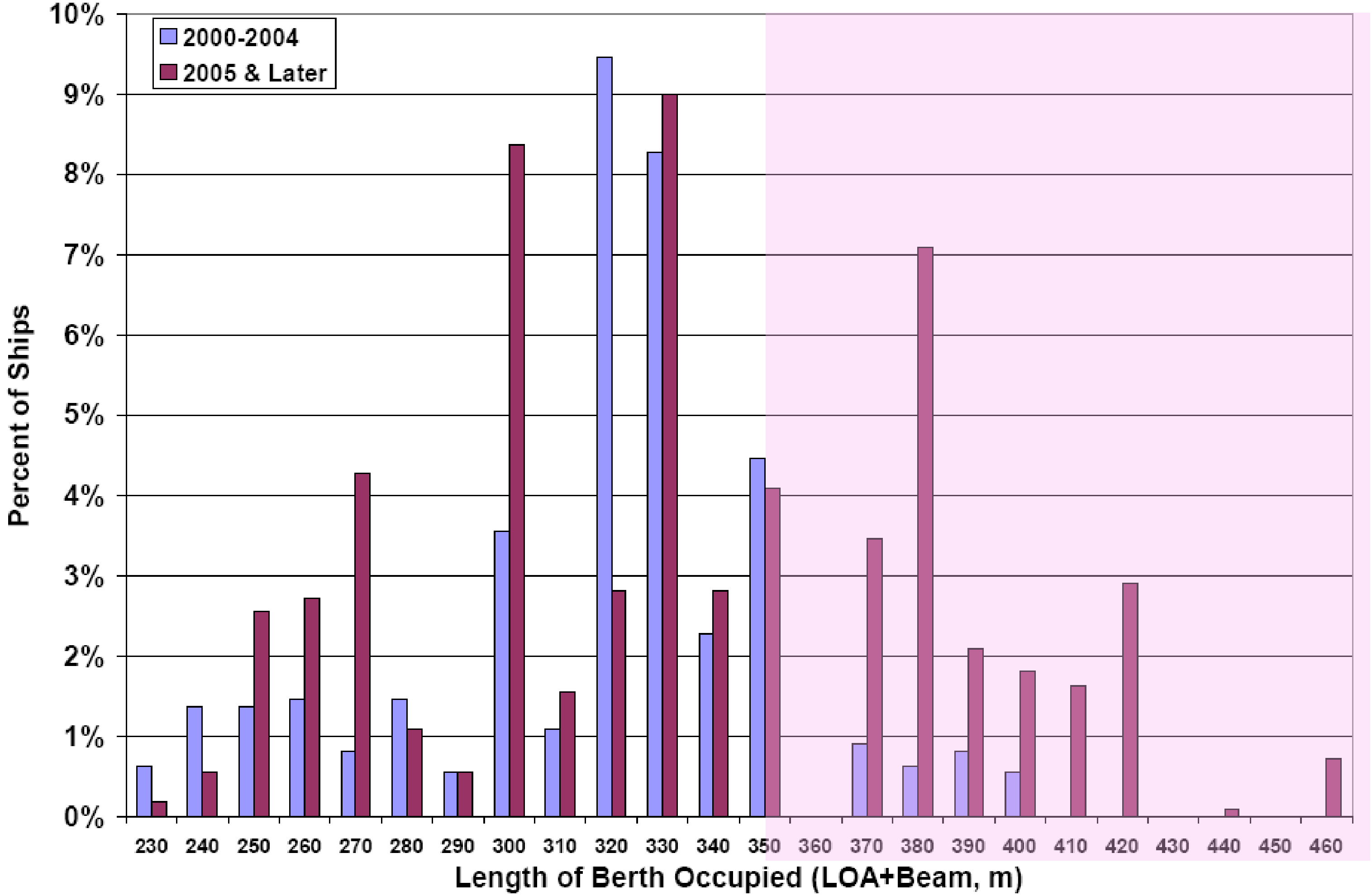


North America Container Port Traffic (% of total)

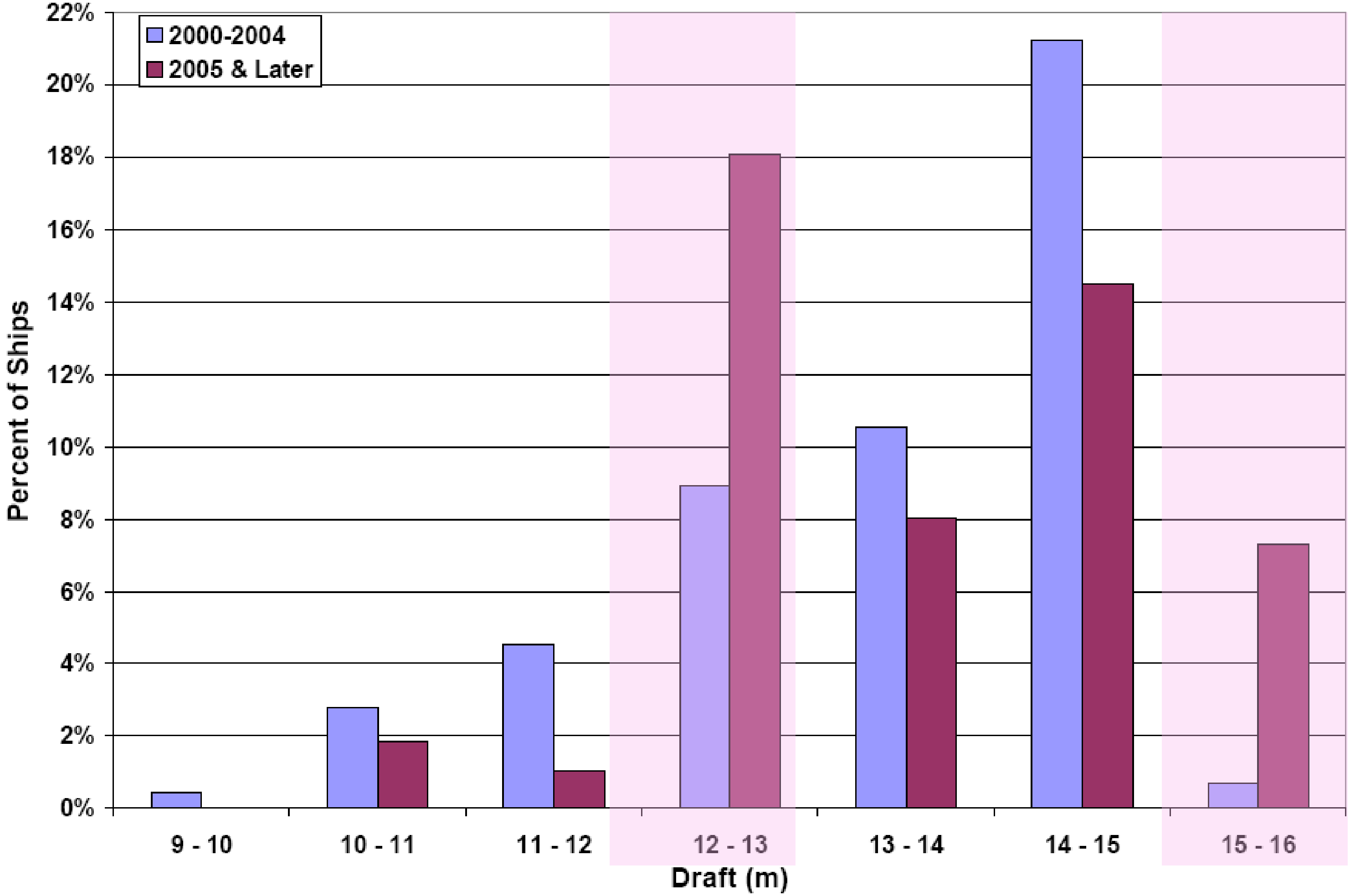
AAPA American Association of Port Authorities
Alliance of the Ports of Canada, the Caribbean, Latin America and the United States



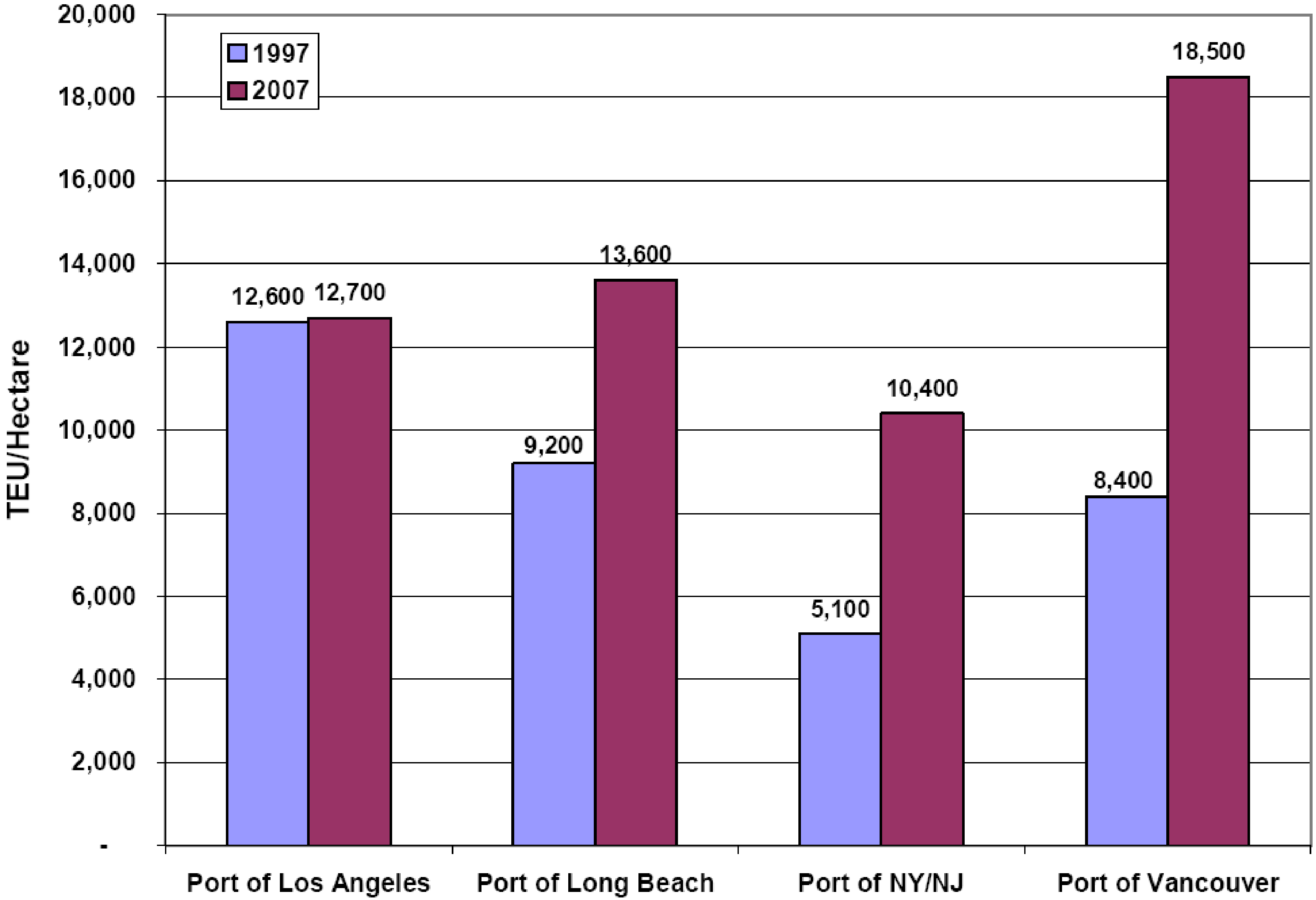
Length Distribution of Recently Built Container Vessels (Panamax or larger)



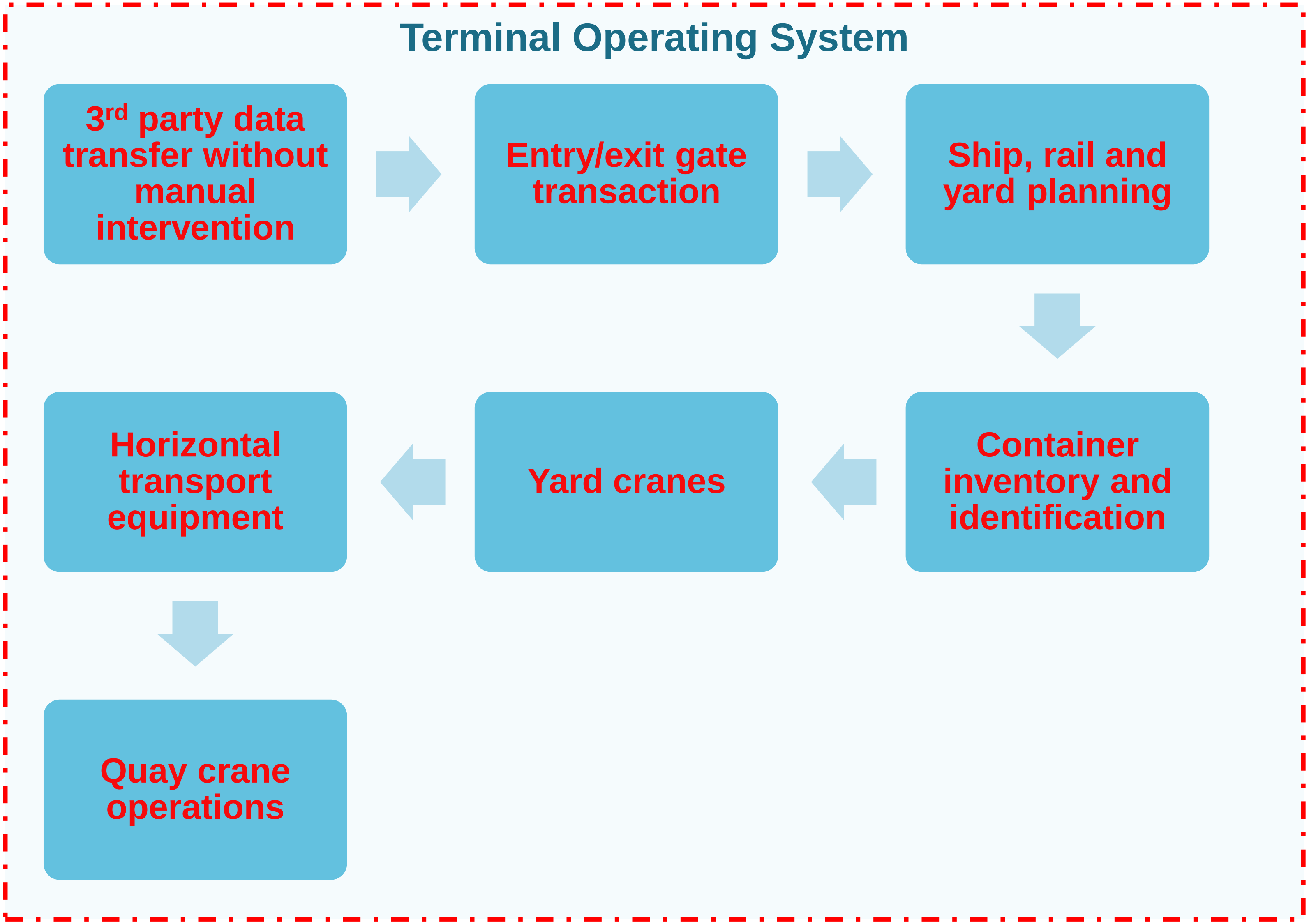
Draft Distribution of Recently Built Container Vessels (Panamax or larger)



Storage Density at Top North America Ports



Automation Technology

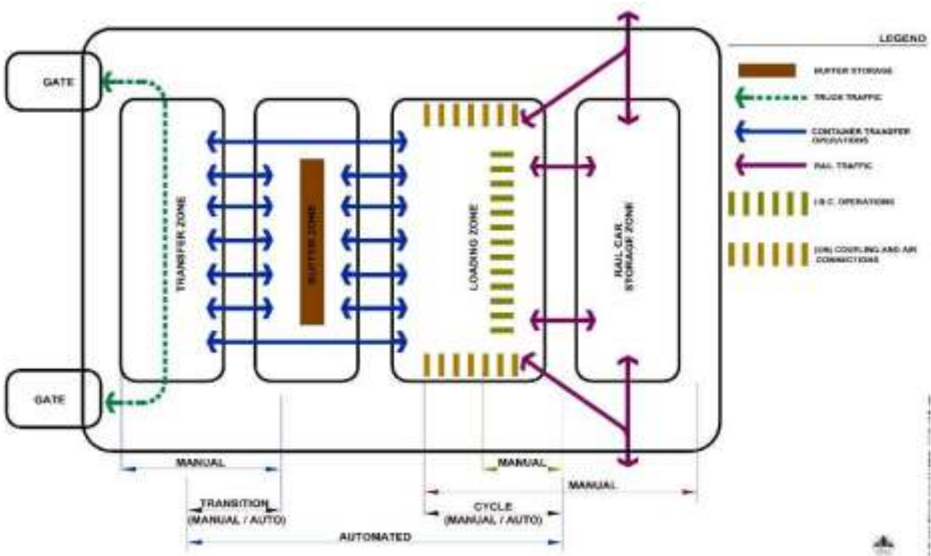


Safety and Security

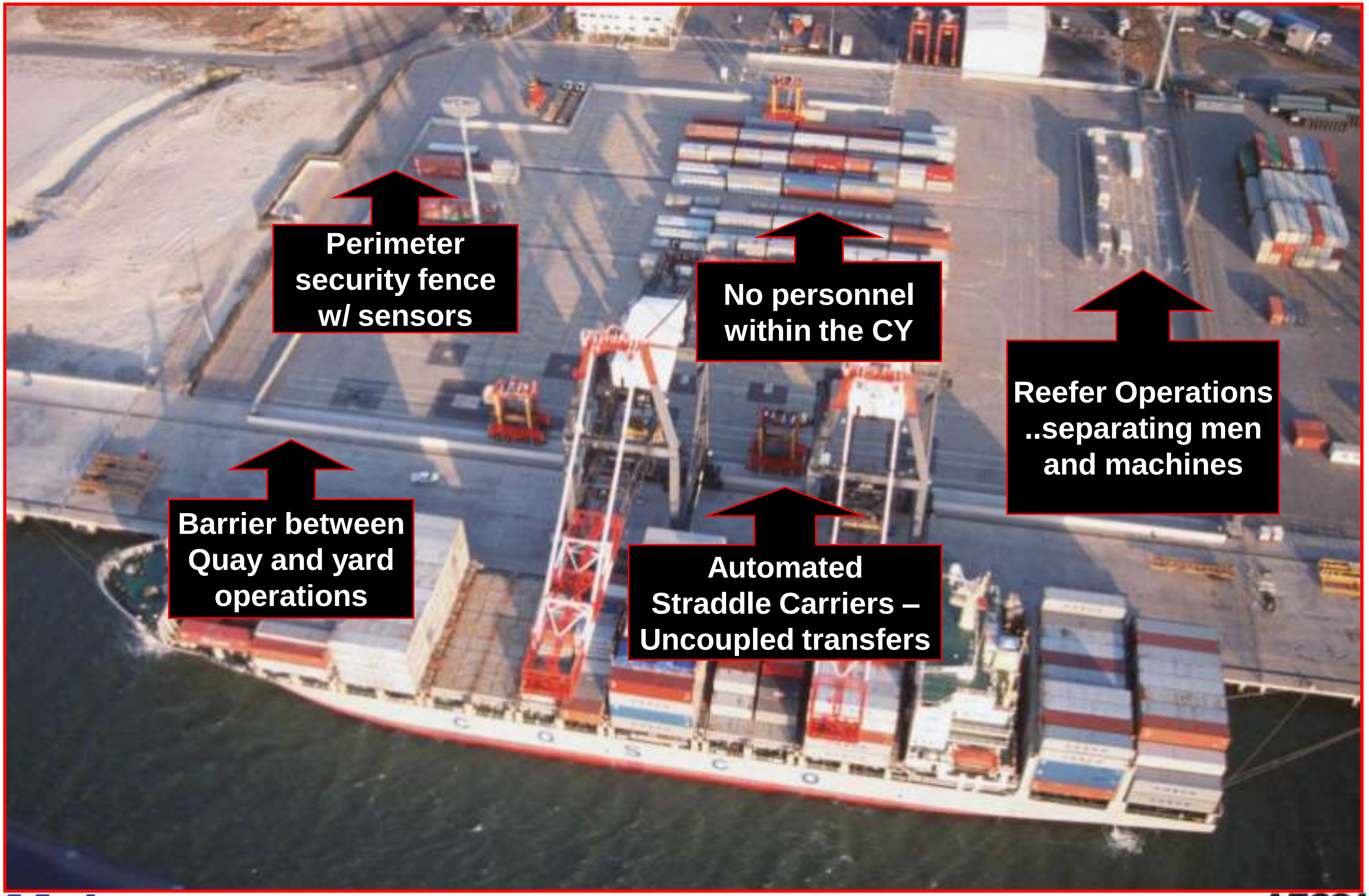
Safety

- Fewer people = fewer people getting hurt
- No need for trucks to drive underneath yard cranes

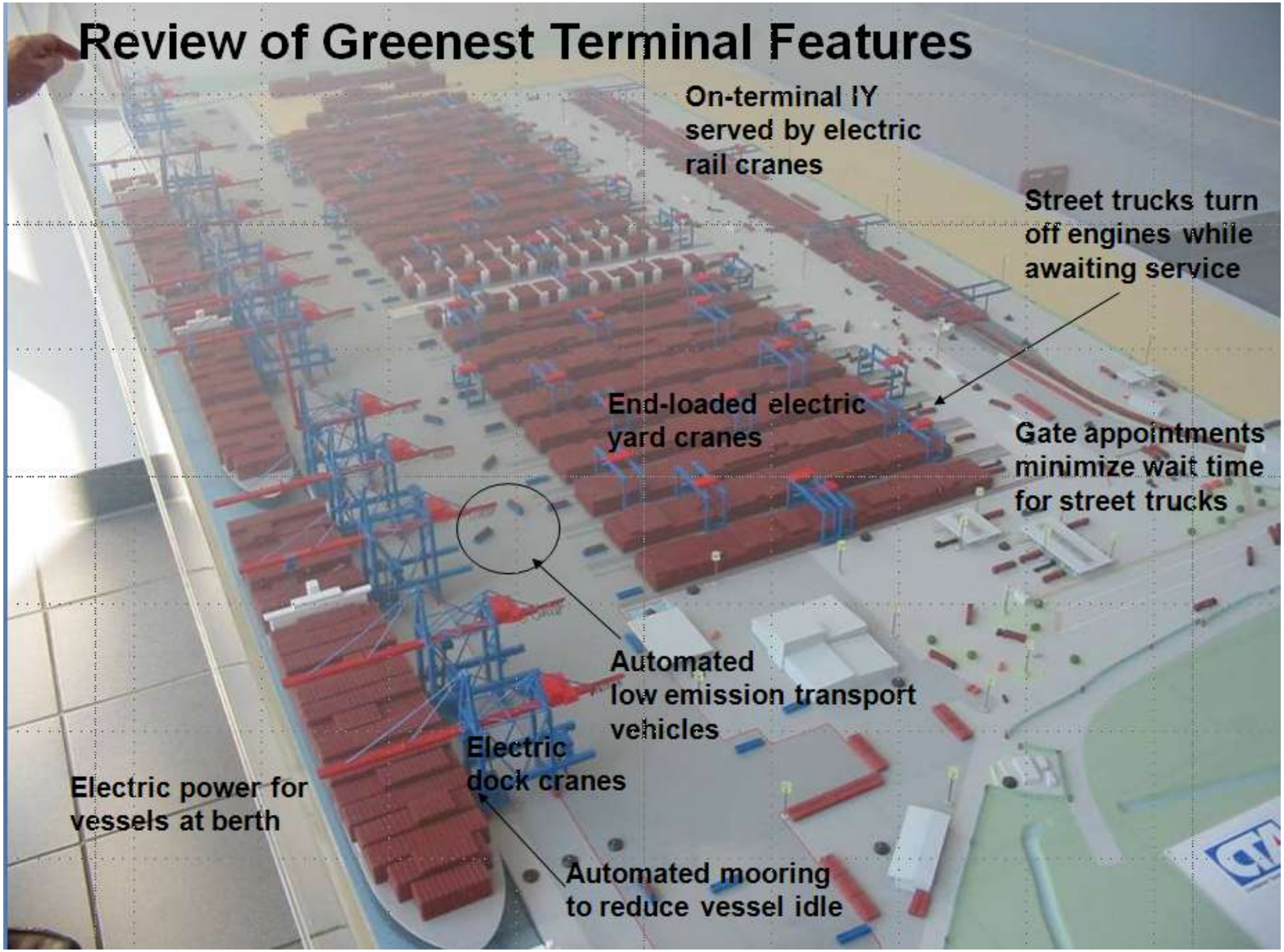
- Security
  - Street truckers cannot access containers directly
  - Fewer terminal personnel
  - Computer control and recording of all container movement
  - Automated scanning of cargo while in the CY



Brisbane, Australia
Fully Automated Operating System

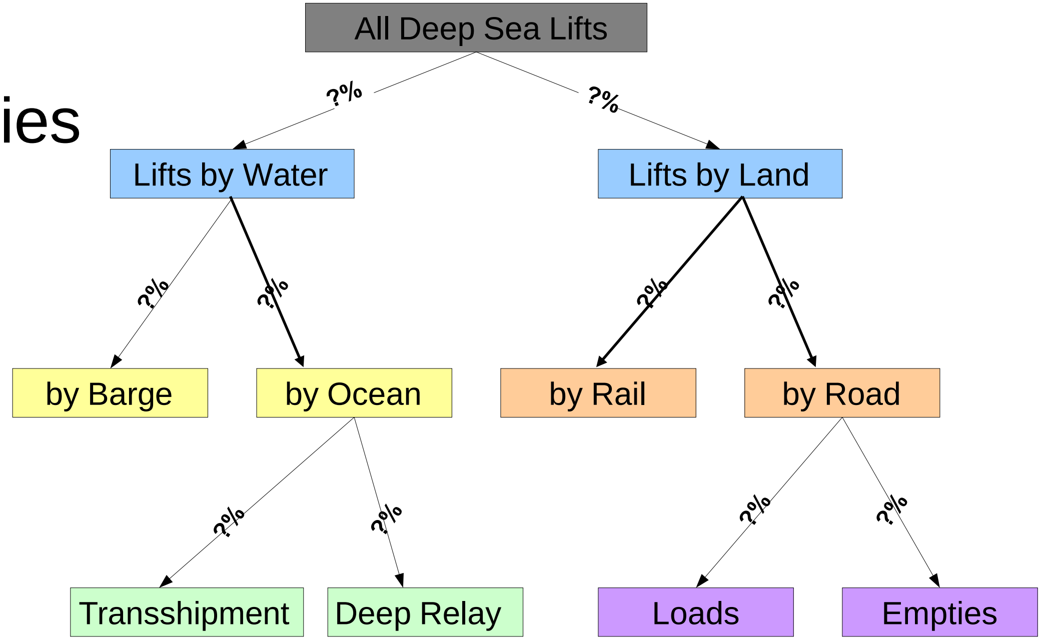


Environmental Concerns

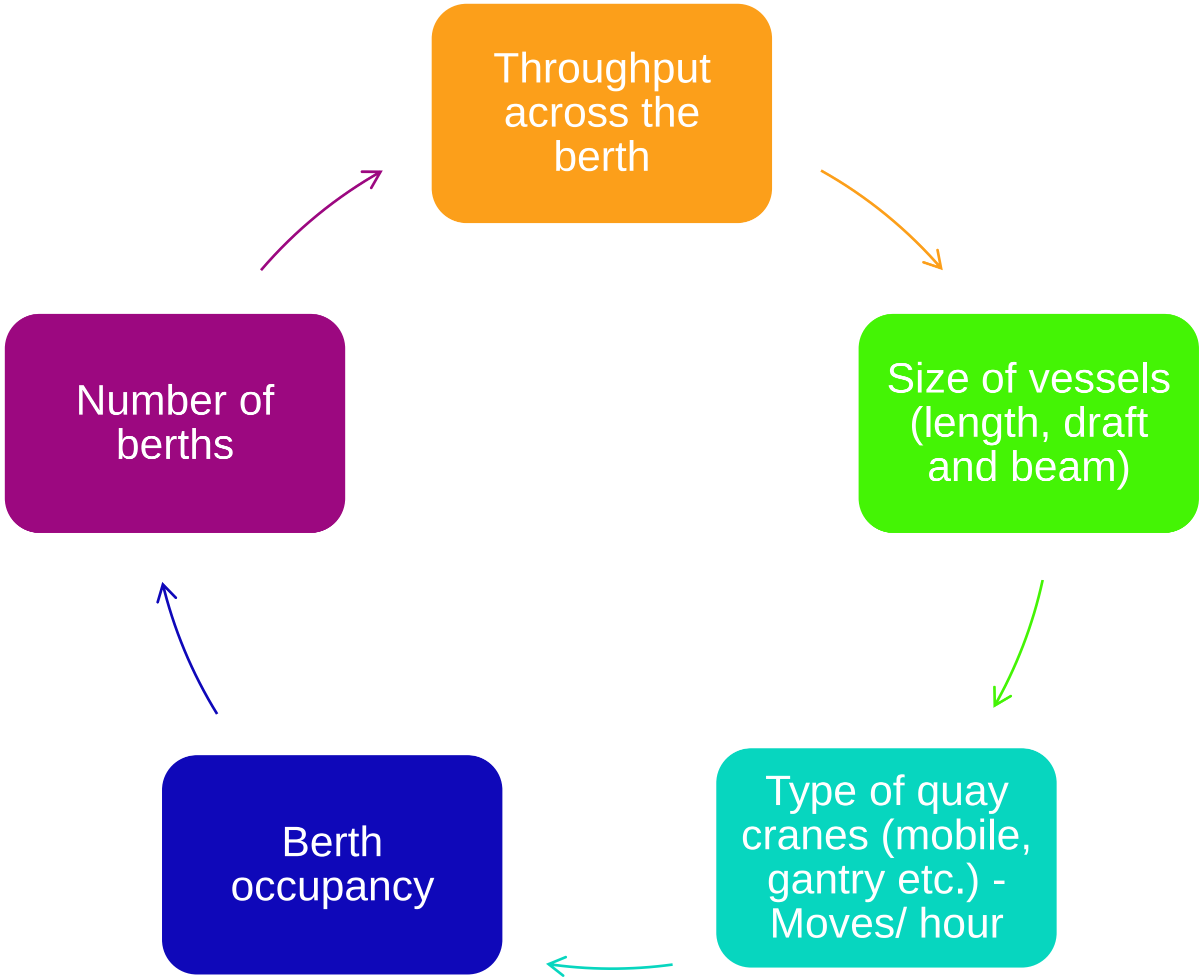


And…..Site Location… Location… Location

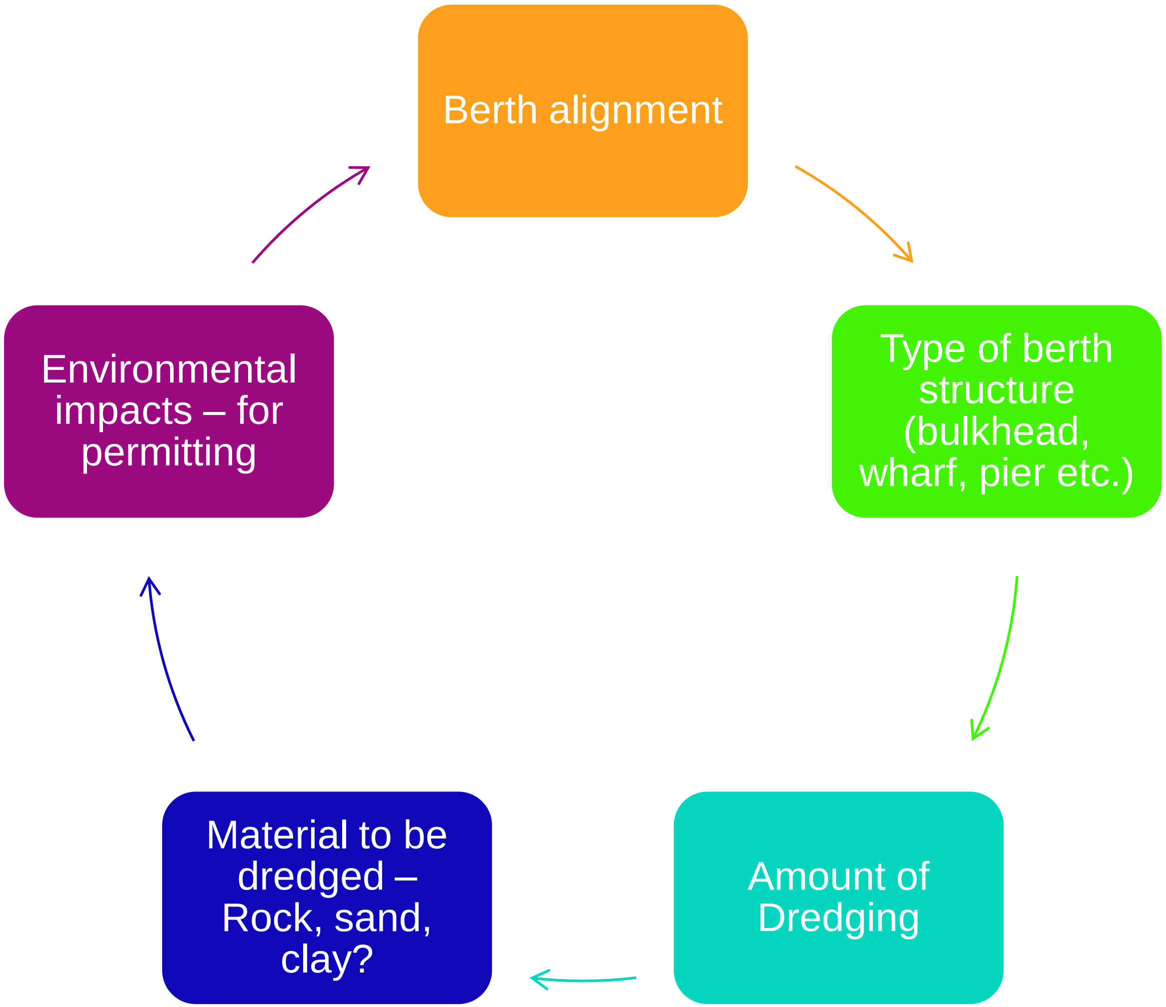
- Green field or brown field?
  - Relocation of existing tenants
- Excavation vs. dredging
  - Environmental mitigation
- Terminal access and utilities



1. Waterside Infrastructure
Planner's Concerns

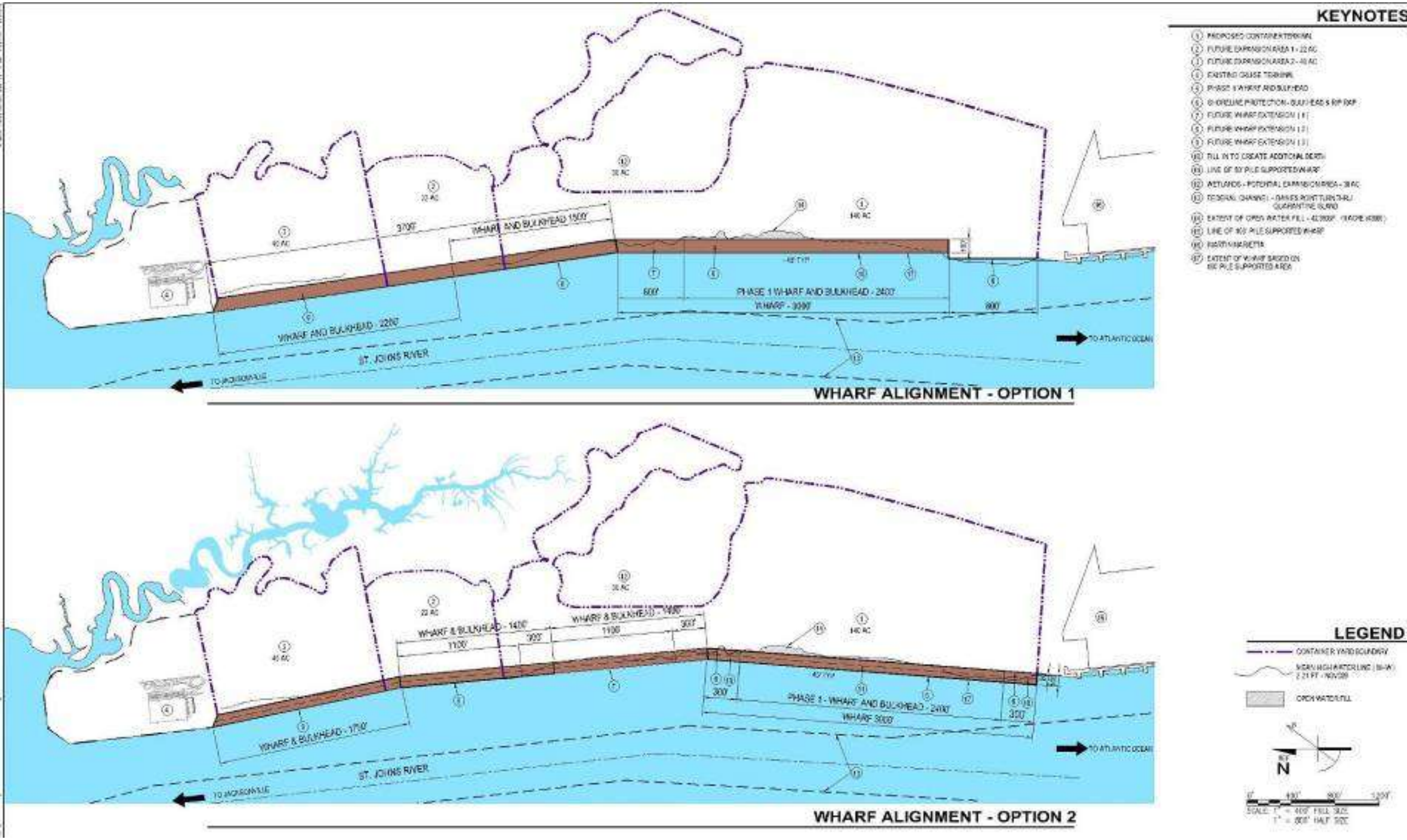


1. Waterside Infrastructure
Engineer's Concerns

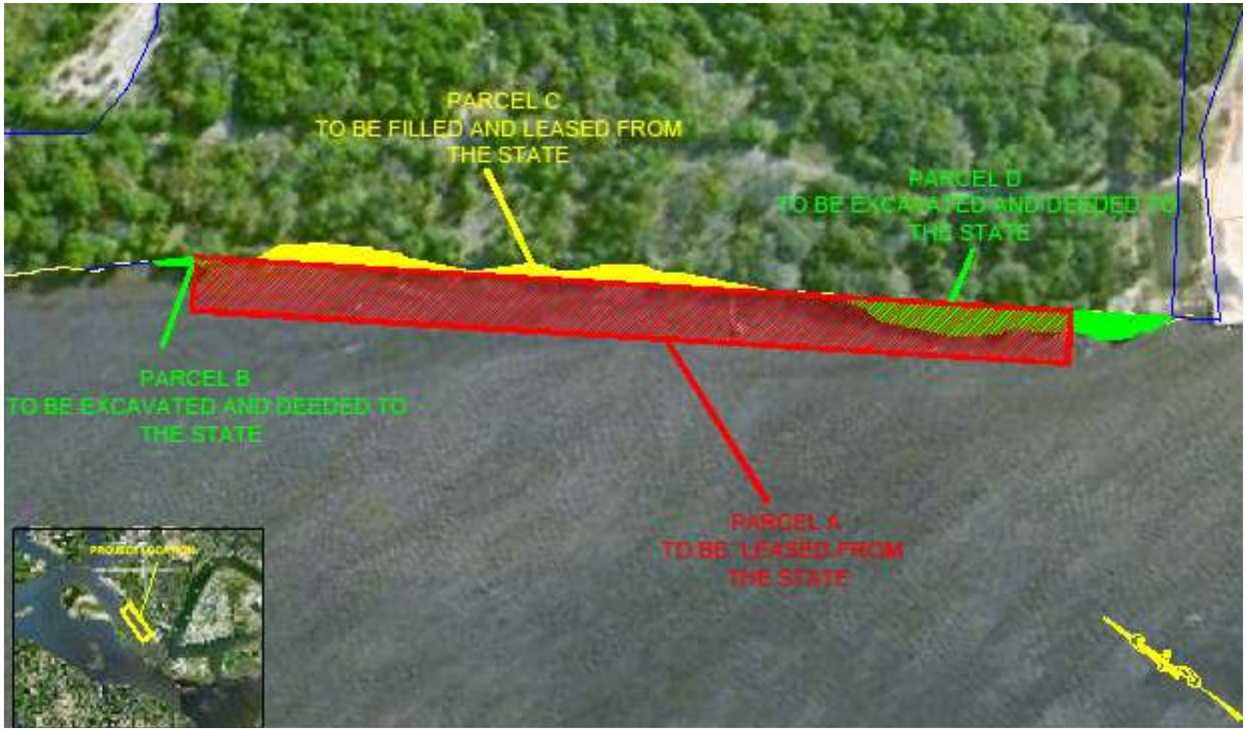


Dames Point Container Terminal, Jacksonville

Berth Alignment Study

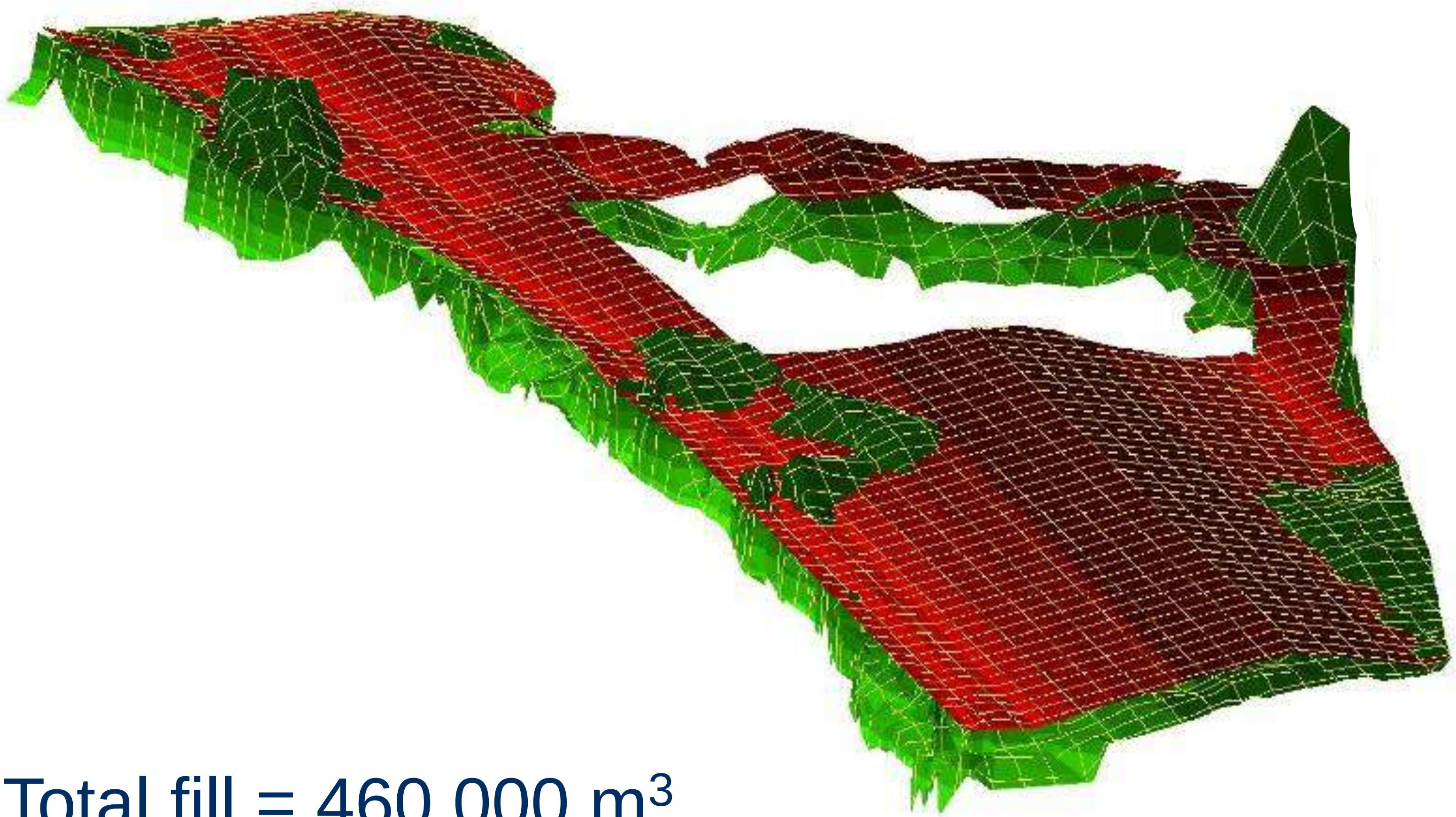


Minimal Environmental Impacts



Bulkhead aligned to minimize impacts on St Johns River

Site fill required

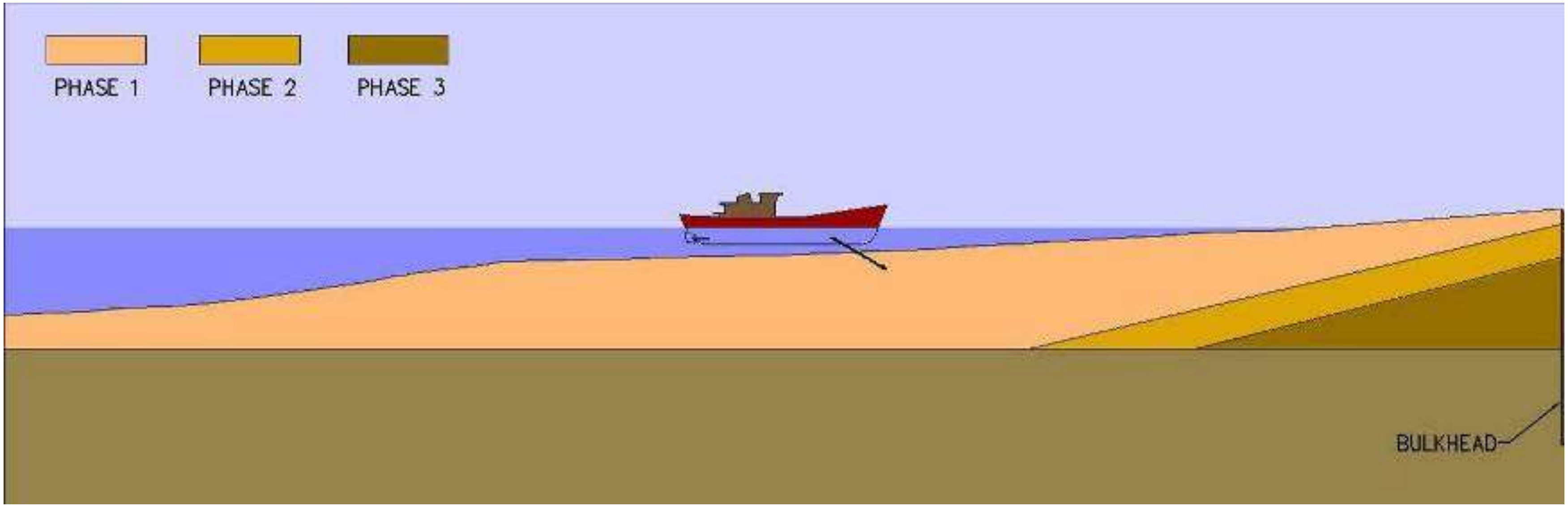


Total fill = 460,000 m^3

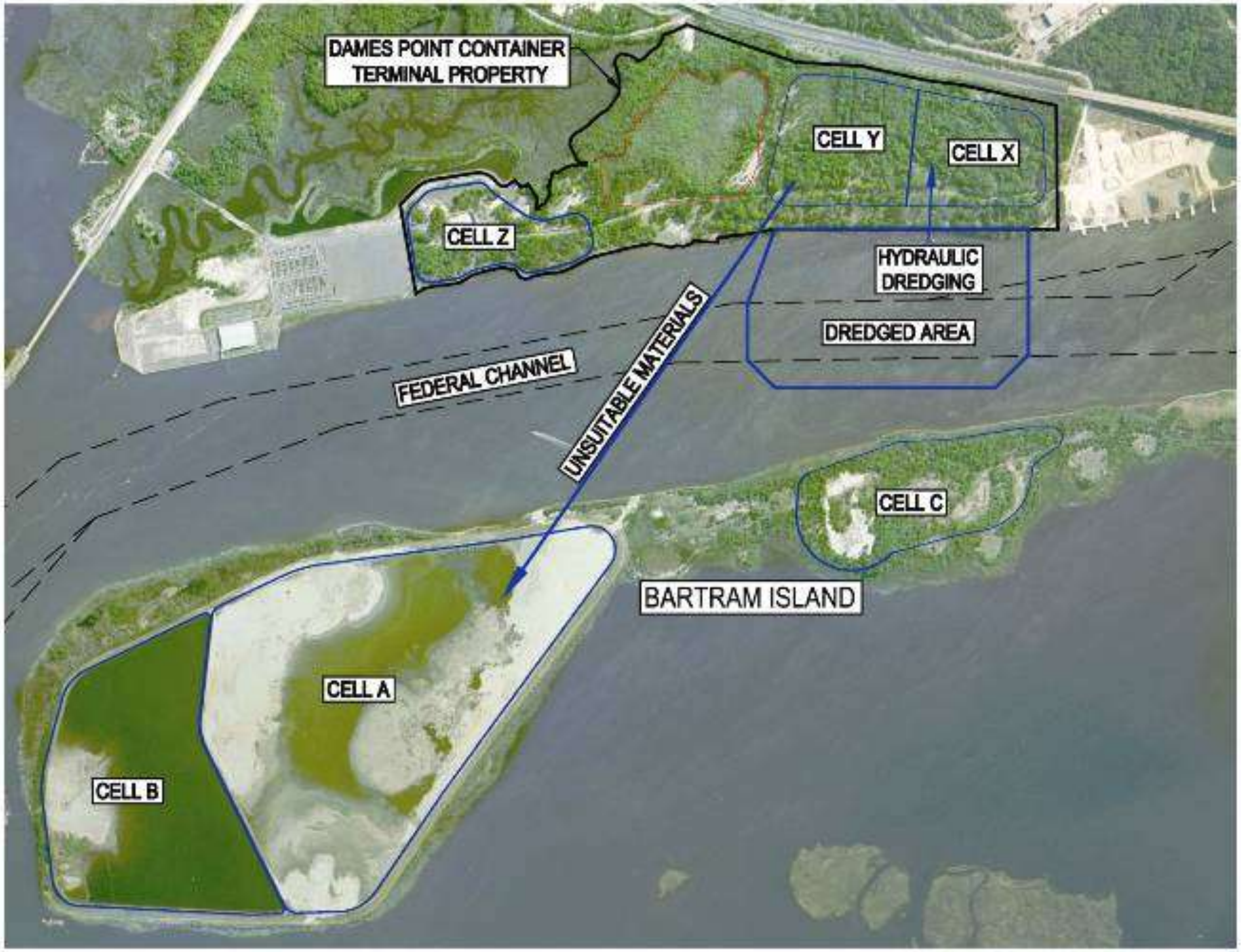
[illegible]ction

Dredging

Solution was to dredge at the same time of bulkhead construction



Temporary and permanent spoil cells



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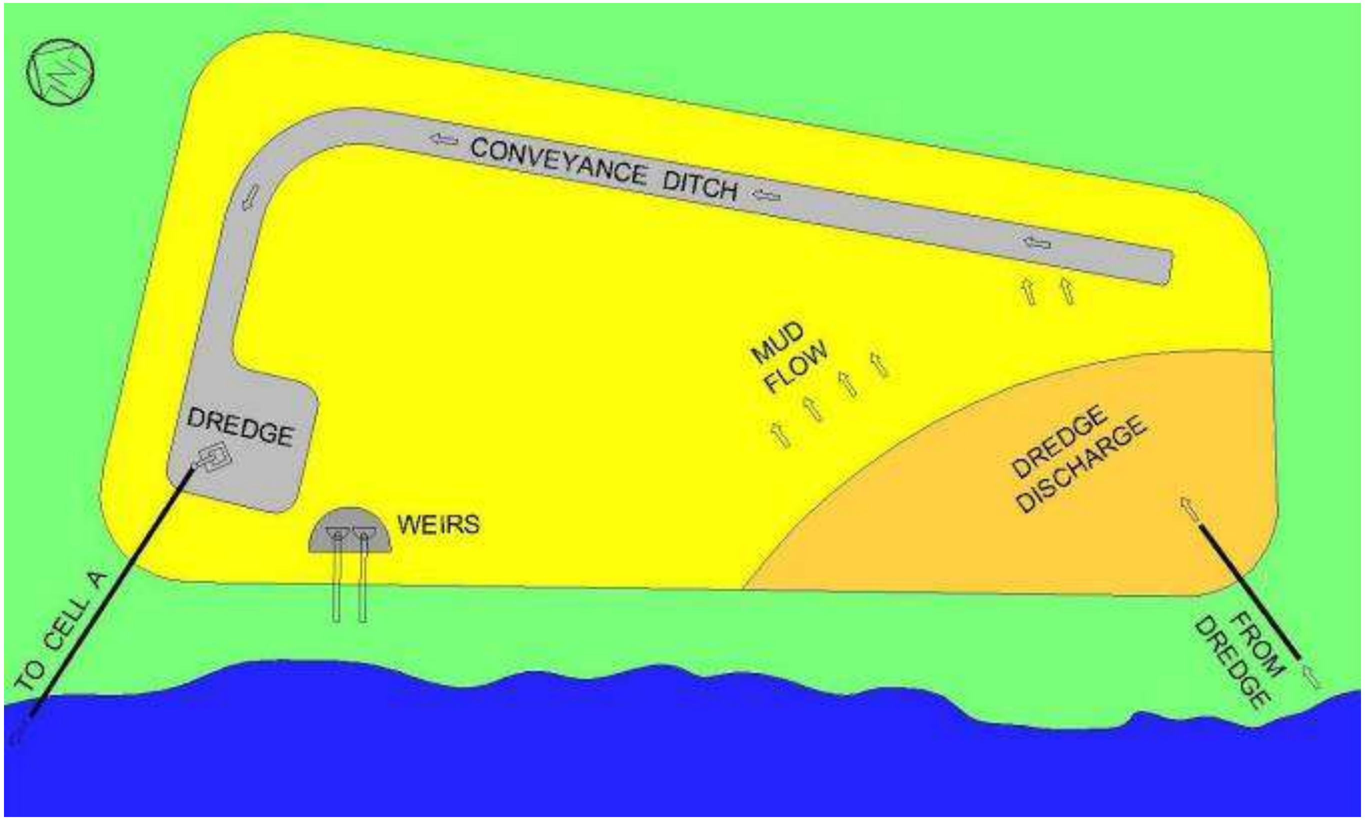
Modified Cell XY



Dredge concept was to allow muds to flow into a channel and be pumped over to Bartram Island

Cell XY

Dredger was placed inside cell to pump excess water and muds over to Bartram Island

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Cell XY

Sand dredged into cells on Dames Point was very good quality

Bartram Island

…and muds that separated out were pumped over to Bartram Island via a submerged pipeline

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Construction activities

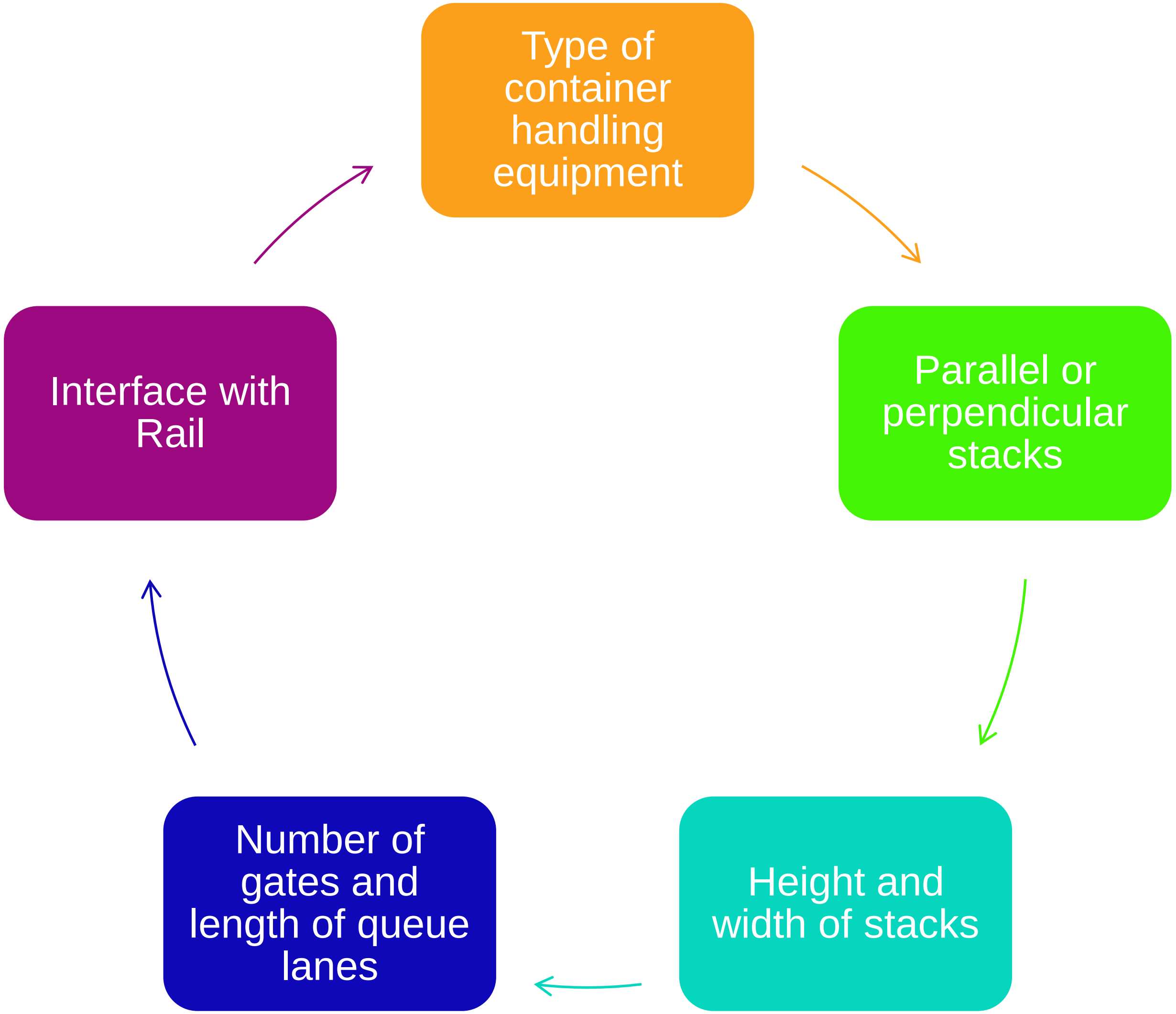
<u>August 2007</u>

Dredging and bulkhead construction scheduled in parallel

By September, dredging, bulkhead and civil works concurrent

2. Land Usage

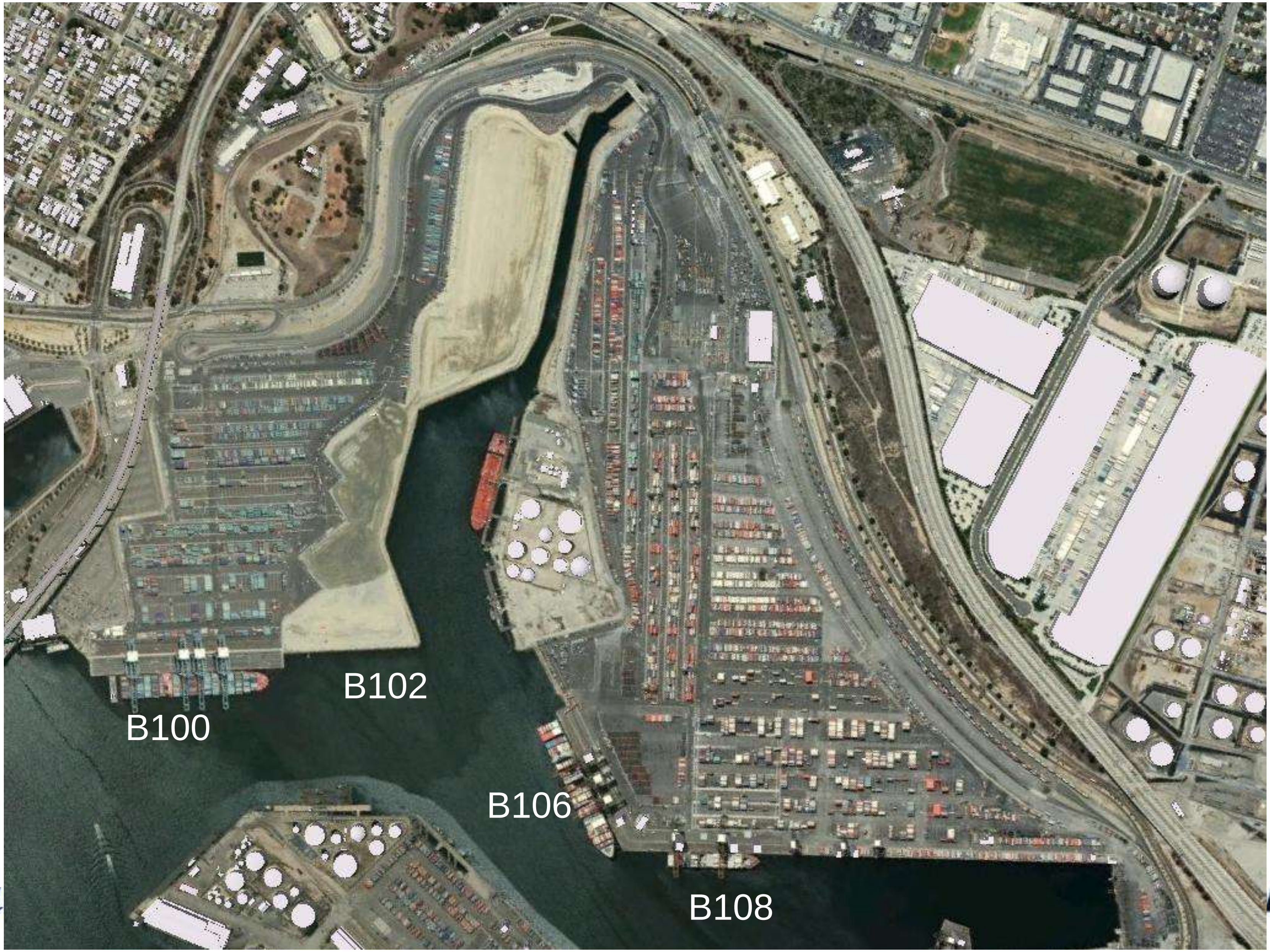
Planner's Concerns



Plus....Terminal Layout Needs to Account for

Productivity	Capacity	Service reliability	Flexibility for increased velocity or capacity
Flexibility for expansion	Startup risk	Suitability for robotic operation	Flexibility to respond to odd operating situations
Maintainability and durability	Capital Cost	Labor	Entry and exit gate locations
Location of any on-terminal queuing locations	Width of traffic aisles	Location of private vehicle parking	Procedure for transporting personnel to and from work locations

Case Study: West Basin Container Terminal



Terminal Layouts (RTG Cases)

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ASC Layouts

Left ASC with Straddle Carriers; Right: ASCs with terminal tractors

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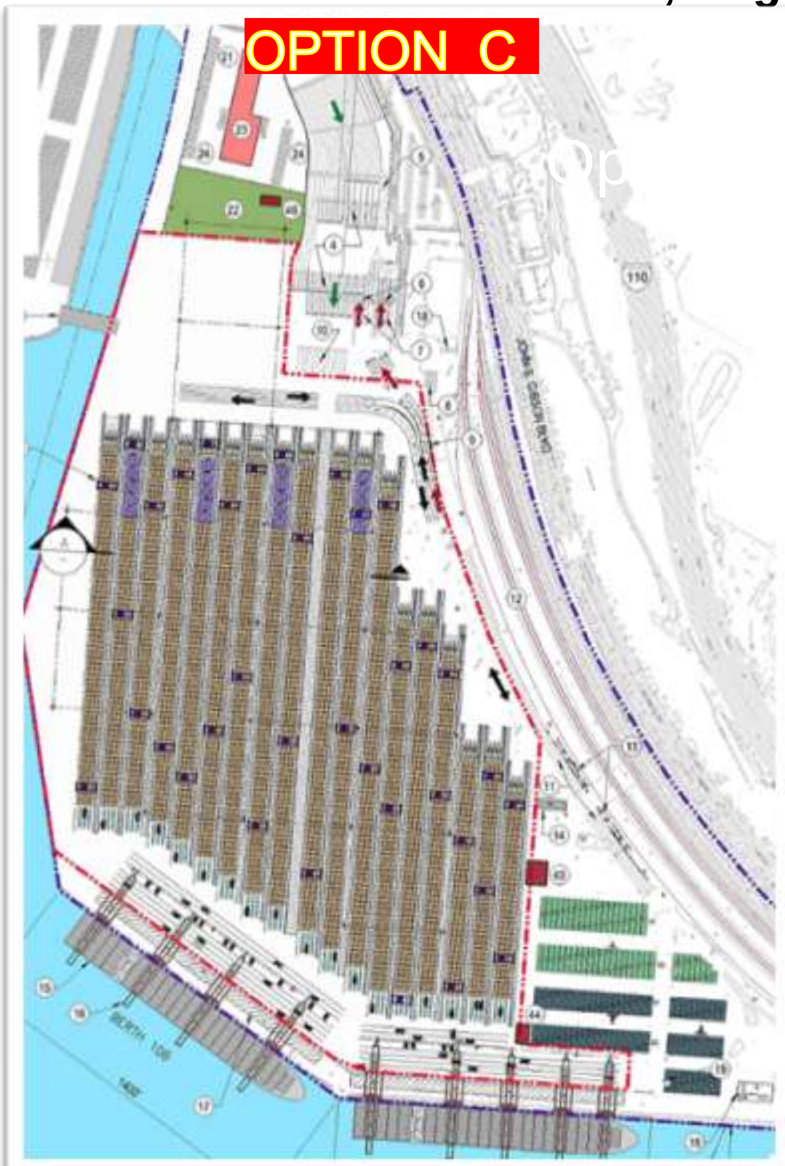
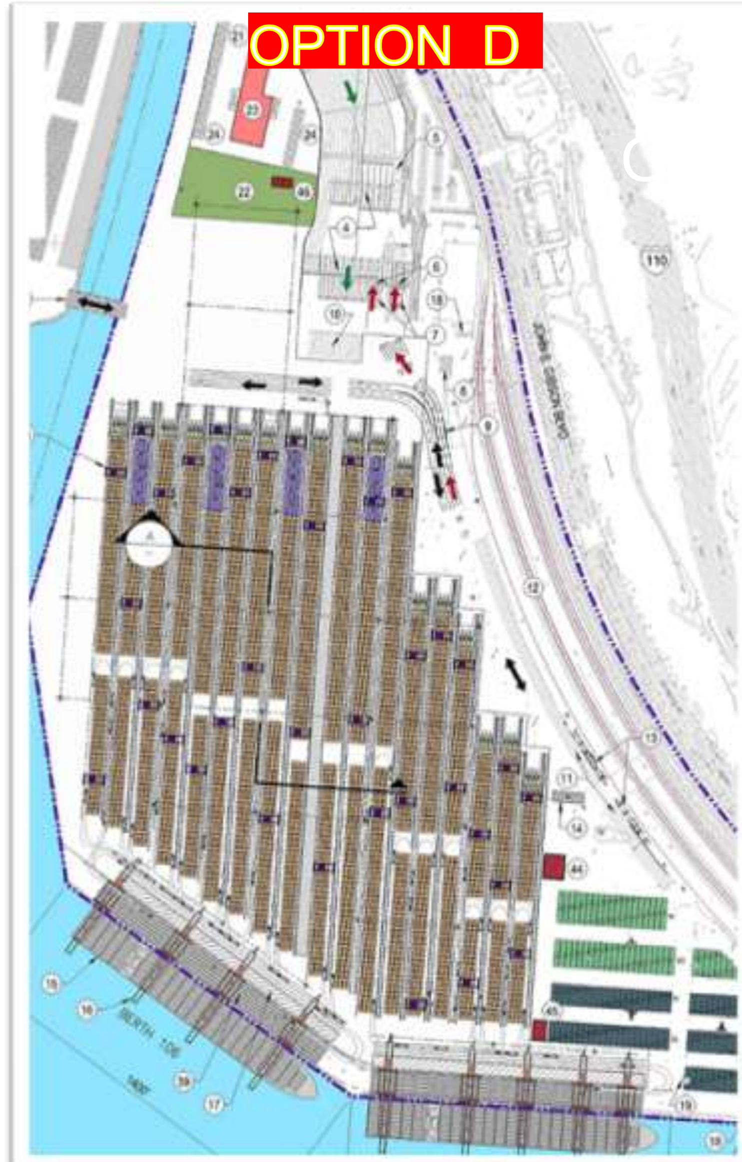
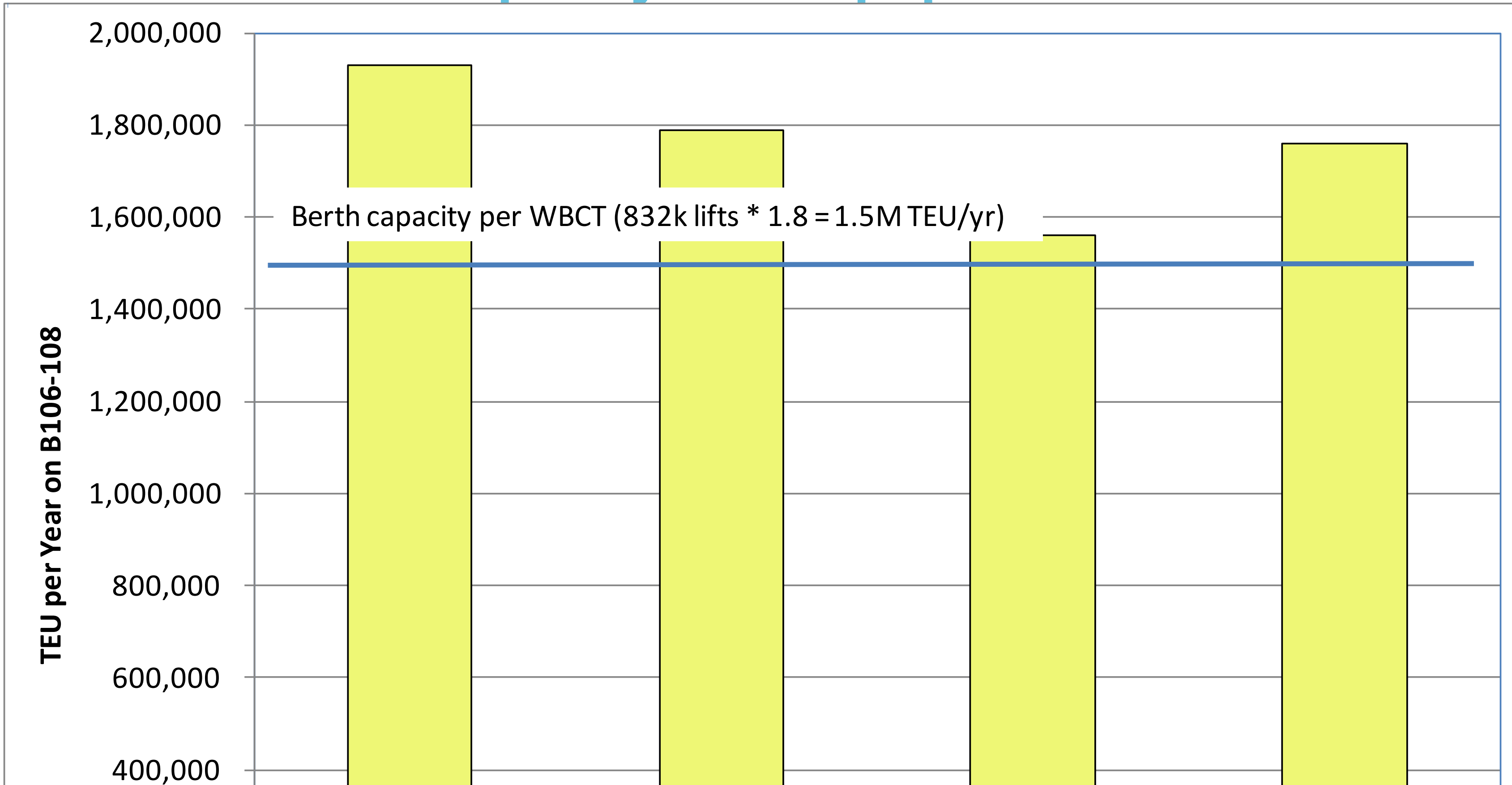


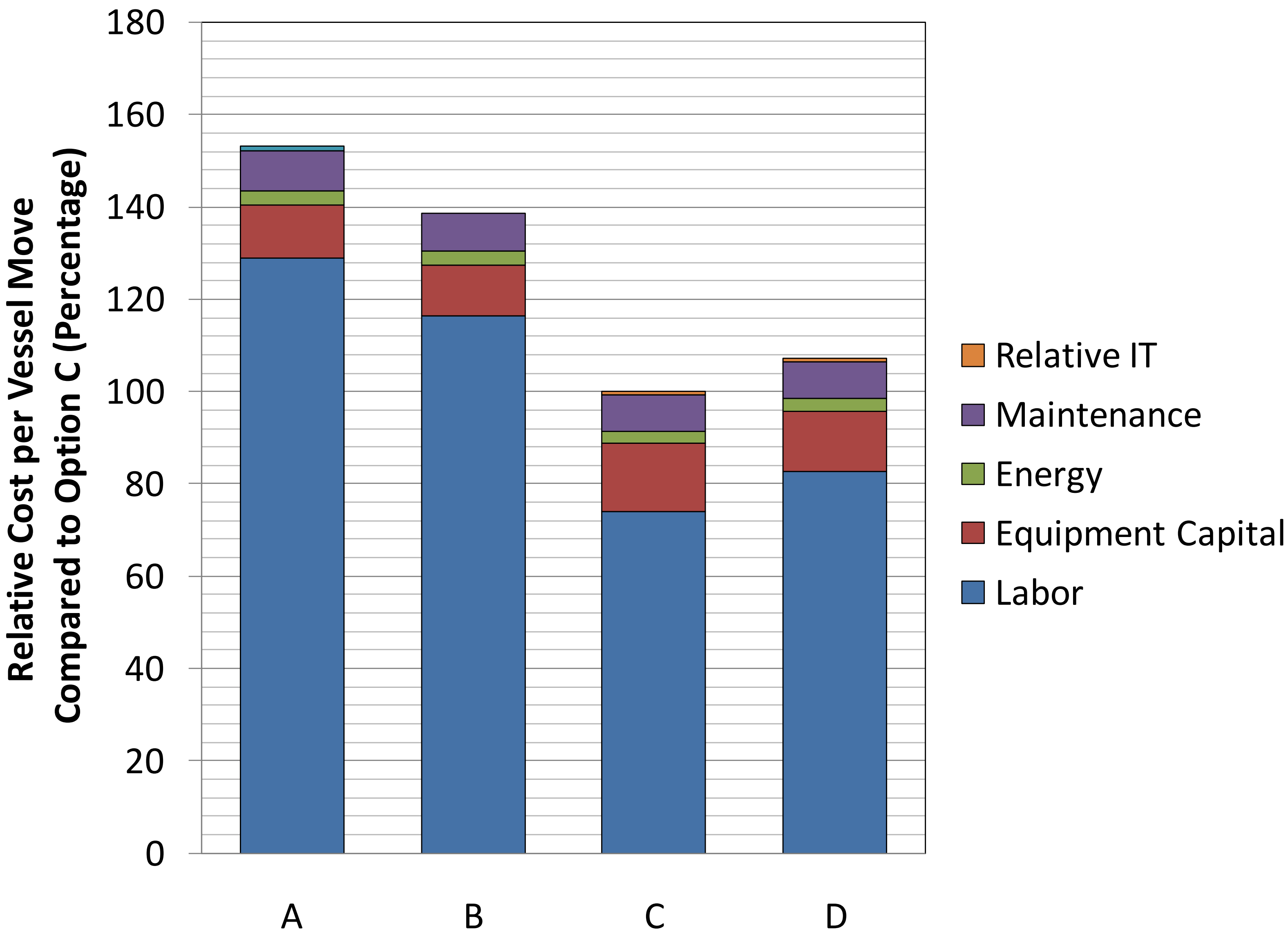


Container Yard Capacity and Equipment Fleet

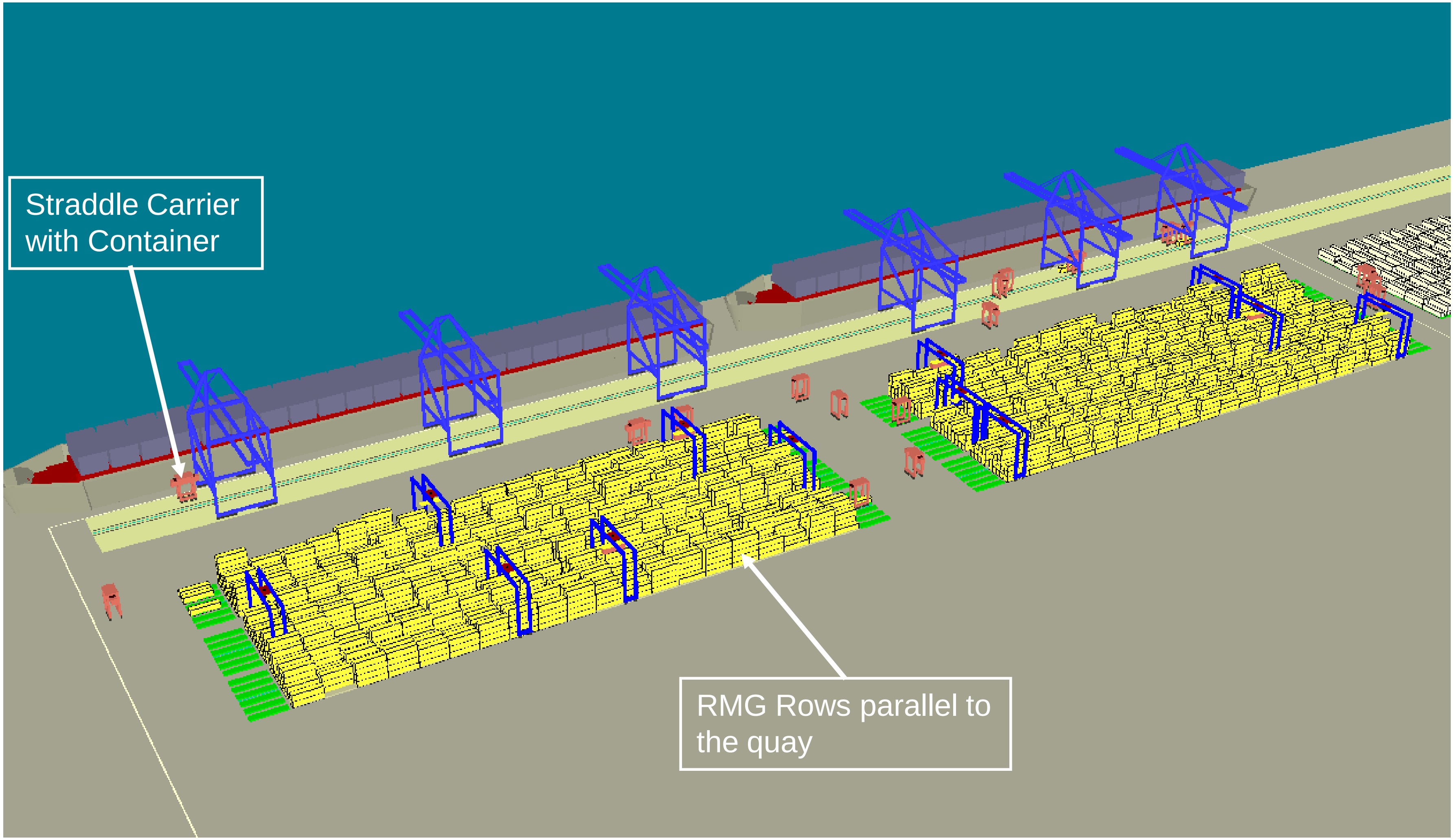


	Option A	Option B	Option C	Option D
Dock Crane	Truck	Truck	Strad	Truck
Stevedoring	RTG + Top Pick	Top Pick	ASC	ASC
Gate	RTG + Top Pick	RTG + Top Pick	ASC	ASC
Intermodal Yard	RMG	RMG	RMG	RMG
CY Support for IY	Stv Top Pick	Stv Top Pick	Gate ASC	Stv ASC
IY Transfer Eqmnt	Terminal Tractor	Terminal Tractor	Terminal Tractor	Terminal Tractor
Berth 100	Berth100 RTG	Berth100 RTG	Gate ASC	Stv ASC

Cost per Vessel Move by Option



Freeport Bahamas – Transhipment Terminal Parallel RMGs with Strads



2. Land Usage
Engineer's Concerns

- Geotechnical information of site (suitability for pavements and building foundations)
- Topography of site – cut and fill
- Environmental impacts – for permitting (wetlands?)
- Storm water drainage
- Tide levels
- Flooding (storm surges, hurricanes, heavy rain)

Minimal Environmental Impacts

Yellow – Freshwater wetlands impacts

3 acres of impact

Red – saltwater wetlands impacts

0.4 acres of impact

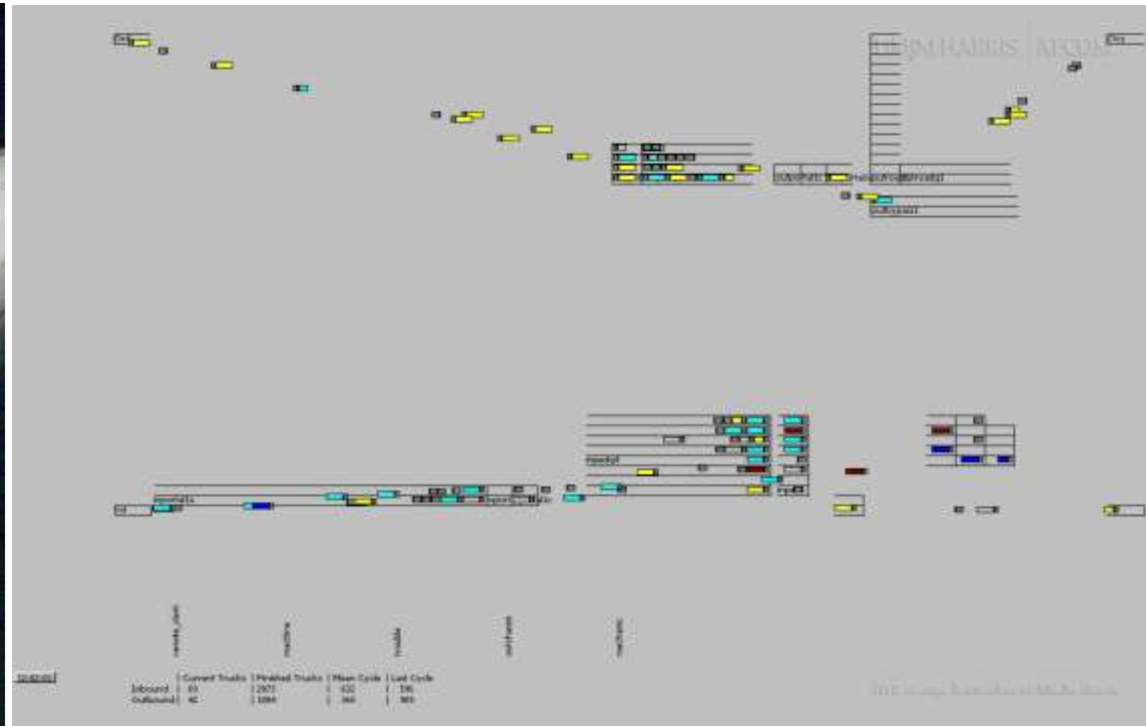
Minimal Environmental Impacts

3. Infrastructure Connectivity

Planner's Concerns

- Access to main roads
- Access to rail
- Connection to local utility providers
  - Terminal demands (power, lighting, sewer, water)
- Intensity of traffic flows

Road Access and Queuing Capacity



Rail Access and Bottlenecks

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Intermodal Container Transfer Facility

3. Infrastructure Connectivity

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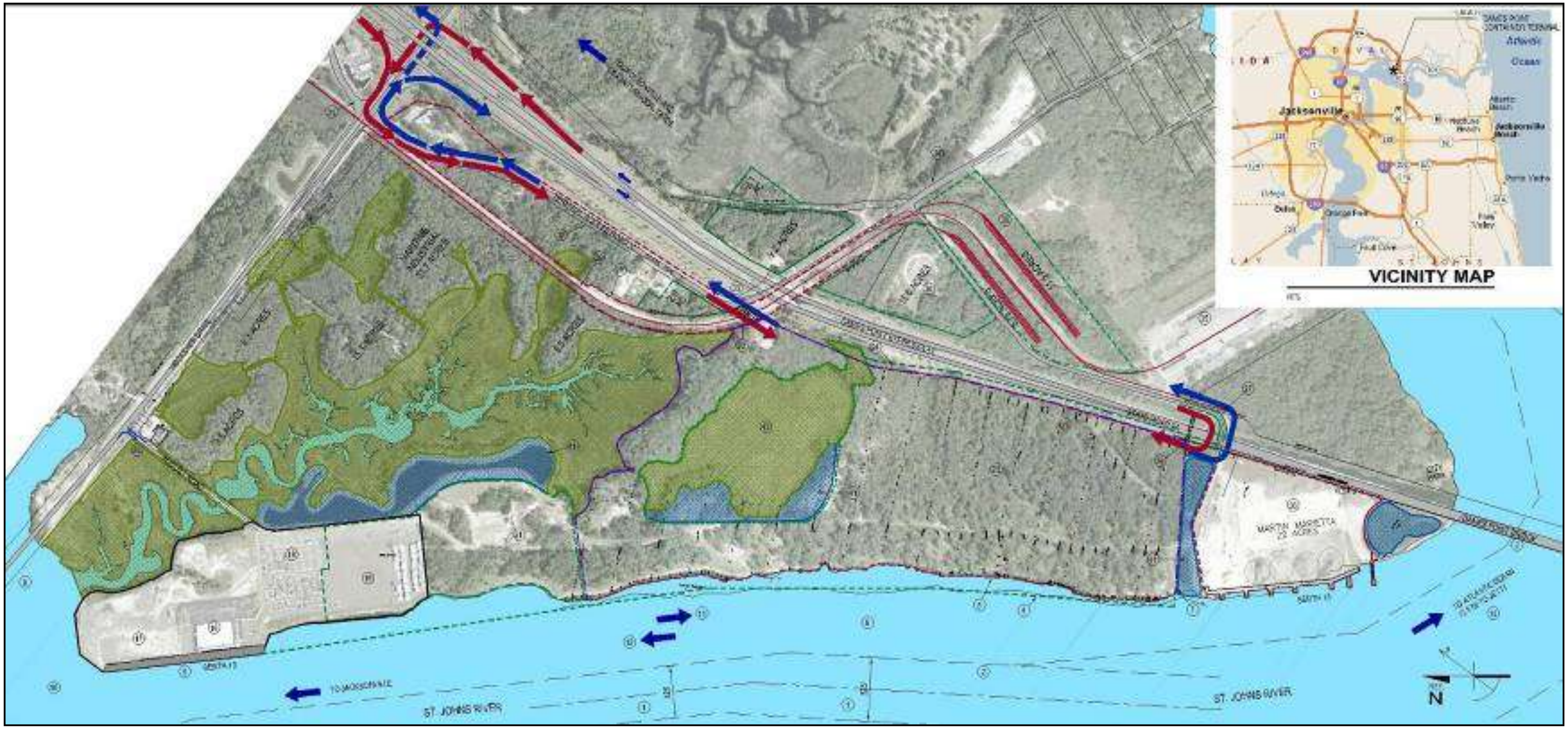
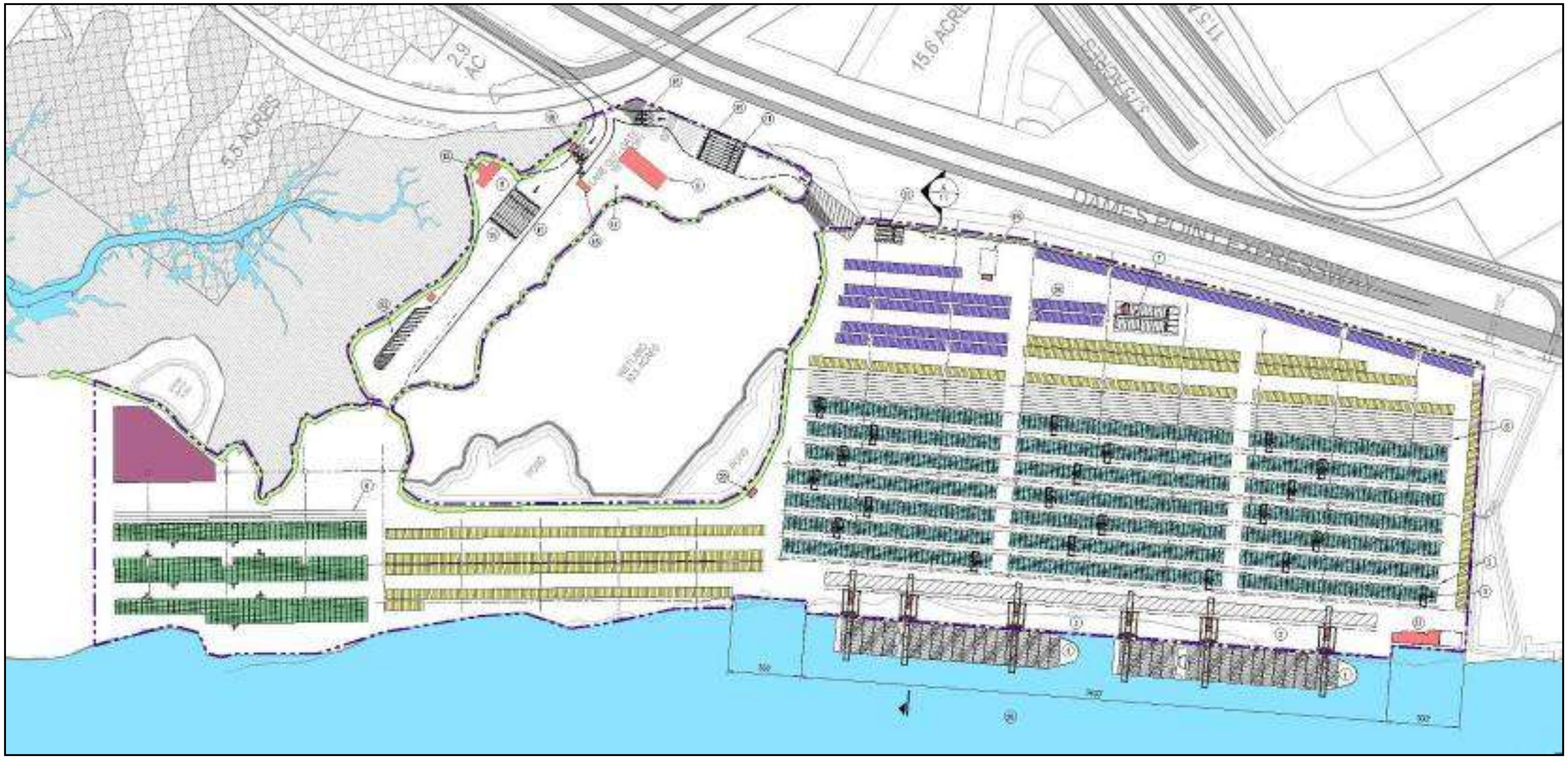
Engineer's Concerns

- Traffic studies (impact on local traffic) – solutions?
- Power demands – substation, direct service, voltage etc.
- Sewer – gravity, force main, pump stations etc.
- Water – potable, fire mains, irrigation (local service, wells, salt water etc.)
- Telephones and data
- Permitting

Site Access


VICINITY MAP
Jacksonville
Atlantic Ocean
MARTIN MARIETTA 22 ACRES
ST. JOHNS RIVER
ST. JOHNS RIVER
N

Early Concept



Final Layout

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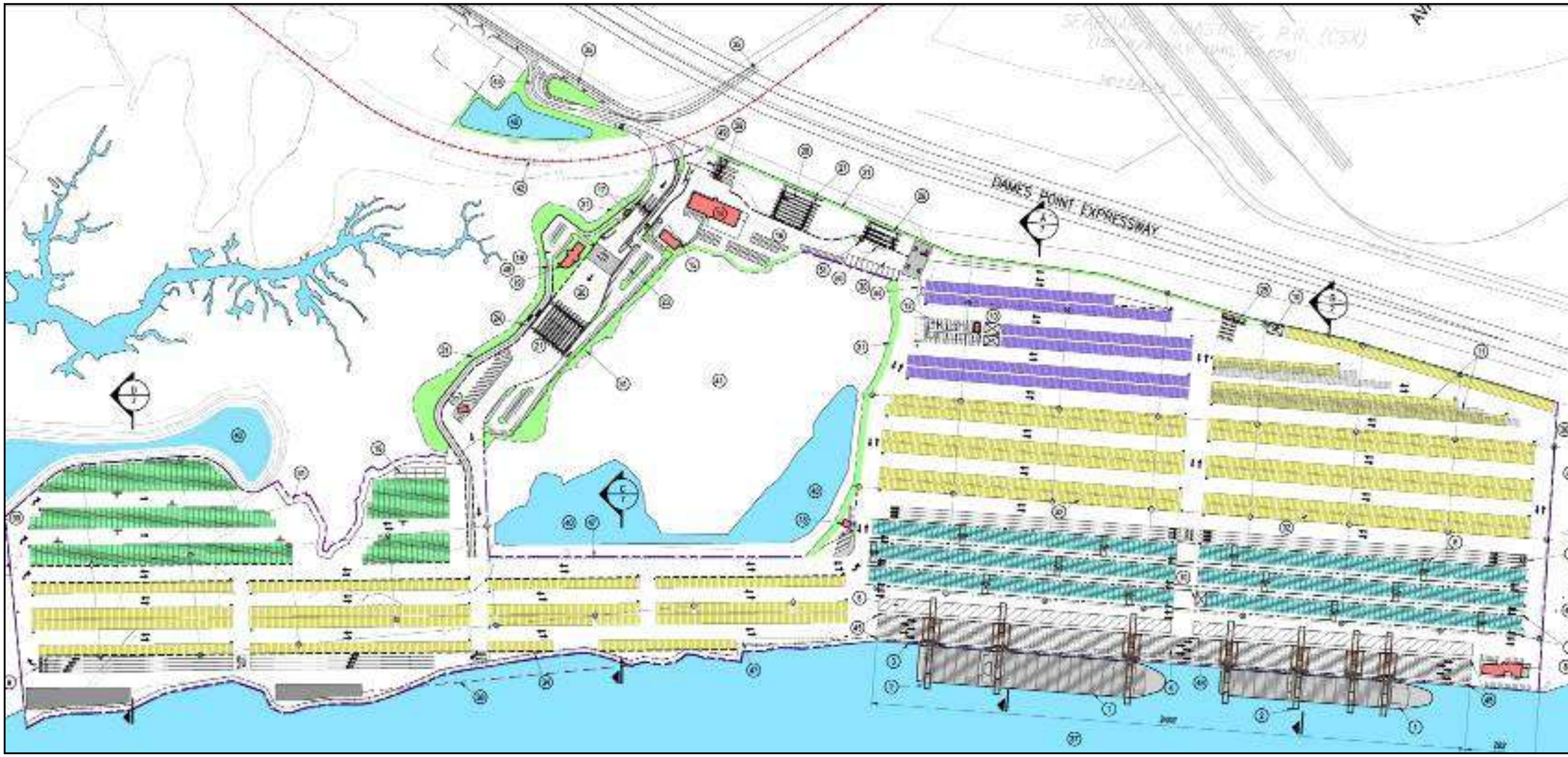

Summary of Container Terminal Design Trends

- **Longer and deeper container vessels**
- **Automation of processes and equipment**
- **Densification of storage**
- **Sustainable and environmentally friendly**

Questions or comments?