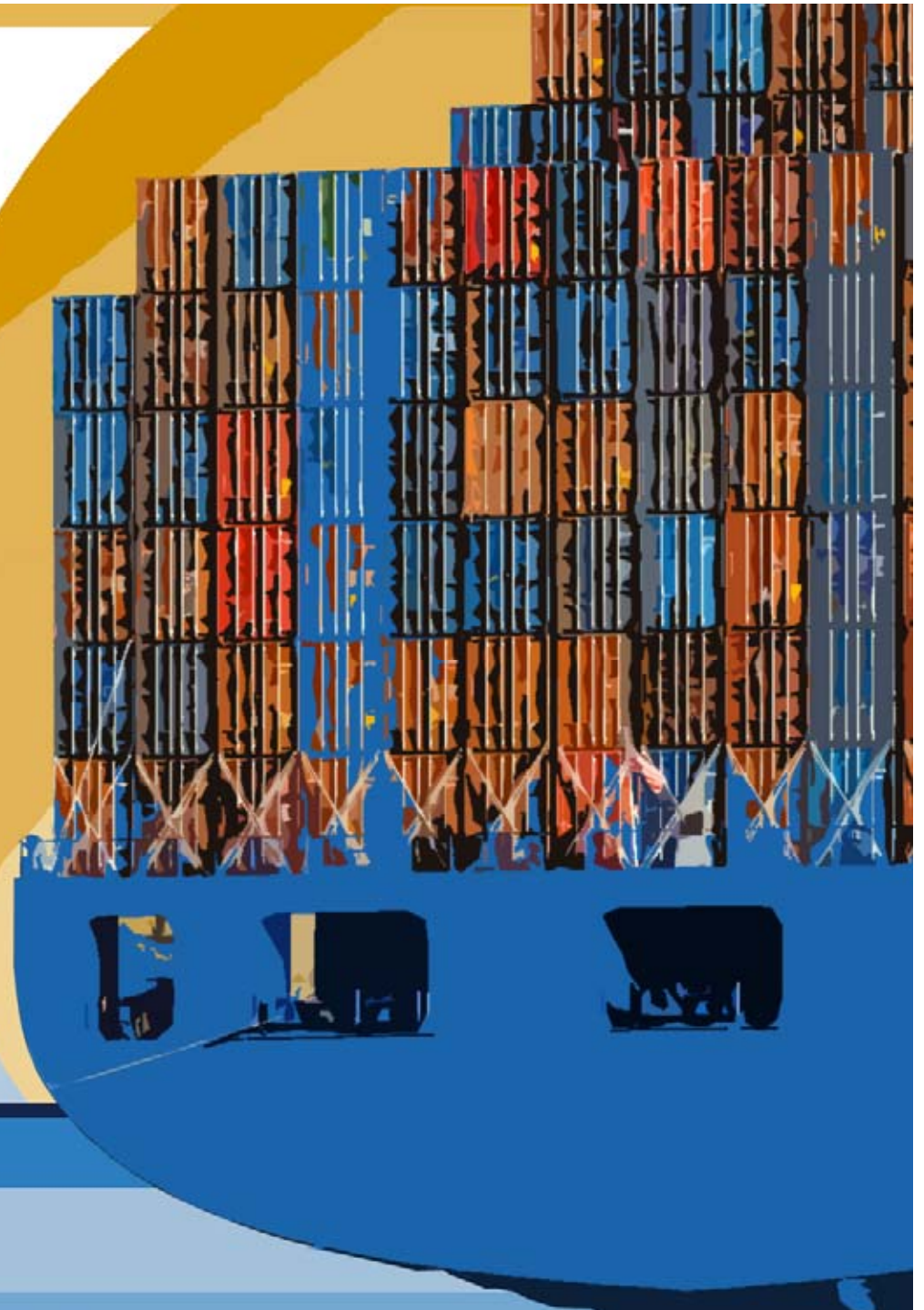




Impact of Large Container Ships on Port Infrastructure

E. D. Allen, *Moffatt & Nichol*

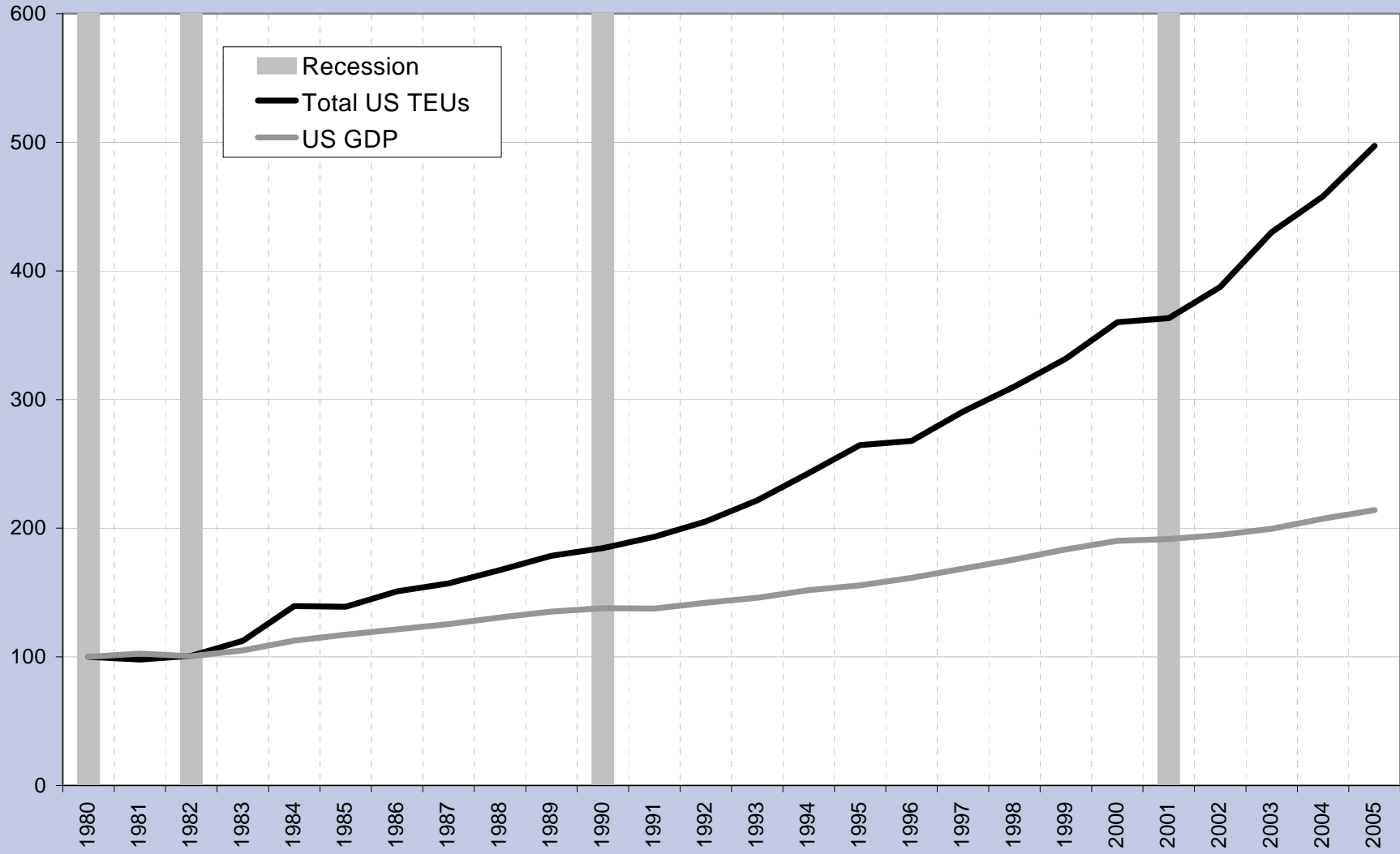
September 30th - October 4th





Growth In Container Volumes

US GDP and TEU Trade: 1980 - 2005



Infrastructure Dependent on Ship Size



- Navigation Channel Widths/Depths
- Turning Basins
- Berth Length
- Crane Size
- Wharf Loading/Appurtenances

Channel Improvement Challenges:

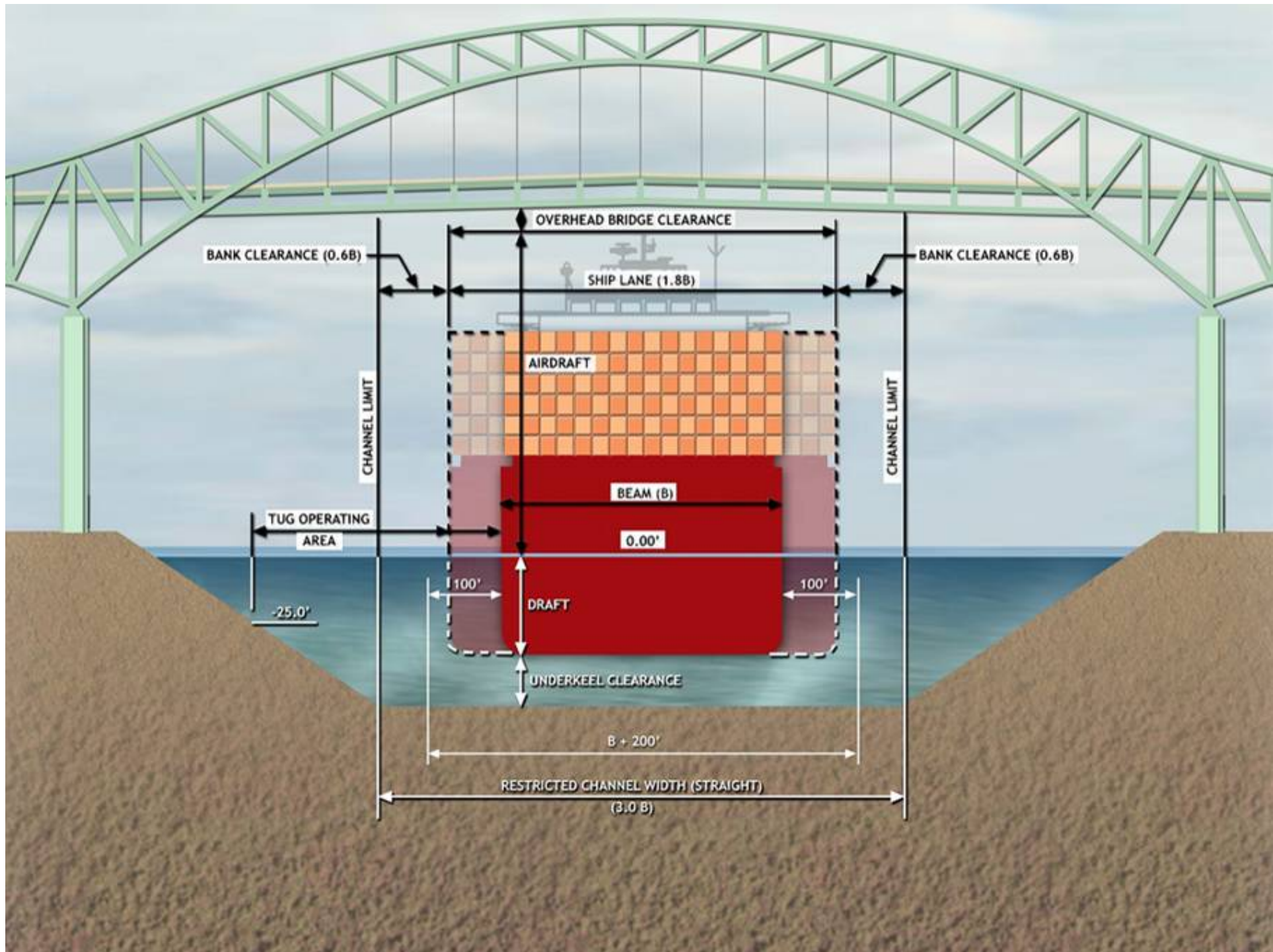


- Channels Under Federal Jurisdiction
- Deepening and Widening Approvals Require a Minimum of 10 Years to Obtain
- Environmental Issues Potentially Slow Process Further
- Competition for Federal Funds for Improvements



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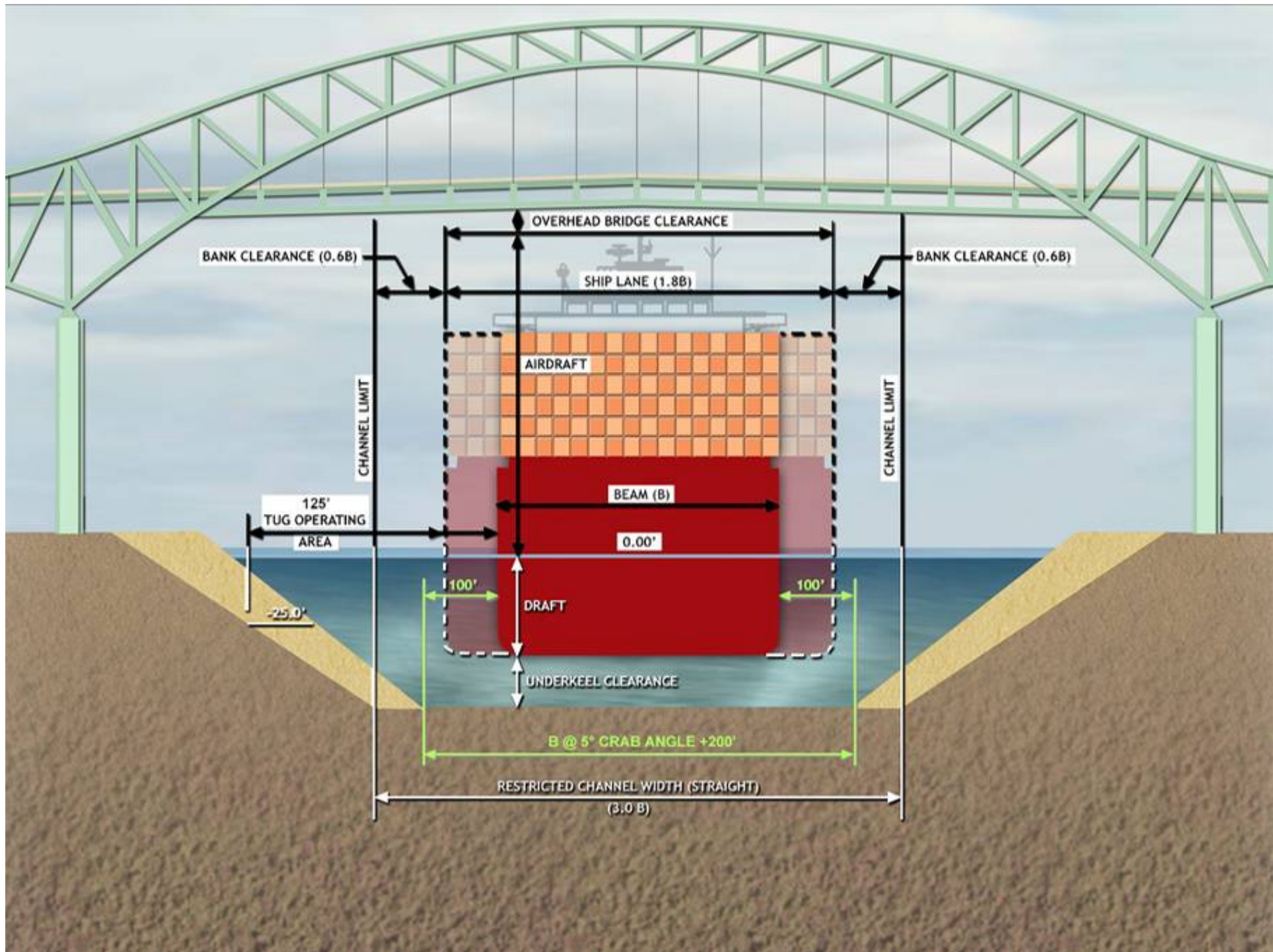


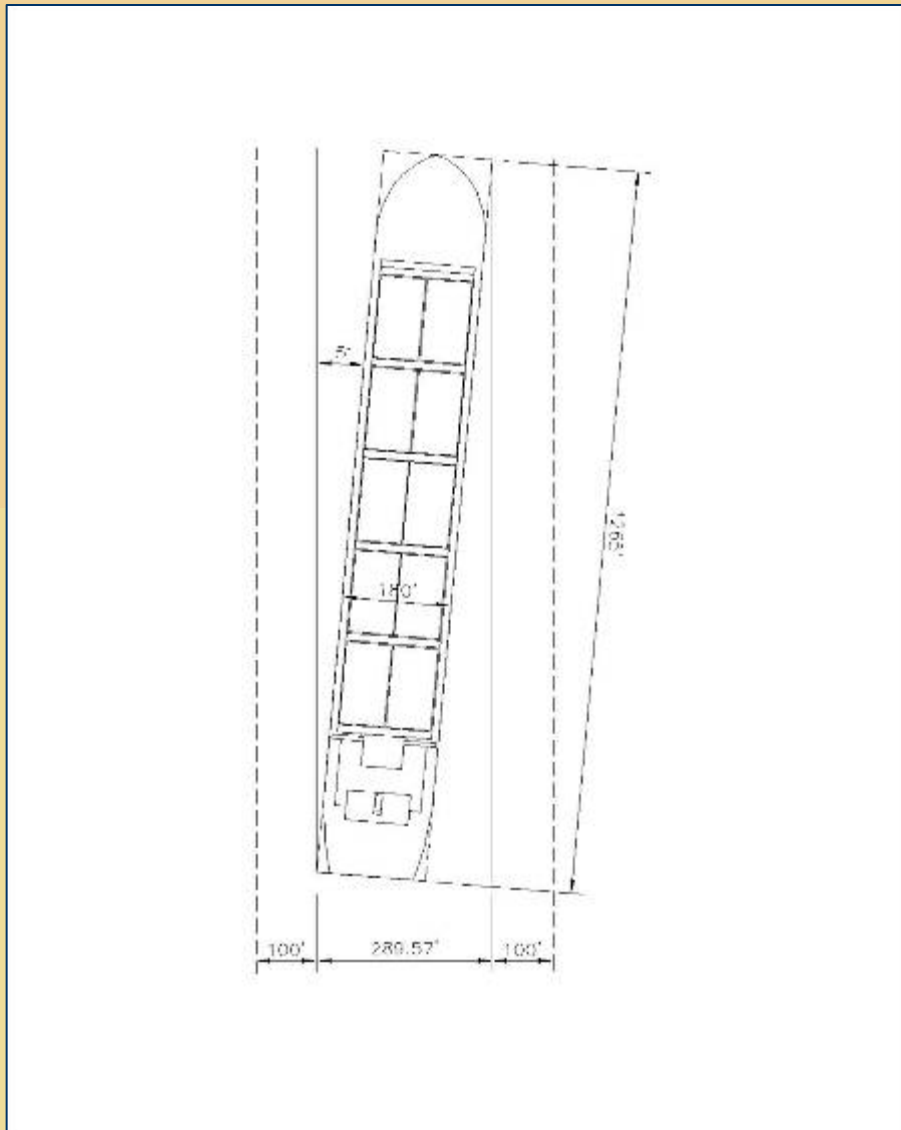


Summary of National & International Guidelines

PIANC	-	Detailed
USACE	-	Summary Fashion
NAFAC	-	Summary Fashion
ASCE	-	Summary Fashion

WIDTH	PIANC	USACE	NAVFAC	ASCE	JPS
Basic Ship Lane width, good	1.3B		1.8B	1.8B	B+5°Crab
Additive for: speed, <8 knots	0		-		
: cross wind, mild	0		-		
: cross current, low	0.2B		-		
: longitudinal current, low	0		-		
: wave height, <1m	0		-		
: aids to navigation, excellent	0		-		
: bottom surface, smooth & soft	0.1B		-		
: depth, <1.5 times draft	0.4B		-		
: cargo hazard, low	0				
Ship Lane Total	2.0B		1.8B	1.8B	
Bank Clearance	0.5B		0.6B	0.6B	100'
Tug Operation Area (>-25' Depth)	-		-	-	125'
Total Width	3.0B	2.5-3.0B	3.0B	3.0B	B@5°+200'
Total Width @ - 25' Depth					B@5°+250'
Total Width for Two -Way Traffic **(Add Basic Ship Lane & Passing Dist. of 1.2B for speed < 8kn & 1-3 vessels/hr)	5.5B**			5.8B	
DEPTH					
Depth/Draft ratio, sheltered	1.1		1.3		
Under keel Clearance	Greater than 1m	Greater than or equal to 2ft.	Greater than or equal to 2ft	Greater than or equal to 2ft.	Greater than or equal to 3ft.
ENTRANCE					
Breakwater Gap			0.8L		
Entrance Channel Length			12L		
TURNING BASIN DIAMETER					
180° turn	1.8-2L	1.2L			1.2L
BENDS					
Radius, < 25 angle		3-5L	3L		
Radius, 25° - 35° angle		5-7L	5L		
Radius, > 35° angle	9-12L	7-10L	10L		
Straight Distance Between	5L	5L	2L		
Width of Swept Track	1.2B	1.5-1.7B		2.6B	





5° crab:

180' → 290'

Increased path due to crab angle

Factors That Affect Channel Depth:



- Tidal change during transit and at berth
- Static draft
- Squat and dynamic list
 - 1° list = 1.6 feet deeper
 - 2° list = 3.1 feet deeper
 - 3° list = 4.7 feet deeper

More Factors Affecting Chan. Depth:



- Waves
- Net safety underkeel clearance
- Bed level uncertainty



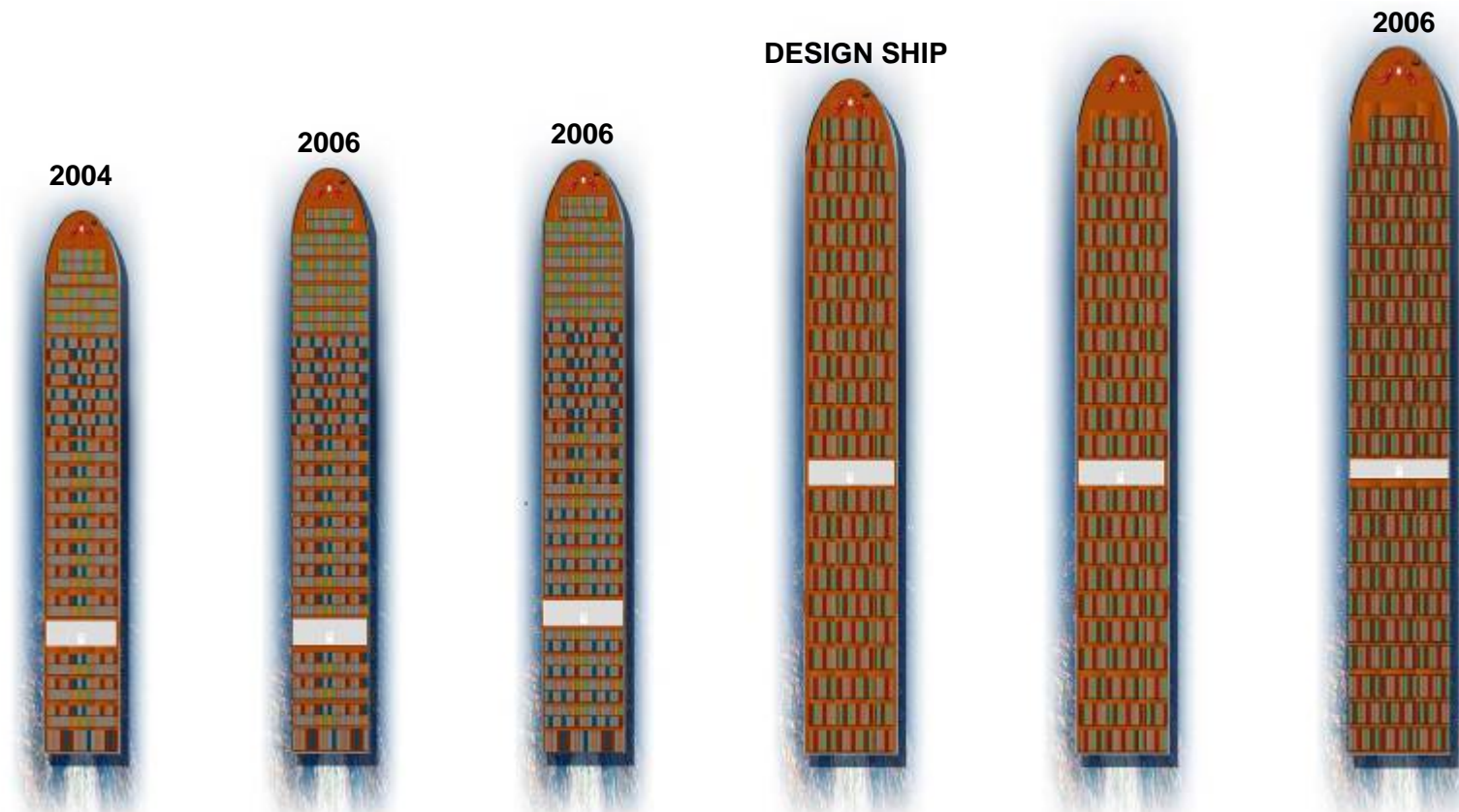
What Ship Size Should You Plan For?

* Based on specific Port of LB TEU Growth Rate
and Panama Canal Expansion Criteria

“New Panamax” Vessel is Defined as Follows:



- 10,000-12,000 TEU
- 105,000 Short Tons (DWT)
- 385.7m length (1,265 ft)
- 54.9m beam (180 ft) (22 container wide)
- 15.2m (50 ft) draft
- 61m (200 ft) air draft
 - Is this the future? It's here now



	6,000 TEU	8,000 TEU	10,000 TEU	10,000-12,000 TEU	12,000 TEU	14,000 TEU
AN. SHIP CALLS		>200				
LENGTH	985	1089'	1150'	1265'	??	1302'
BEAM	134	142'	150'	180'	??	184'
BOXES	16	19	18	22	??	22
DRAFT	47'	49'	49'	50'	??	51'
		MSC HEIDI	XIN LOS ANGELES	NEW PANAMAX	SUEZMAX	MAERSK EMMA

Recommended Dredge Depth:



Vessel Draft	-50.0
Minus Tide (So. Calif. Case)	-2.5
Underkeel Clearance	<u>-2.0</u>
	-54.5 feet (say -55')

-Stable Bottom (assumed)

-Protected Harbor (assumed)

What's Needed Waterside



Width (one-way)	490'*
Width (two-way)	1000'
Width @ Bends	1070'
Depth	55'
Depth @ Berth	53'*
Turning Basin Diameter	1500'

*Special LB Pilots Criteria

Bridge Air Drafts



<u>Bridge</u>	<u>Location</u>	<u>Air Draft</u>
Stonecutters	Hong Kong, China	241' (73.5m)
Vincent Thomas	Los Angeles	185' (56.4m)
Golden Gate	San Francisco	225' (68.6m)
Verrazano Narrows	NY/NJ	229' (69.8m)
Bayonne	NY/NJ	151' (46.0m)
Bridge of the Americas	Panama Canal (Pacific Entrance)	201' (61.3m)
Centennial	Panama Canal (Second Crossing)	262' (80m)
Cooper River	Charleston, SC	186' (56.7m)
Tallmadge	Savannah, GA	185' (56.4m)

Factors that Effect Ship Motion:



- Long Period Energy Moves Large Ships
- Problematic Basin are those with 90-120 Sec Natural Response Frequencies (Resonant Frequencies)
- “New Panamax” Size Shifts Response Away From 90-120 Sec Waves



How Does Ship Size Impact Wharf and Cranes?

What Will Be Needed Landside?

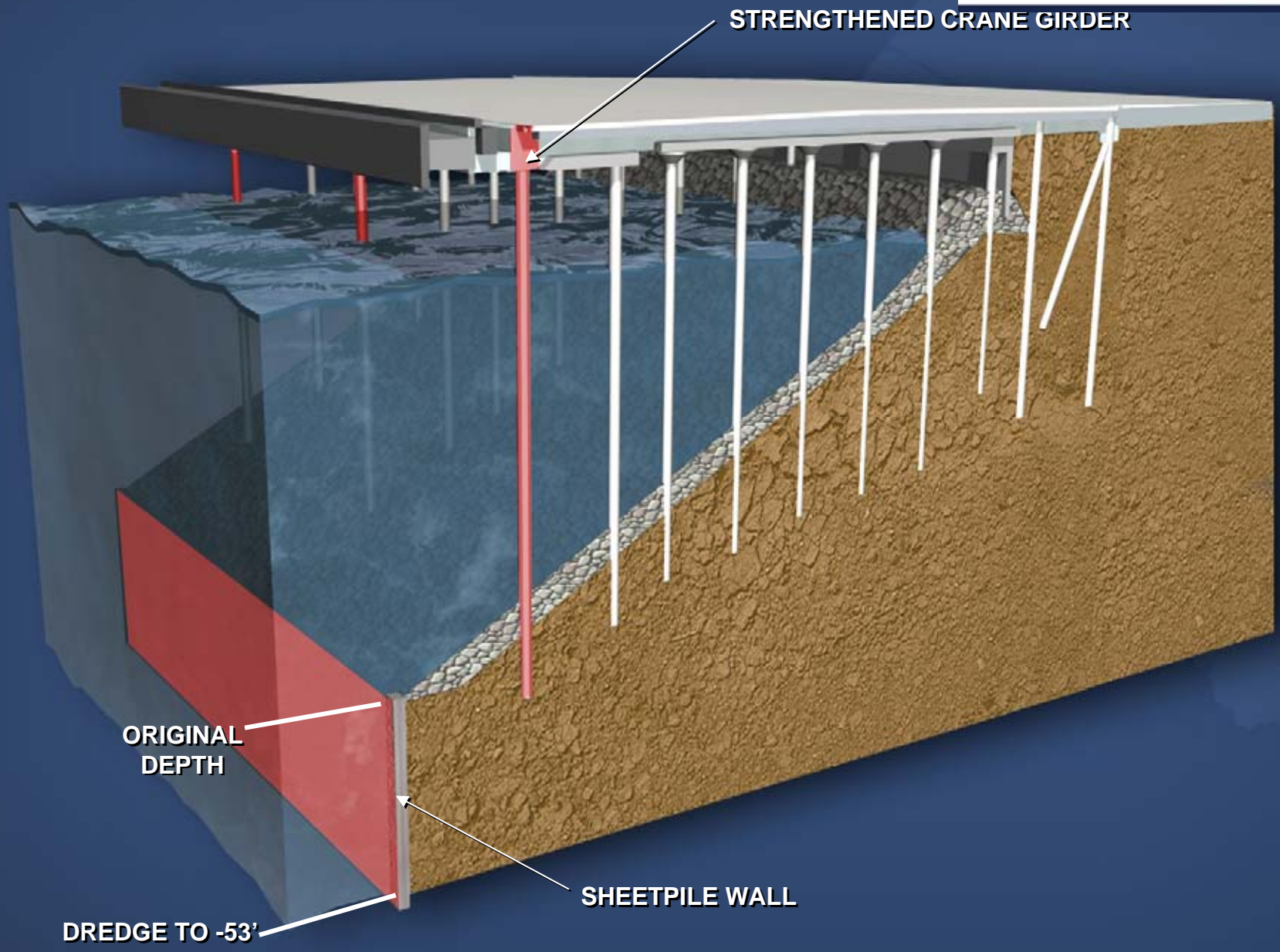


- Wharf Structure Strengthening
 - Depth
 - Crane Loads
 - Fendering/Mooring
- Crane Upgrades
 - Rope Lengths
 - Wheel Modifications
 - Replacement/More Cranes?
- Terminal Equipment Transformation
- Ship-in-Slip?





Modified Wharf



STRENGTHENED CRANE GIRDER

ORIGINAL DEPTH

SHEETPILE WALL

DREDGE TO -53'

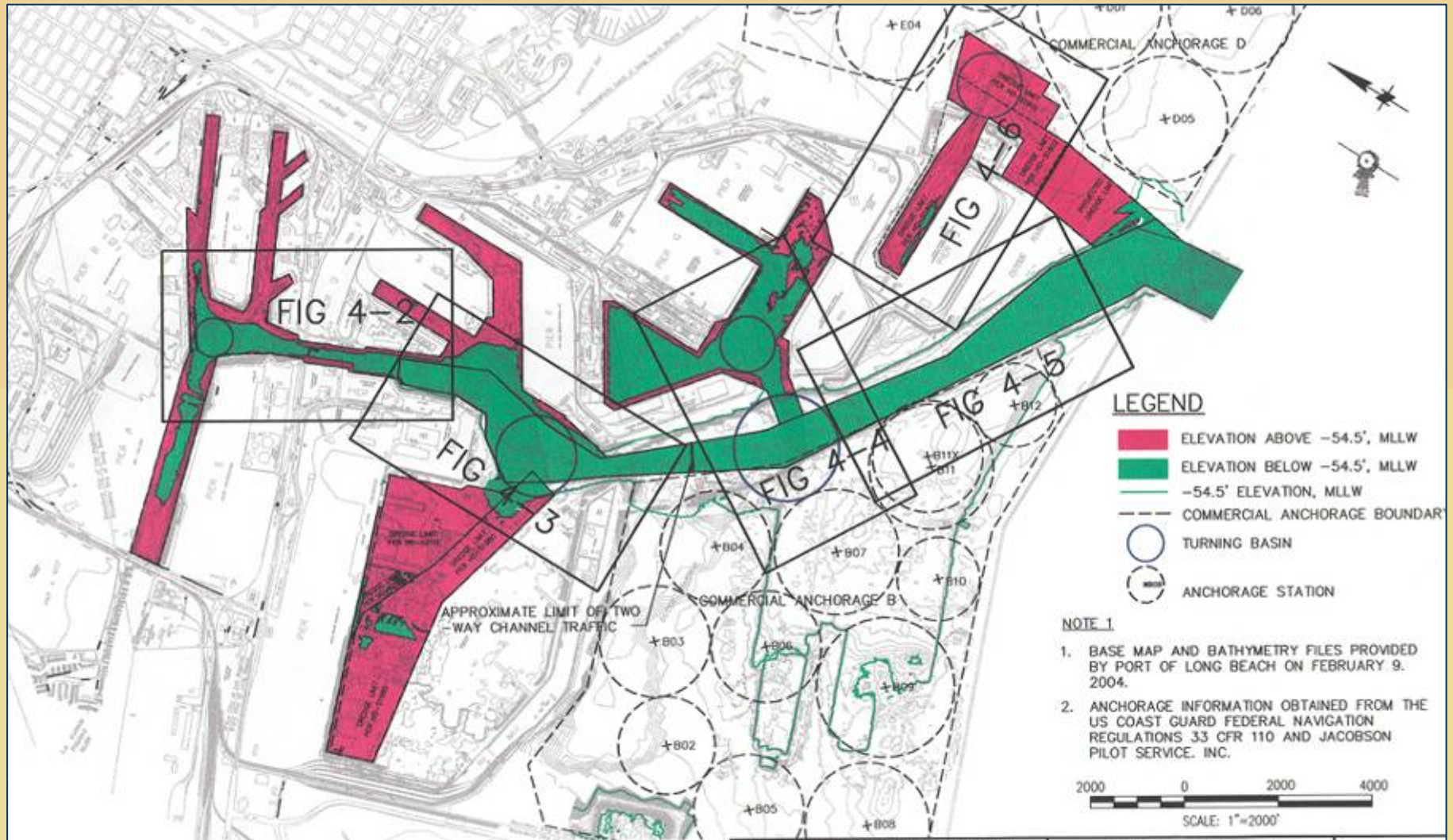
What's Needed at Wharf



Fender Capacity	460 ft/kips
Mooring Capacity	200 tons
Spreader Clearance	120 ft
Crane Outreach	201 ft (22 wide)
Ship Power	7.5+ MVA Min



How Do the Requirements Compare to What your Port Has? (Long Beach Example)



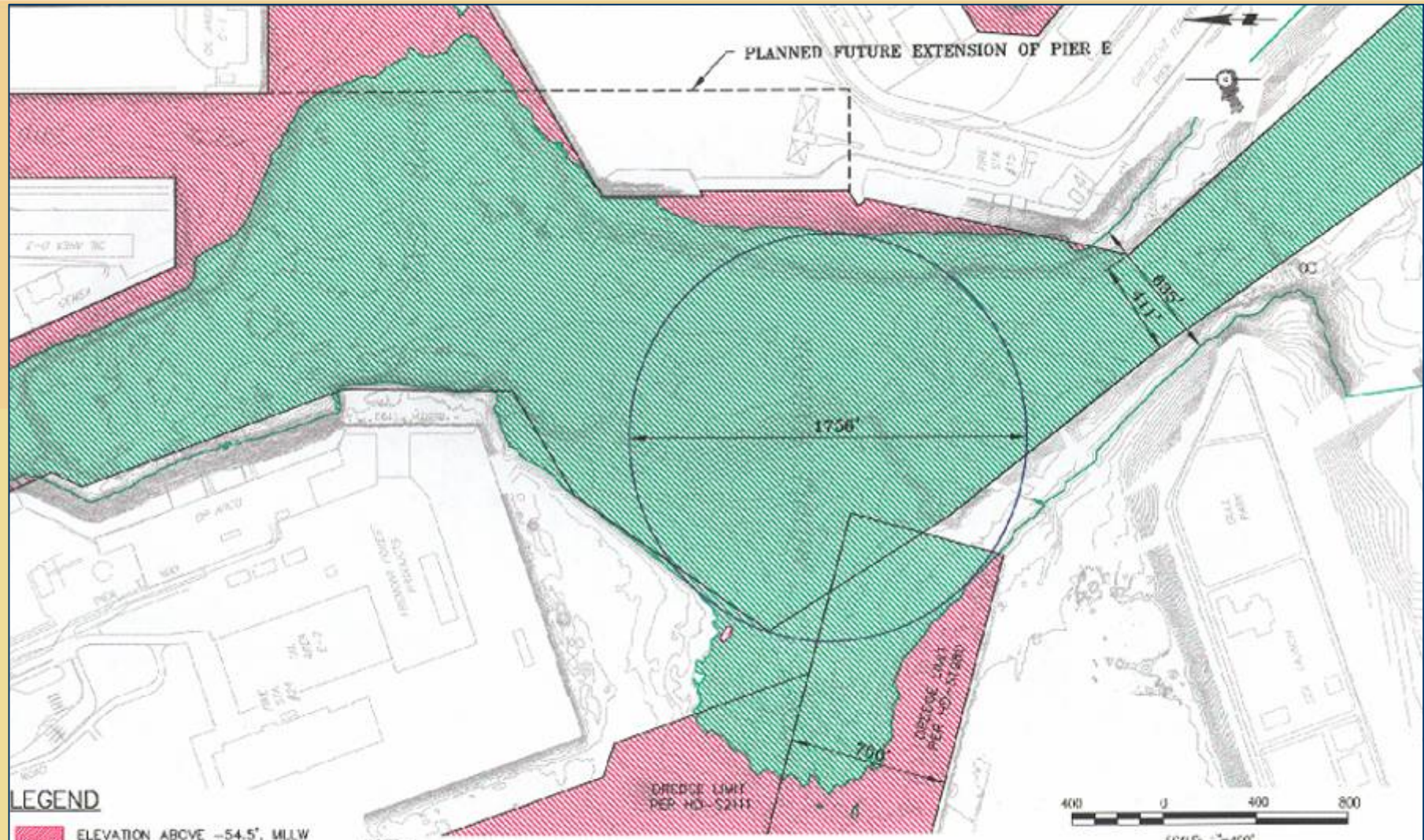
LEGEND

- ELEVATION ABOVE -54.5', MLLW
- ELEVATION BELOW -54.5', MLLW
- 54.5' ELEVATION, MLLW
- COMMERCIAL ANCHORAGE BOUNDARY
- TURNING BASIN
- ANCHORAGE STATION

- NOTE 1**
1. BASE MAP AND BATHYMETRY FILES PROVIDED BY PORT OF LONG BEACH ON FEBRUARY 9, 2004.
 2. ANCHORAGE INFORMATION OBTAINED FROM THE US COAST GUARD FEDERAL NAVIGATION REGULATIONS 33 CFR 110 AND JACOBSON PILOT SERVICE, INC.



MOFFATT & NICHOL 250 WARDLOW ROAD LONG BEACH, CALIFORNIA, 90807 562-426-9551		PORT OF LONG BEACH "NEW PANAMAX" VESSEL STUDY		DATE 7-15-04
		EXISTING CHANNEL WIDTH INDEX MAP		SHEET OF
GGN ADD NO.	GLL SUBMITTED BY	DR TITLE	GLL DATE	EDA FILE



LEGEND

- ELEVATION ABOVE -54.5', MLLW
- ELEVATION BELOW -54.5', MLLW
- 54.5' ELEVATION, MLLW
- COMMERCIAL ANCHORAGE BOUNDARY
- TURNING BASIN

NOTE 1

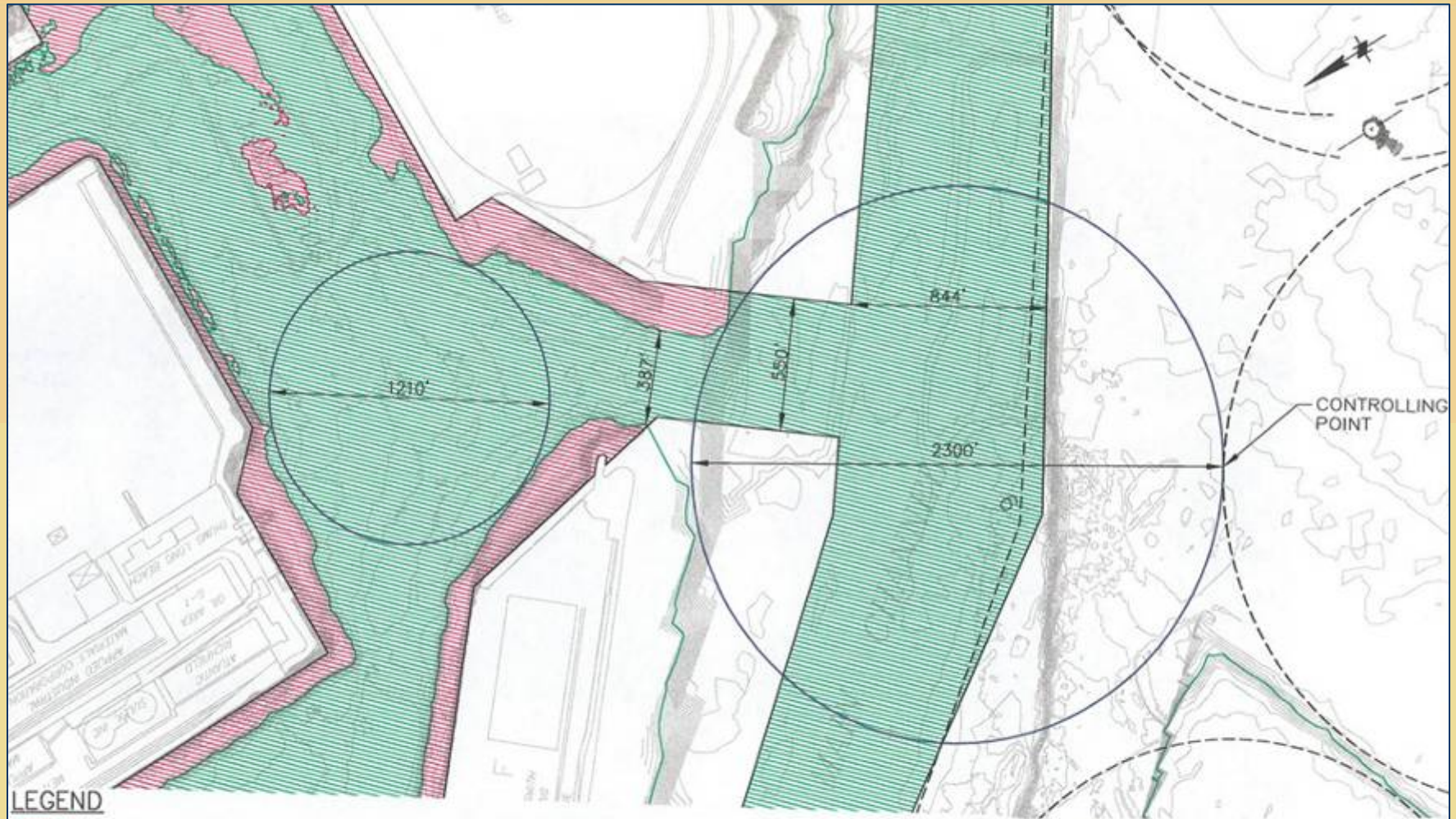
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MOFFATT & NICHOL
 7700 MARITIME BLVD
 LONG BEACH, CALIFORNIA, 90807
 562-426-9551

DATE	BY	CHK	EVA
APP NO.	SUBMITTED BY	DATE	

PORT OF LONG BEACH
"NEW PANAMAX" VESSEL STUDY
 EXISTING CHANNEL WIDTH
 MIDDLE HARBOR

DATE	7-15-04
SHEET	OF
FIG 4-3	



LEGEND

- ELEVATION ABOVE -54.5', MLLW
- ELEVATION BELOW -54.5', MLLW
- 54.5' ELEVATION, MLLW
- COMMERCIAL ANCHORAGE BOUNDARY
- TURNING BASIN
- ANCHORAGE STATION

NOTE 1

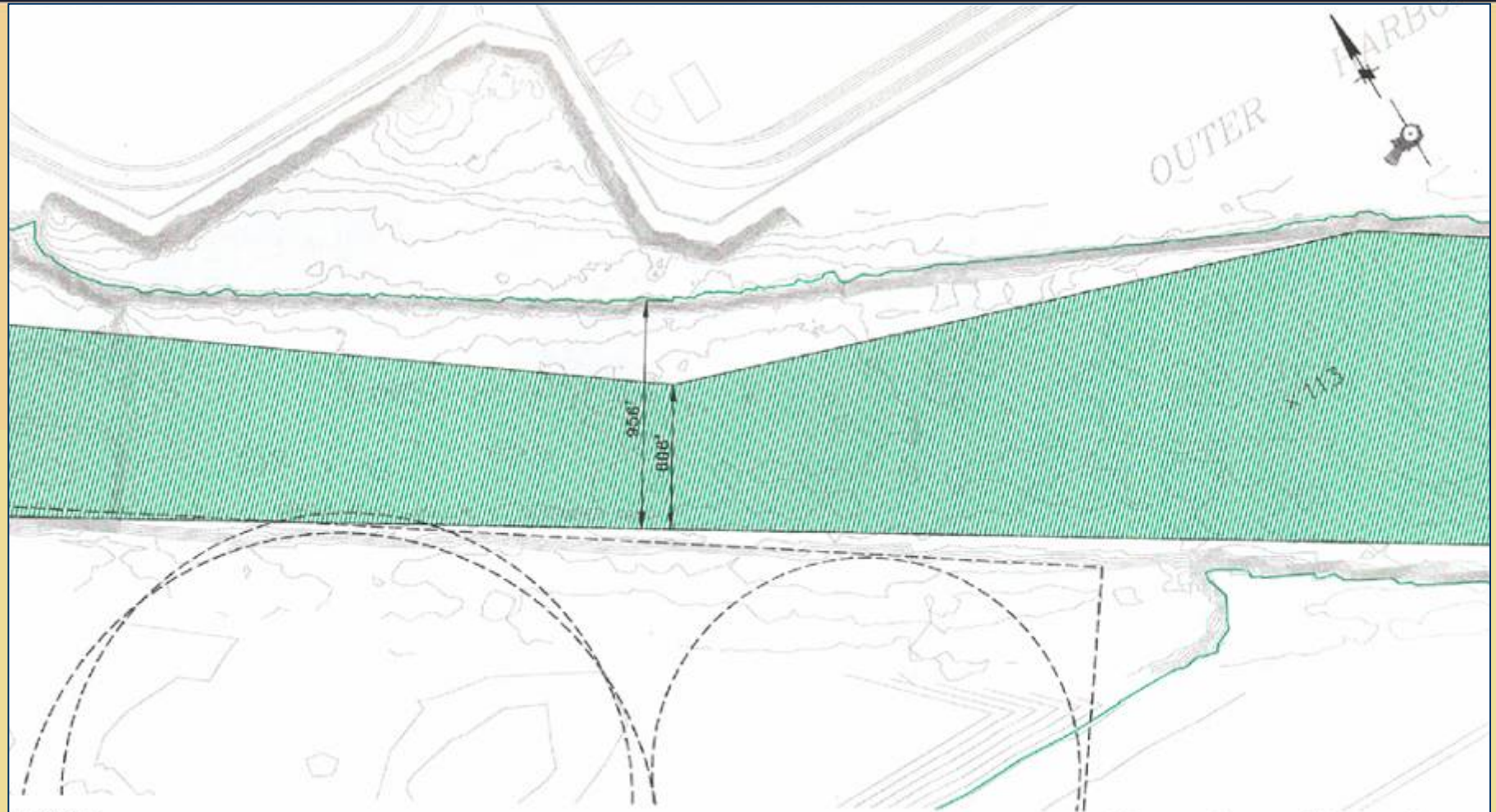
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MOFFATT & NICHOL
 250 WARDLOW ROAD
 LONG BEACH, CALIFORNIA, 90807
 562-426-9551






DESIGN	GLL	DR	GLL	CHK	EDA
JOB NO.	SUBMITTED BY		TITLE		

PORT OF LONG BEACH
 "NEW PANAMAX" VESSEL STUDY
 EXISTING CHANNEL WIDTH
 MAIN CHANNEL

DATE	7-15-04
SHEET	OF
FIG 4-4	



LEGEND

-  ELEVATION ABOVE -54.5', MLLW
-  ELEVATION BELOW -54.5', MLLW
-  -54.5' ELEVATION, MLLW
-  COMMERCIAL ANCHORAGE BOUNDARY
-  ANCHORAGE STATION

NOTE 1

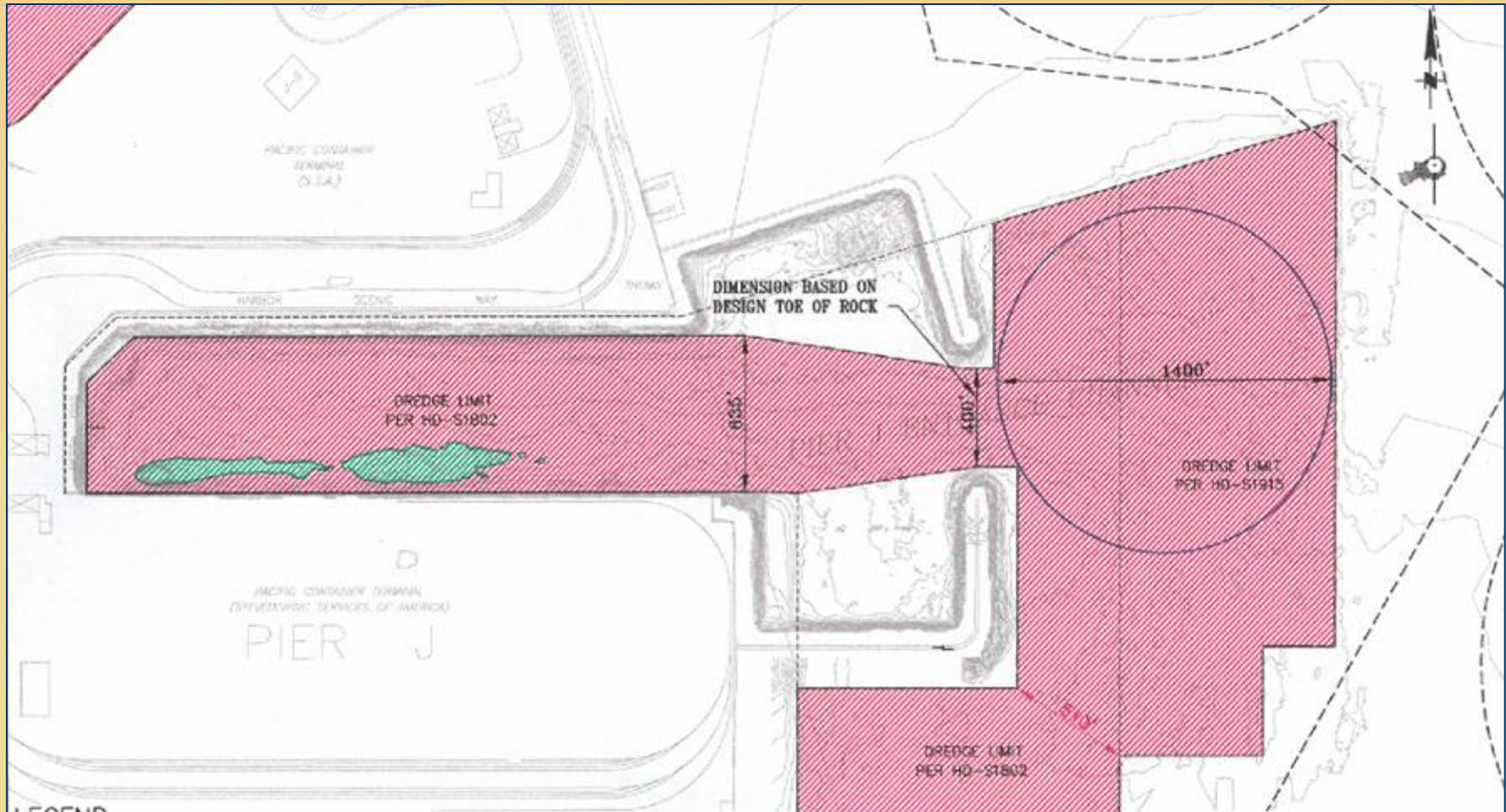
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 LONG BEACH, CALIFORNIA, 90807
 562-426-9551

DRN	GLL	DR	GLL	CHK	EDA
DATE	DATE	DATE	DATE	DATE	DATE

PORT OF LONG BEACH
 "NEW PANAMAX" VESSEL STUDY
 EXISTING CHANNEL WIDTH
 MAIN CHANNEL

DATE	7-15-04
SHEET	OF
FIG 4-5	



LEGEND

- ELEVATION ABOVE -54.5', MLLW
- ELEVATION BELOW -54.5', MLLW
- 54.5' ELEVATION, MLLW
- COMMERCIAL ANCHORAGE BOUNDARY
- TURNING BASIN
- ANCHORAGE STATION

NOTE 1

1. BASE MAP AND BATHYMETRY FILES PROVIDED BY PORT OF LONG BEACH ON FEBRUARY 9, 2004.
2. ANCHORAGE INFORMATION OBTAINED FROM THE US COAST GUARD FEDERAL NAVIGATION REGULATIONS 33 CFR 110 AND JACOBSON PILOT SERVICE, INC.

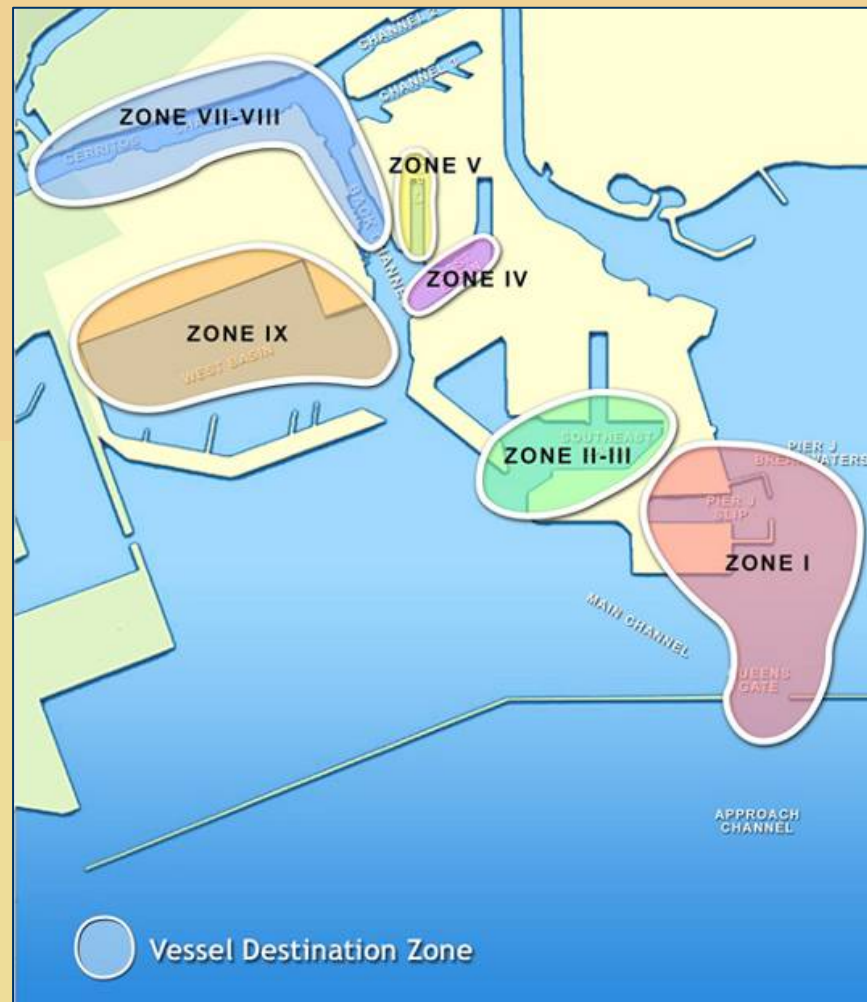
MOFFATT & NICHOL
 250 WARDLOW ROAD
 LONG BEACH, CALIFORNIA 90807
 562-426-9551

DRAWN	G.L.	CHK	G.L.
DATE	G.L.	CHK	E.D.A.
JOB NO.	4639-14.2	DESIGNED BY	E.M.
		CHECKED BY	E.M.

PORT OF LONG BEACH
 "NEW PANAMAX" VESSEL STUDY
 EXISTING CHANNEL WIDTH
 PIER J CHANNEL

DATE	7-10-04
SHEET	OF
FIG 4-6	

Costs by Destination Zone



Infrastructure NOT Dependent on Ship Size

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- Terminal Size
- Gate Size
- Yard Equipment
- Pavement
- Railyard Size

One 10,000 TEU Ship = Two 5,000 TEU Ships

Terminal Size Dependent Upon:

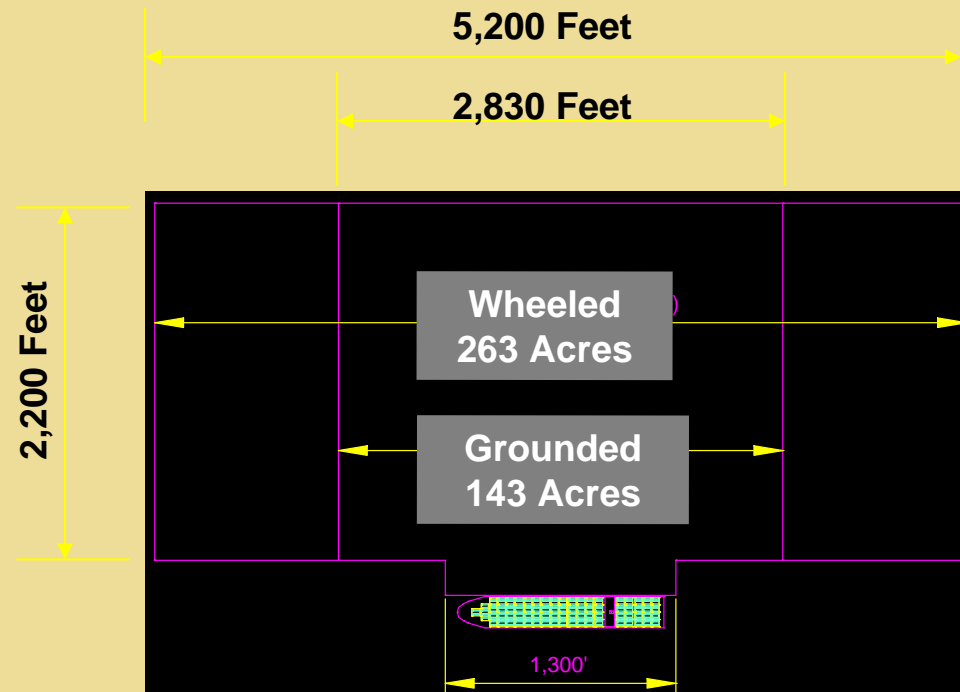


- Containers Discharged/Loaded per Day
- Dwell Time
- Storage Mode
- Intermodal Yard Operation – Hot Boxes Vs. Steady State

Terminal Area Requirements (12,000 TEU Vessel)



- 12,000 TEU Container Ships in a Weekly Rotation
- 85% Average Discharge / Load
- 1,000,000 TEU's / Year
- Wheeled: 3,800 TEU's / Acre / Year = 263 Acres
- Grounded: 7,000 TEU's / Acre / Year = 143 Acres



IY Size Dependent Upon:



- Volume of Intermodal Boxes
- Hot Boxes Vs. Steady State
- Ship Arrival Schedule

Other Infrastructure Challenges:



- Growing highway volume and congestion
 - 12,000 TEU → 24 trains or 6,800 trucks
- Rail terminal and mainline capacity/velocity
- All, however, are problems of growth, requiring more investment and labor

Initiatives to Deal with these Challenges

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- Extended Gate Hours
- Congestion Pricing (Pier Pass)
- Shuttle Trains
- Virtual Container Yards
- Enhanced On-Dock Rail
- Dedicated Truckways
- Inland Port Concepts

What the Ports Need to Consider :



- Time to Get Permits!!
- Acceptable Channel Dimensions
- Logical Areas to Dredge
- Options
 - Zones to Pursue
 - Ship-in-Slip Potential
- Forward Plan
 - Mid Term VS. Long Term
 - Studies (Forecasts, Engineering)
- Terminal Transformation Issues
- Off Terminal Impacts
 - Road
 - Rail



THE END
THANKS FOR LISTENING





Impact of Large Container Ships on Port Infrastructure

E. D. Allen, *Moffatt & Nichol*

September 30th - October 4th

