Accommodating Larger Vessels: Ship Maneuverability and Channel Depth;

A discussion of vessel motion in shallow water and future research needs.

PANELISTS:

Paul Amos: President, Columbia River Pilots.

Larry Daggett: Vice President, Waterway Simulation Technology. Previously with Army Corps ERDC labs.

Dan Jordan: Columbia River Bar Pilot, currently involved in a study of vessel dynamics on the Columbia River Bar.

Mike Morris: Houston Ship Channel Pilot.

Eric Burnette: Sr. Waterways Planner, Port of Portland, Oregon (moderator).

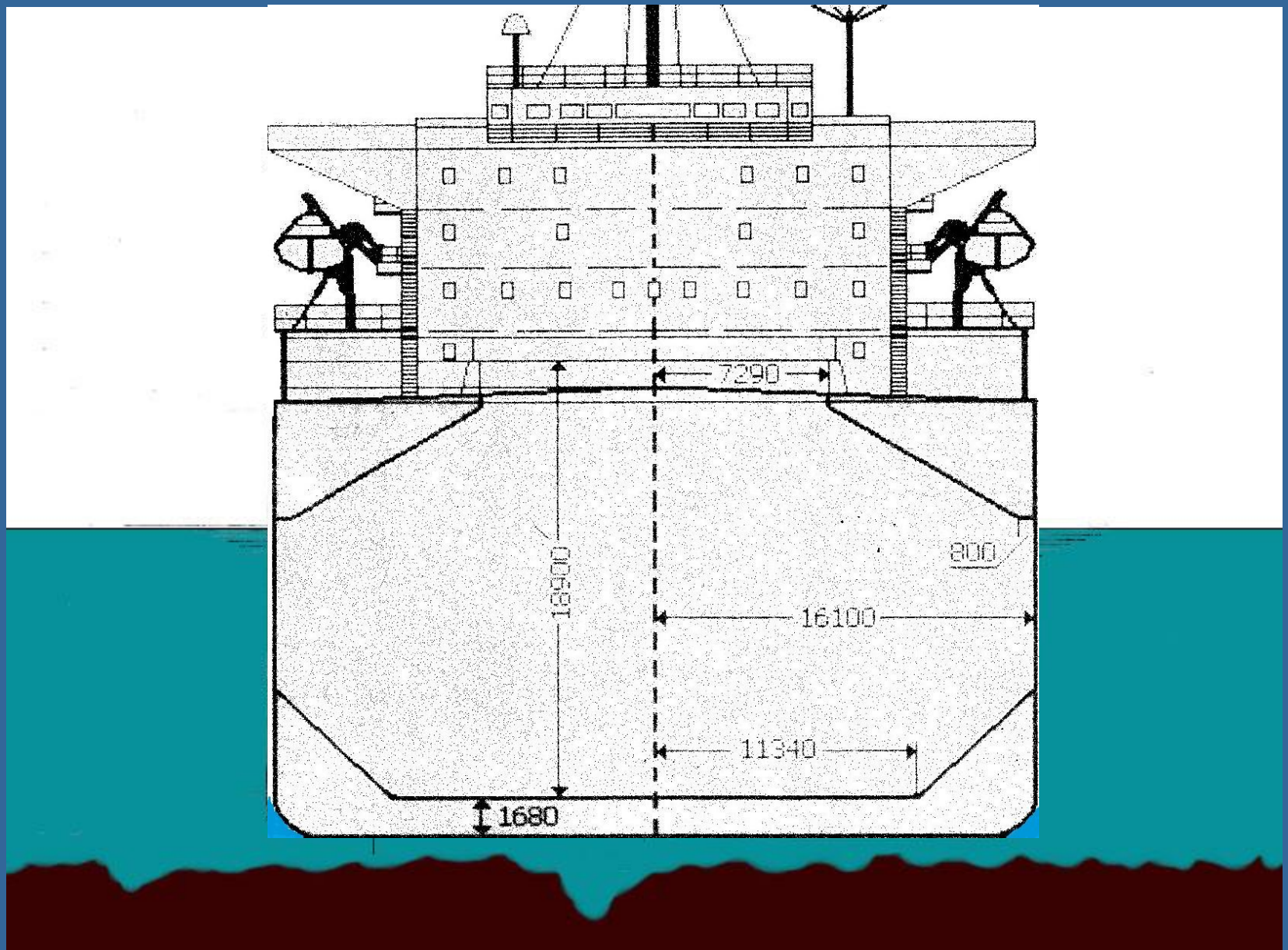
Big Ships in Small, Shallow Channels

- Deepened Channels – same width
  - Same ship
    - Deeper Draft
    - More Mass
    - Same power; rudder
    - More exposure to currents
    - Larger bank effects
    - Smaller percentage under keel clearance to draft
    - More difficult to control, sluggish response
    - Cross-current effects more pronounced
    - Harder to slow and stop
    - Most likely narrower channel; deepening along existing slopes to save dredging

Big Ships in Small, Shallow Channels

- Deepened Channel – Larger Ships
  - Longer the existing ships
  - More exposure to currents/leverage arm longer
  - Larger bank effects
  - Smaller under keel clearance to draft
  - More mass
  - Harder to steer
  - May have more power; larger rudder
  - Probably wider; more channel blockage
  - Less room to meet another ship
  - More pronounced ship response (squat) during meeting
  - Probably more air draft; less clearance to bridges/power lines, etc.
  - Channel is probably narrower due to dredging on same slopes to reduce dredging

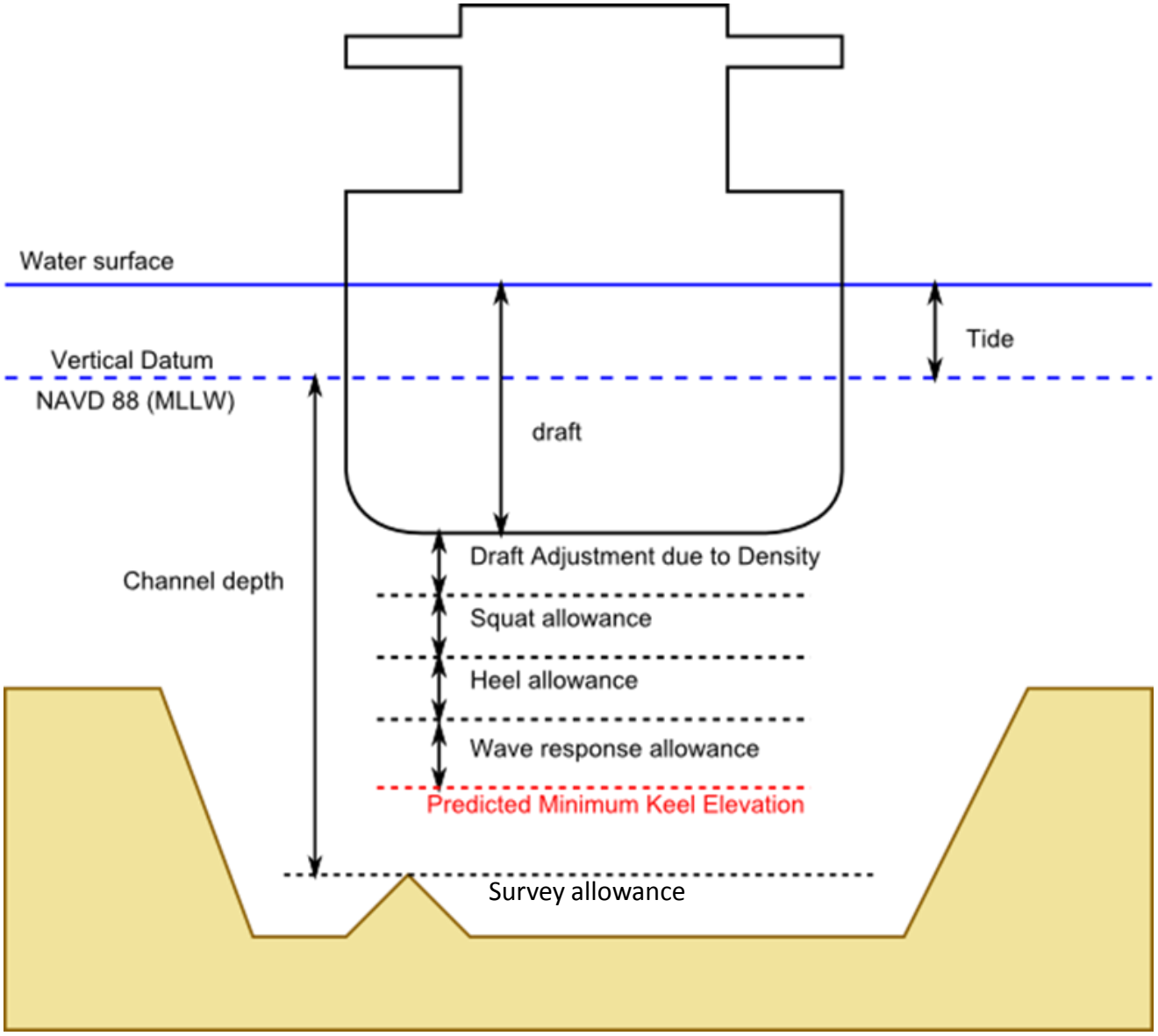
Real Scale in Calm Water



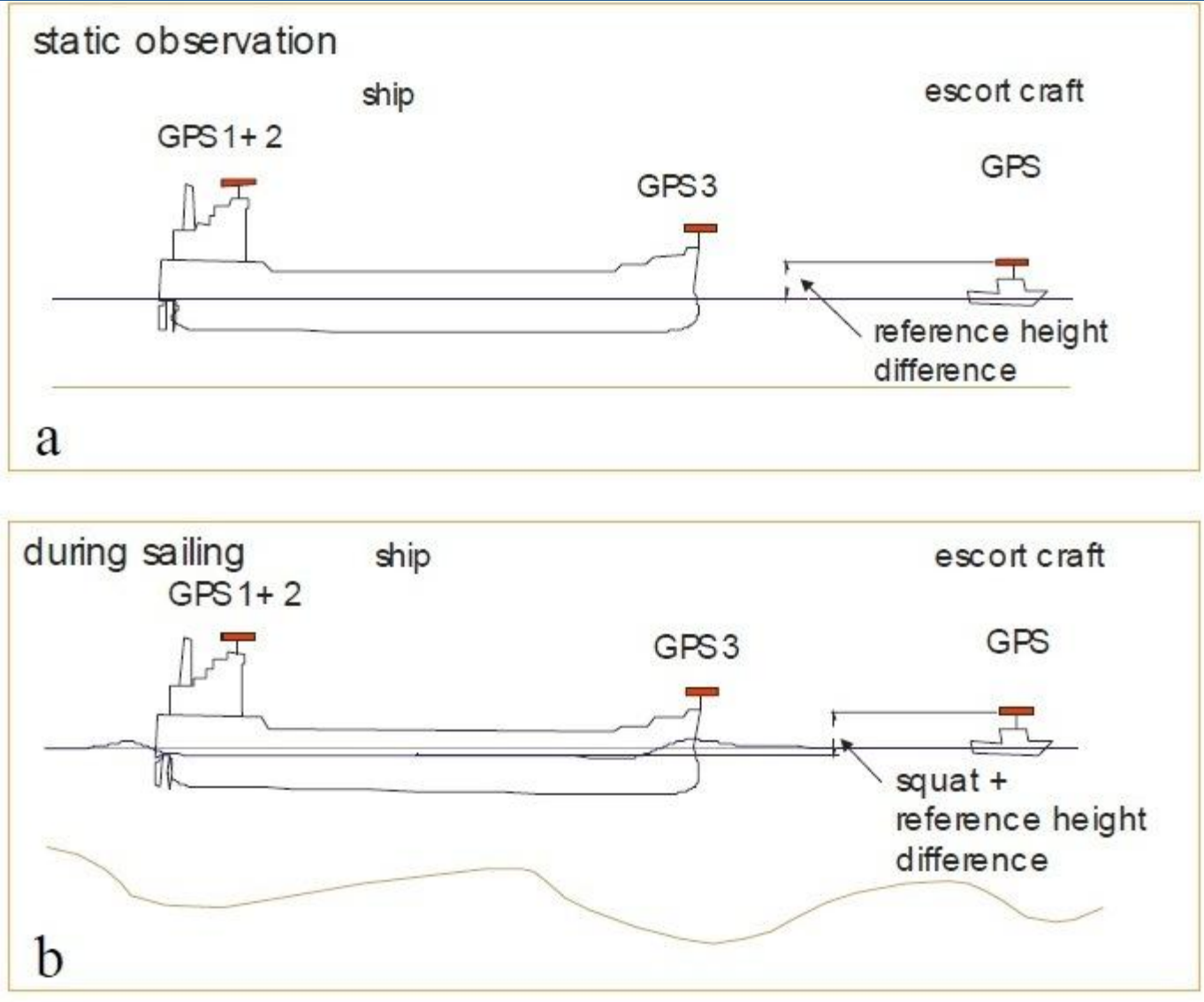
An operational view of **Vessel Motions**

Squat / Sinkage
Heel / Roll
Pitch / Wave Response

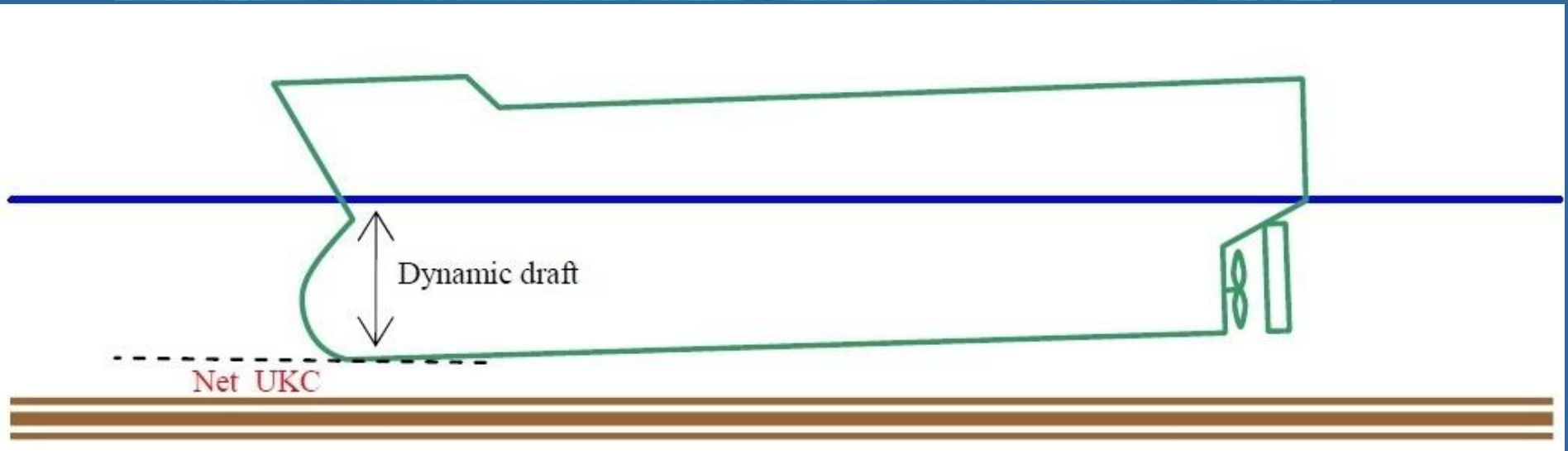
Components of Under Keel Clearance



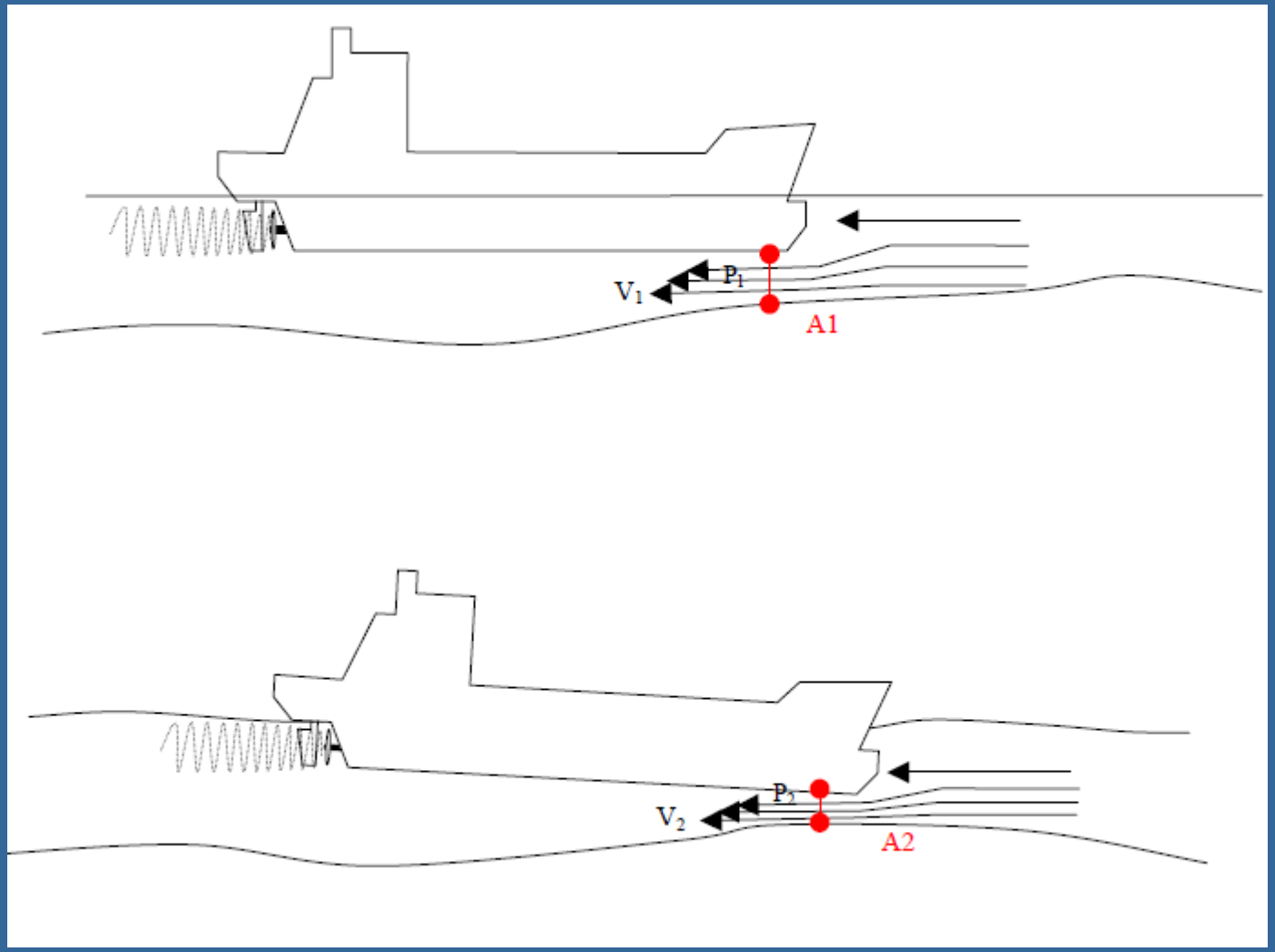
Vessel Motion Analysis



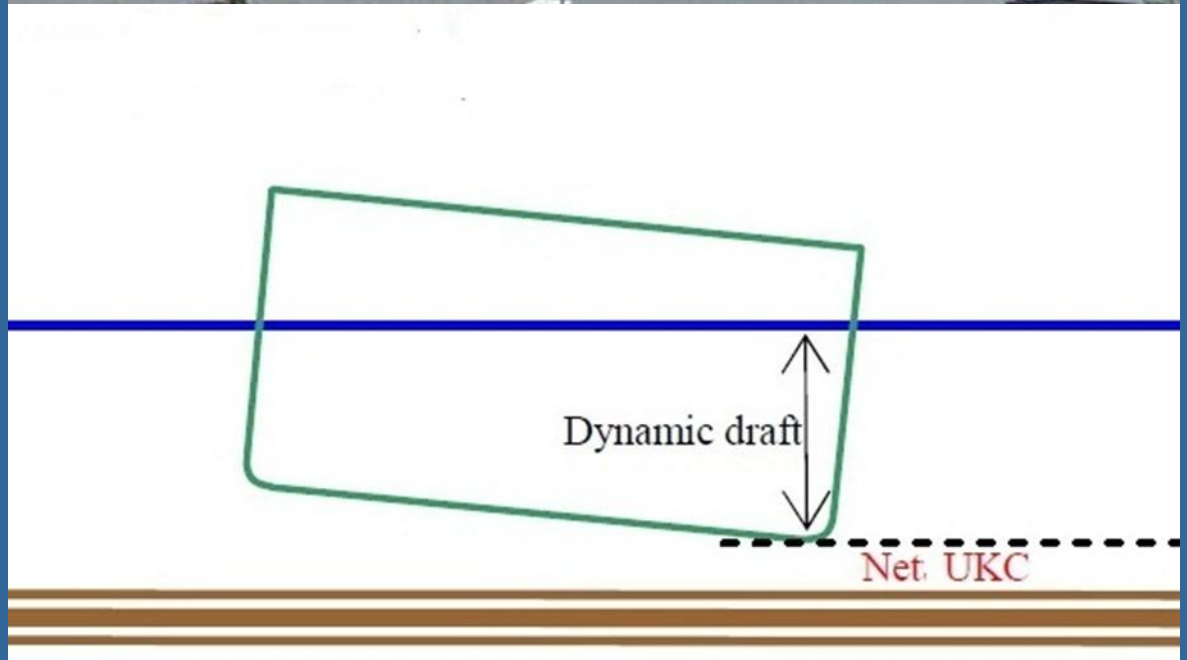
Squat / Sinkage



Squat changes with speed and bottom contours



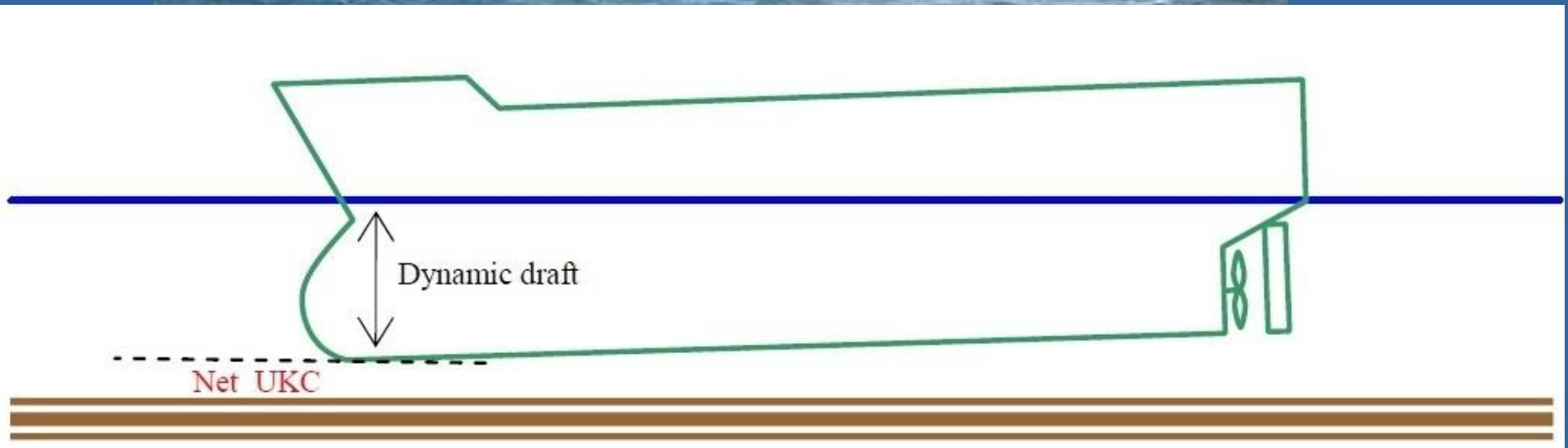
Roll / Heel



Increase of Draft due to List

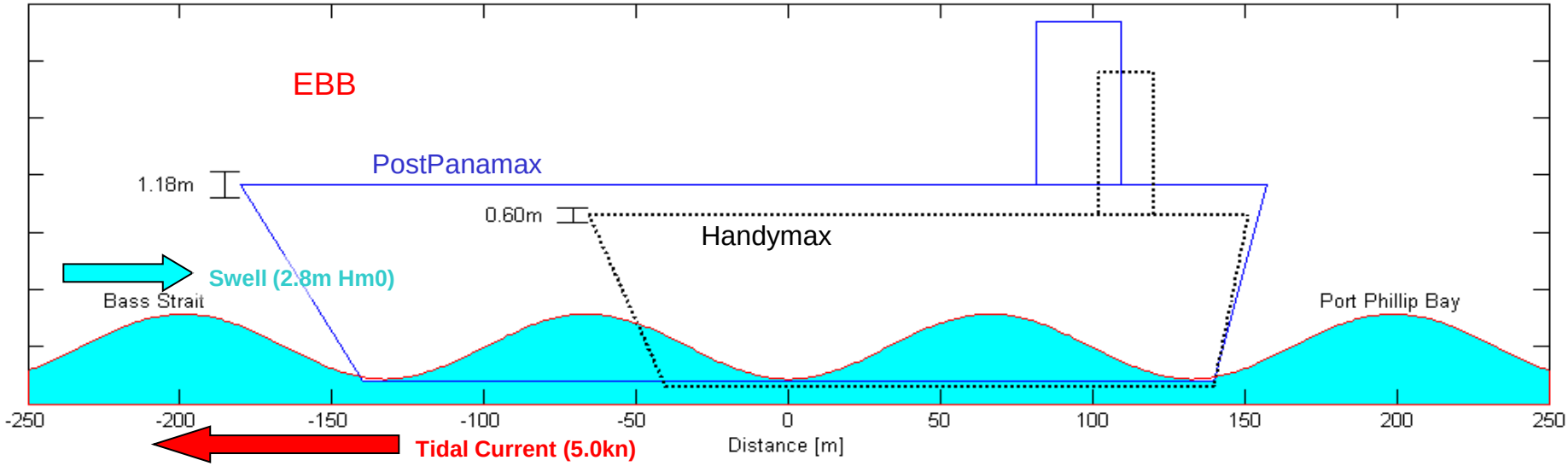
Beam	1º	2º	3º
60’	0.52’	1.05’	1.57’
80’	0.70’	1.40’	2.09’
100’	0.87’	1.75’	2.62’
110’	0.96’	1.92’	2.88’
120’	1.05’	2.09’	3.14’
140’	1.22’	2.44’	3.66’
160’	1.40’	2.79’	4.19”

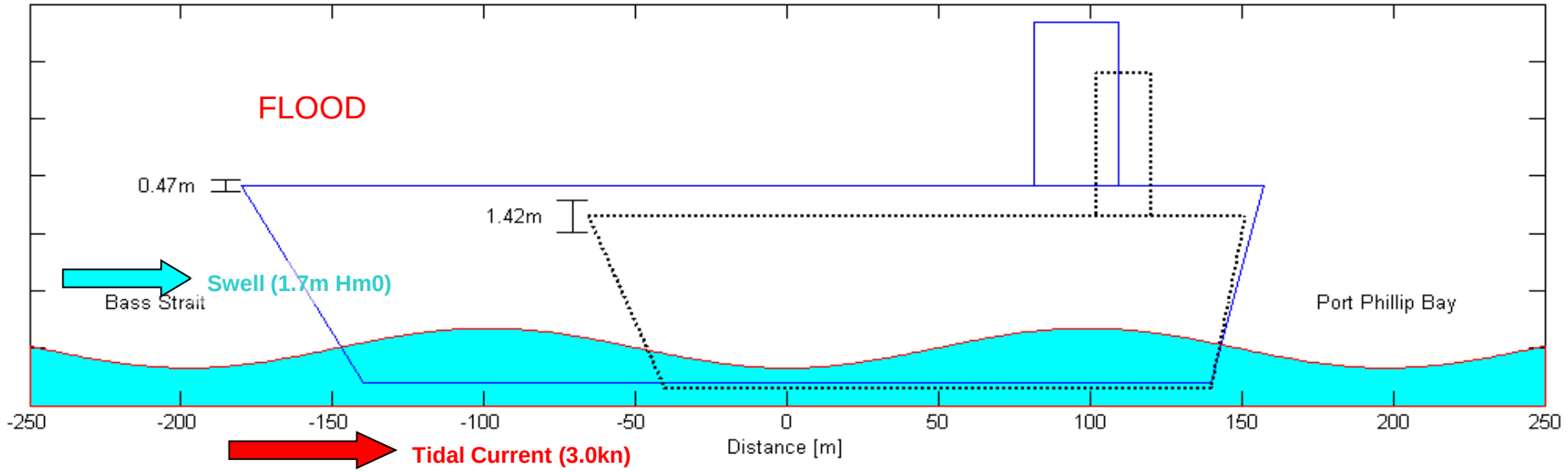
Wave Response



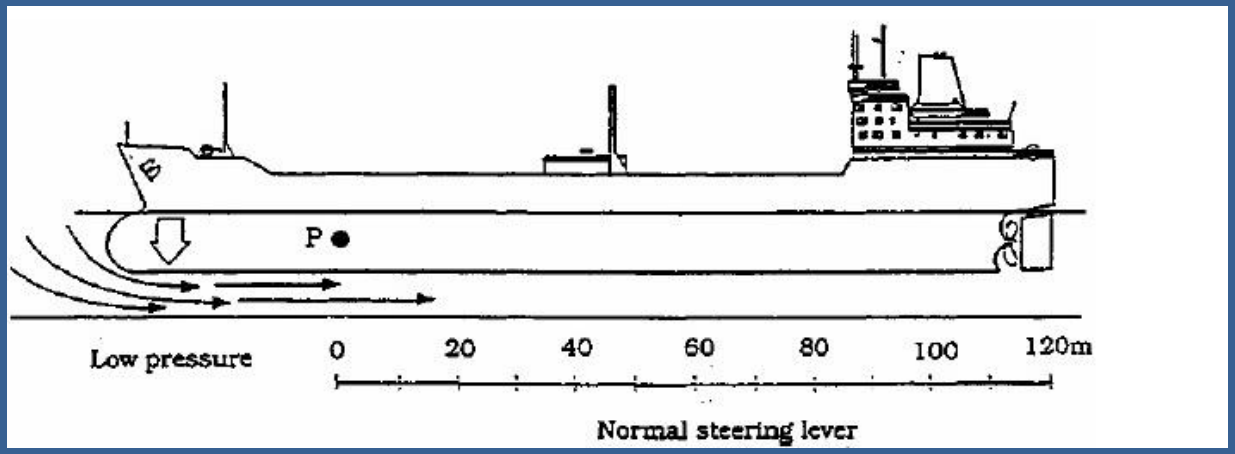
Wave Response

Offshore Swell height = 2m, period = 14 seconds

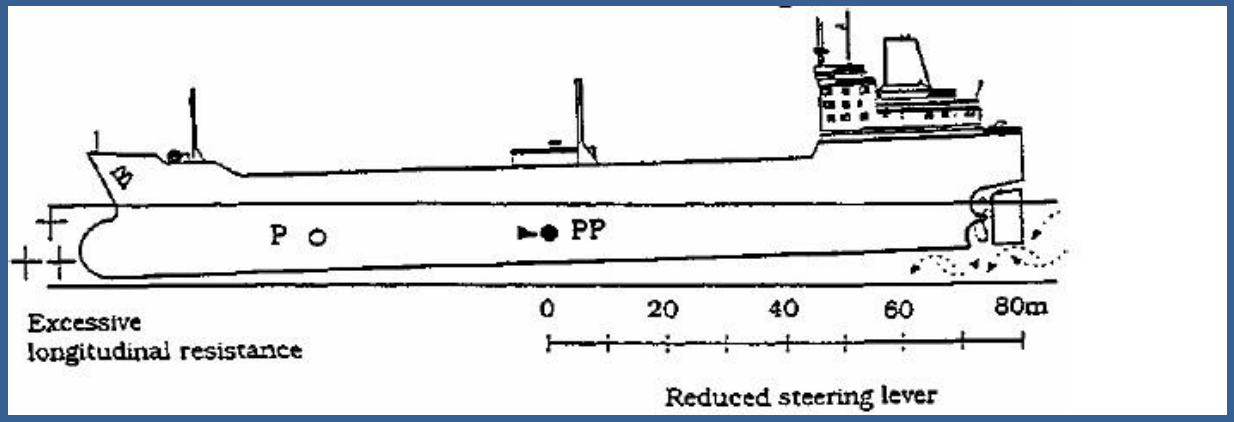




Effects of Squat on Vessel Maneuverability

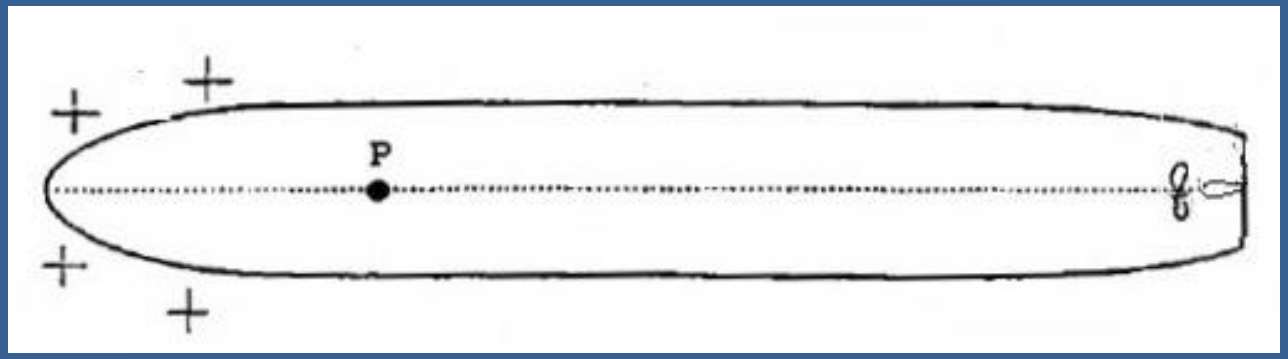


Directionally Stable with Pivot Point forward

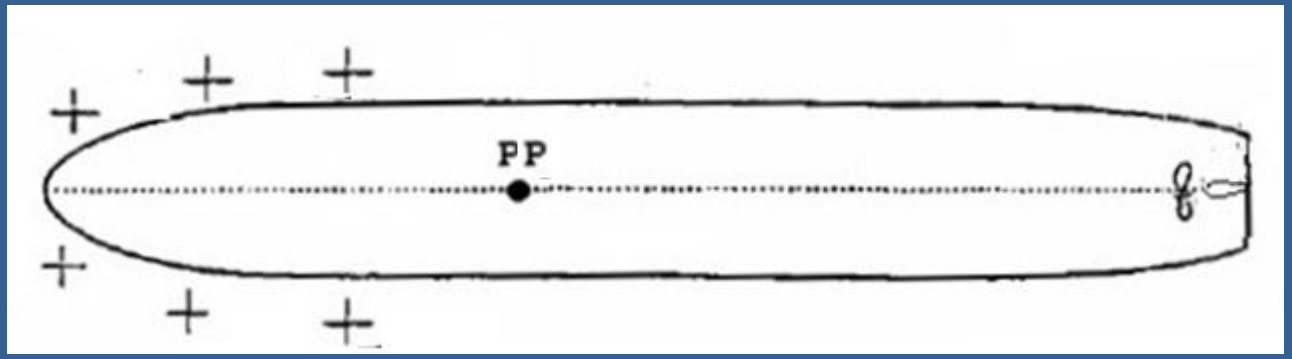


Directionally Unstable with Pivot Point aft

Effects of Squat on Vessel Maneuverability

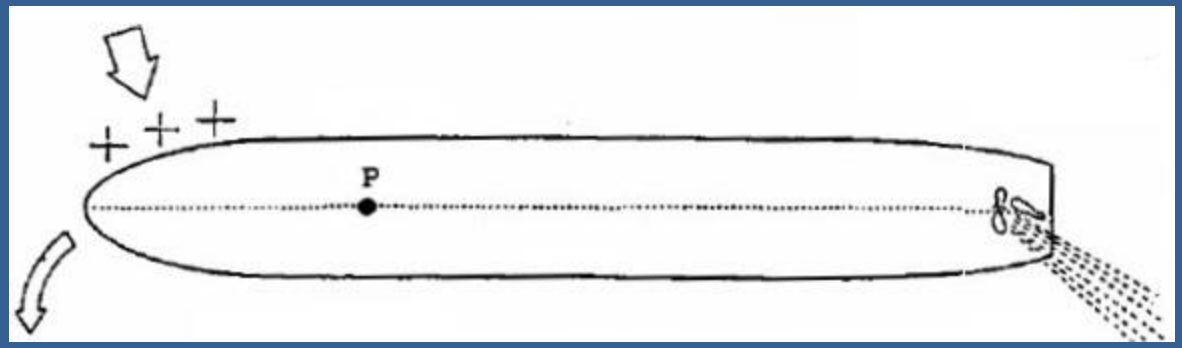


Normal Bow Pressure with Pivot Point forward

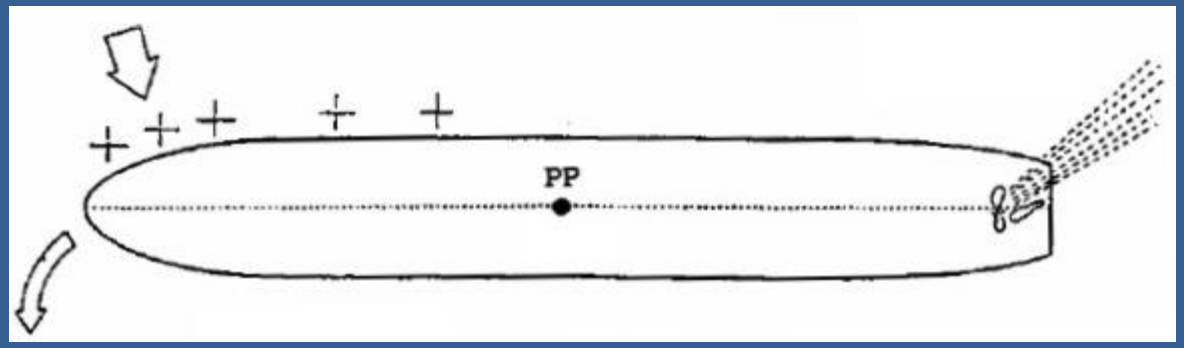


Increased Bow Pressure with Pivot Point aft

Effects of Squat on Vessel Maneuverability

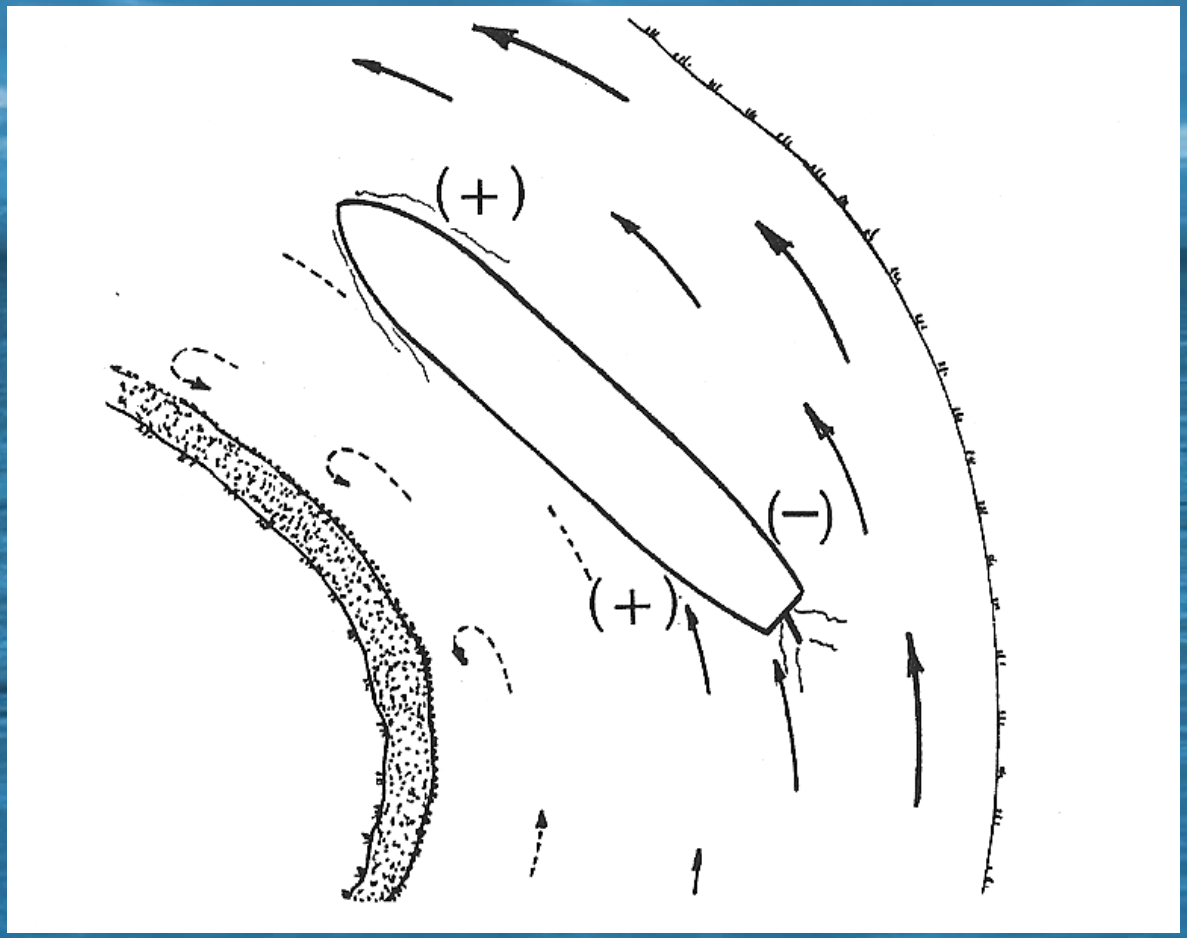


Normal turning forces



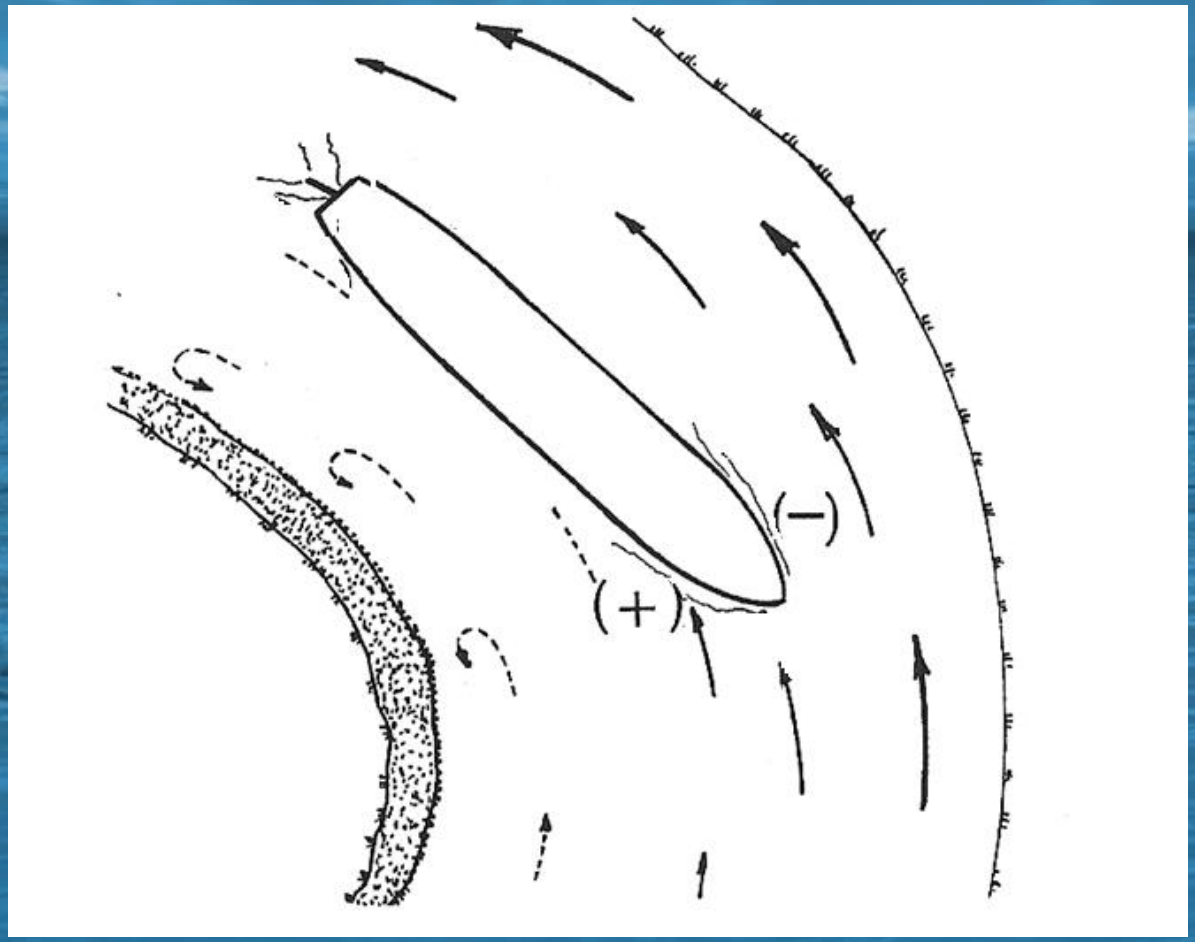
Increased bow pressure and shortened steering lever make turns difficult to control

Effects of Current on Vessel Maneuverability



A following current can increase the rate of turn

Effects of Current on Vessel Maneuverability



An opposing current can decrease the rate of turn

Swept Path

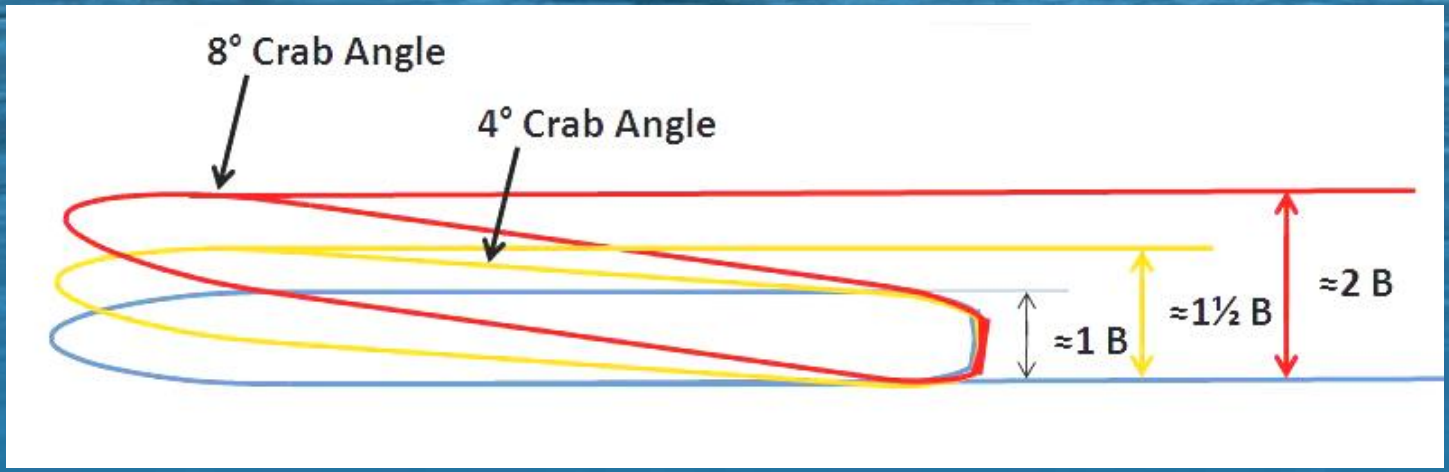
Examples

600’ x 106’ (Handy-max) with 1° leeway will have a 116.4’ actual beam width

800’ x 142’ (Afro-max) with 3° leeway will have a 183.7’ actual beam width

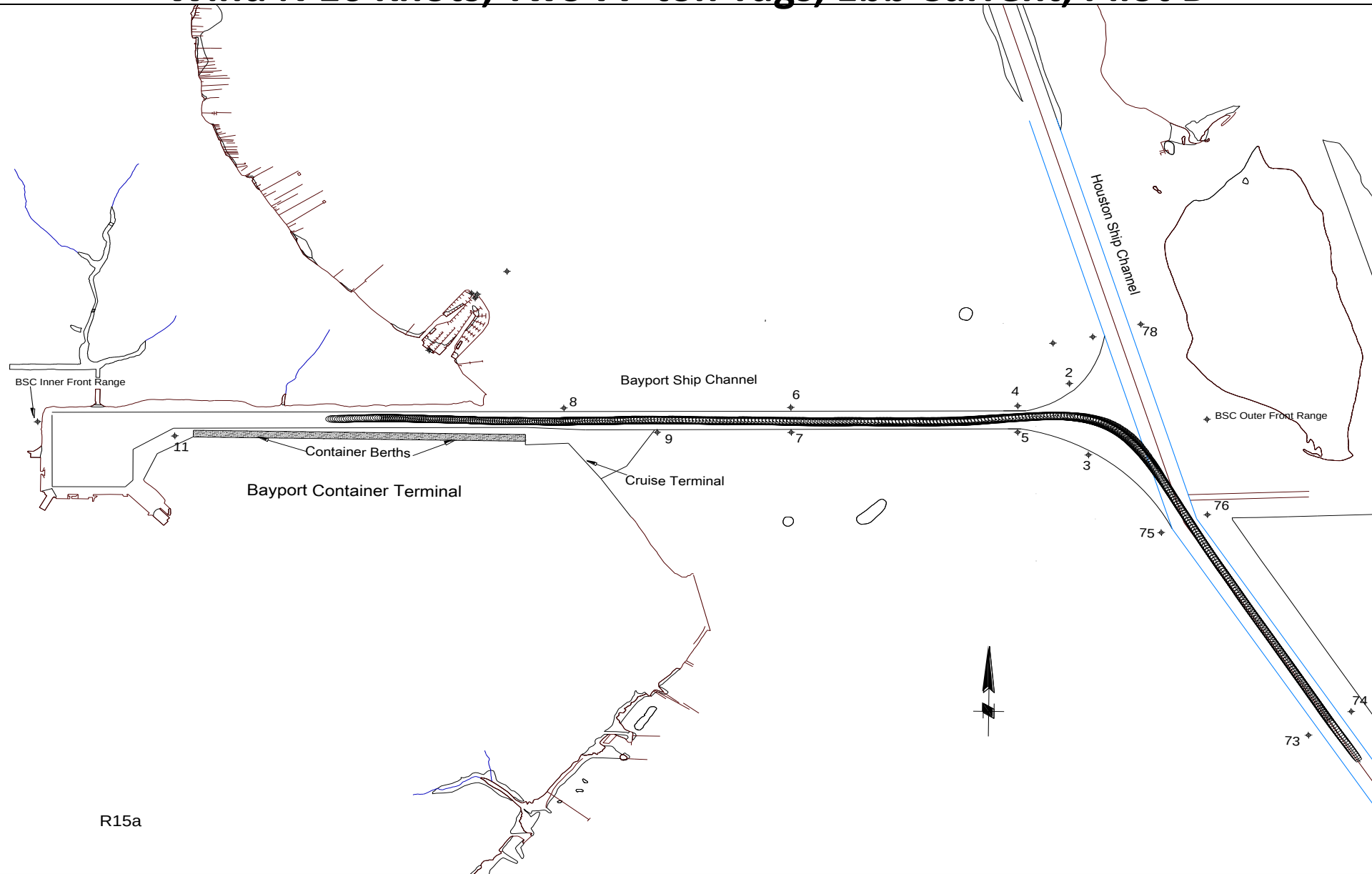
1100’ x 141’ (Container) with 4° leeway will have a 217.4’ actual beam width

1100’ x 141’ (Container) with 8° leeway will have a 292.7’ actual beam width



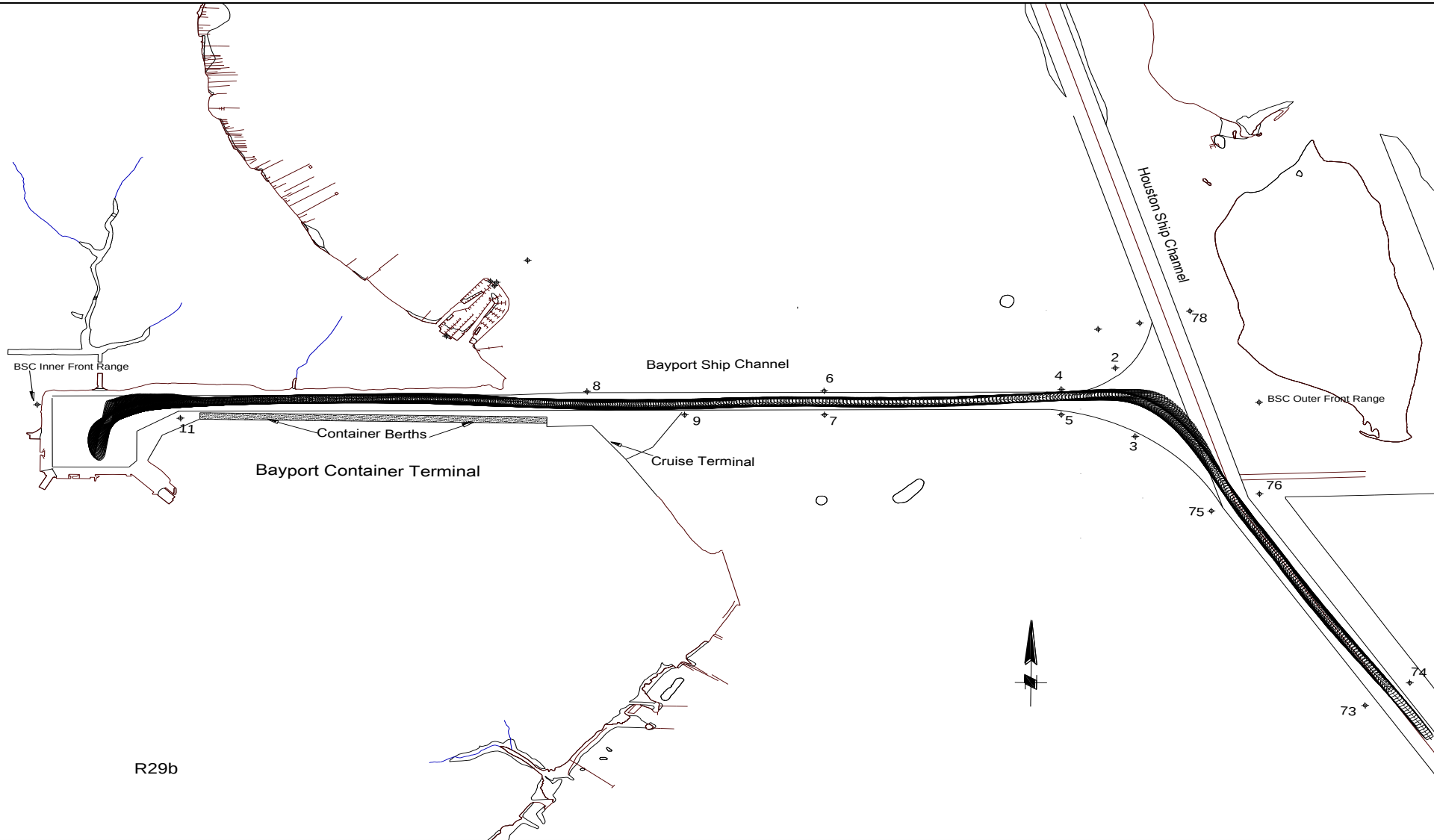
Rule of Thumb

Inbound 9K TEU Containership, 400-ft Channel – Widened 50 ft N & S - w/4000-ft Flare
Wind N 16 Knots, Two 77-ton Tugs, Ebb Current, Pilot B

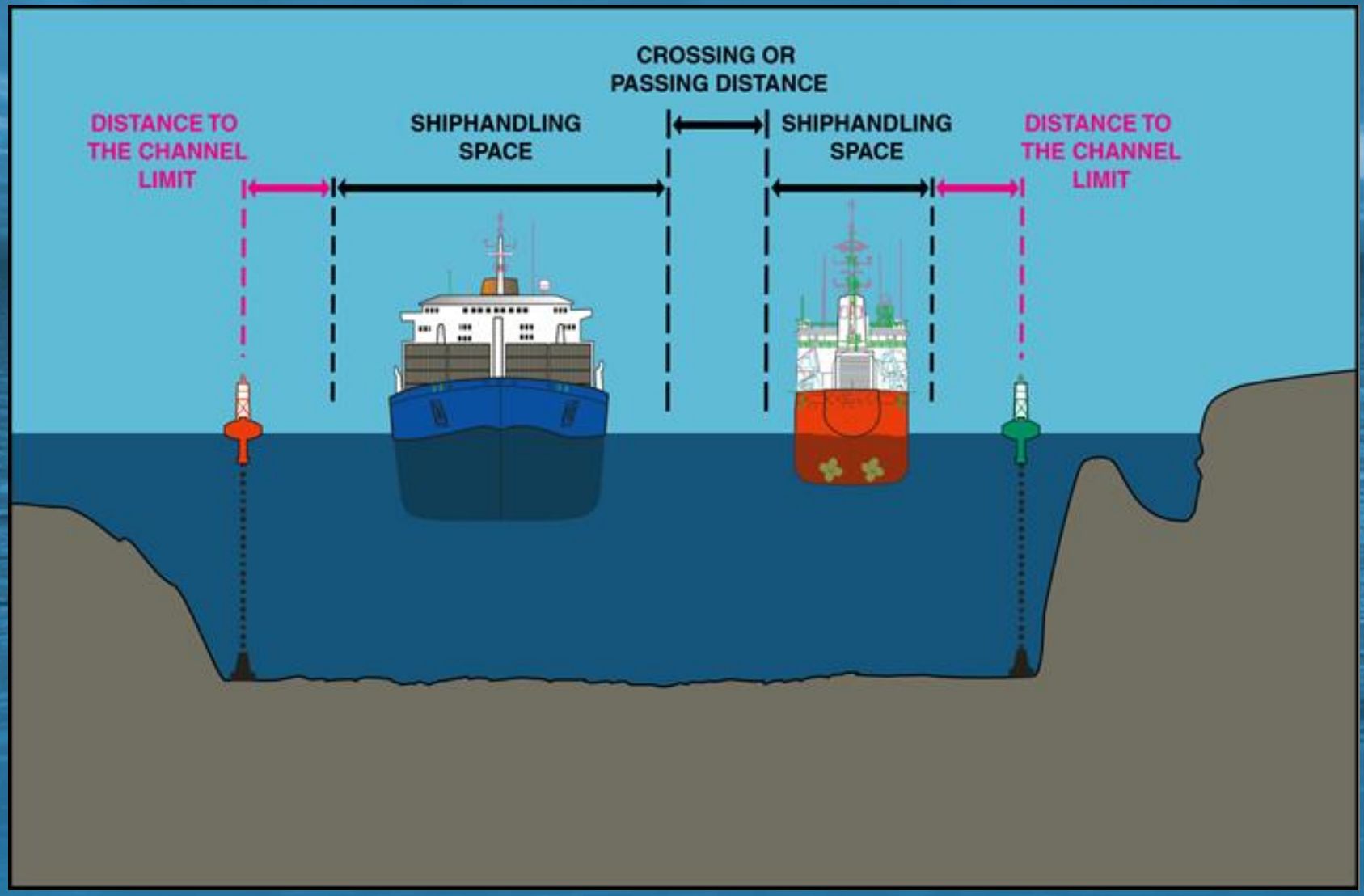


R15a

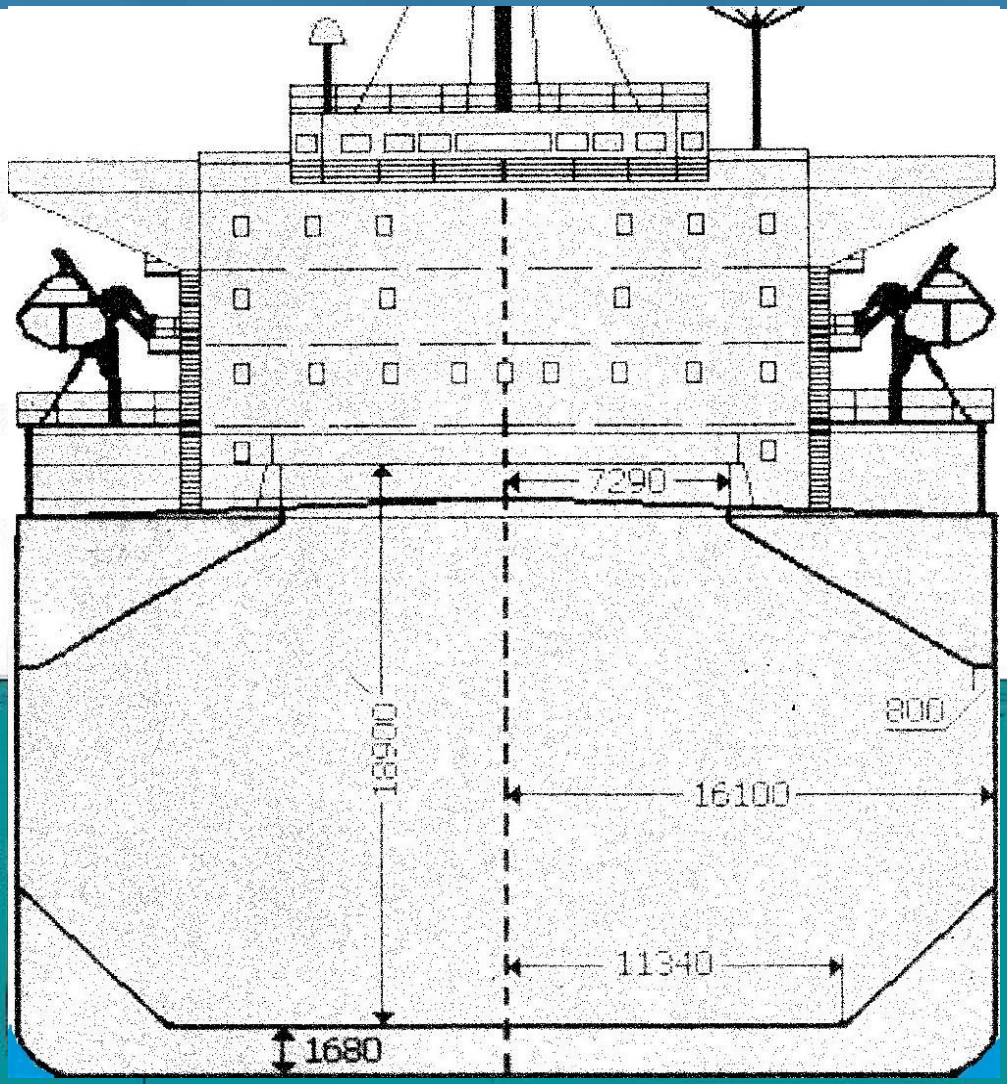
Inbound 15K TEU Containership, 400-ft Channel – Widened 100 ft to North - w/4000-ft Flare Wind N 16 Knots, Three 77-ton Tugs, 0 Current, Pilot D



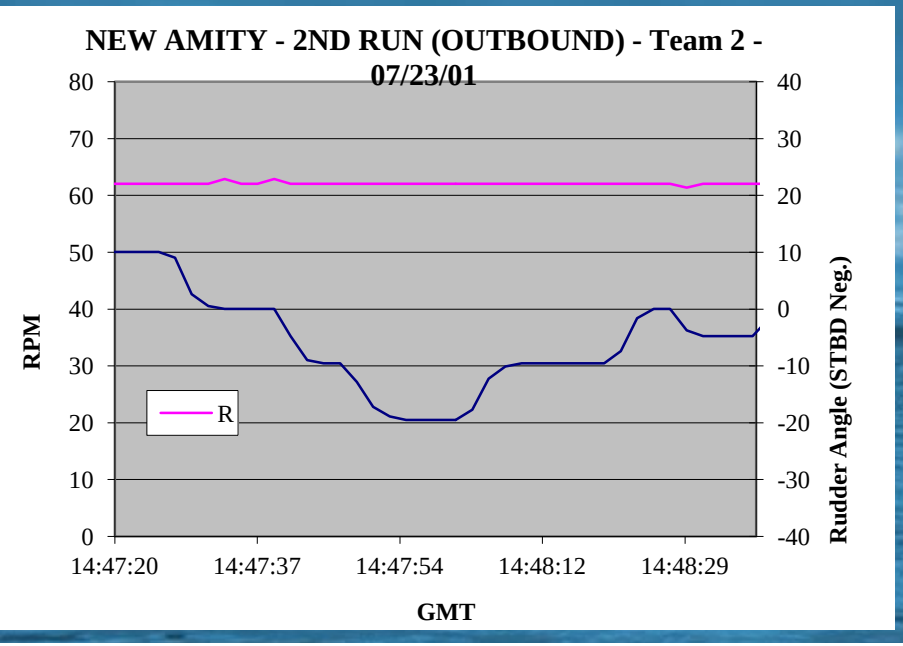
Safe Channel Width

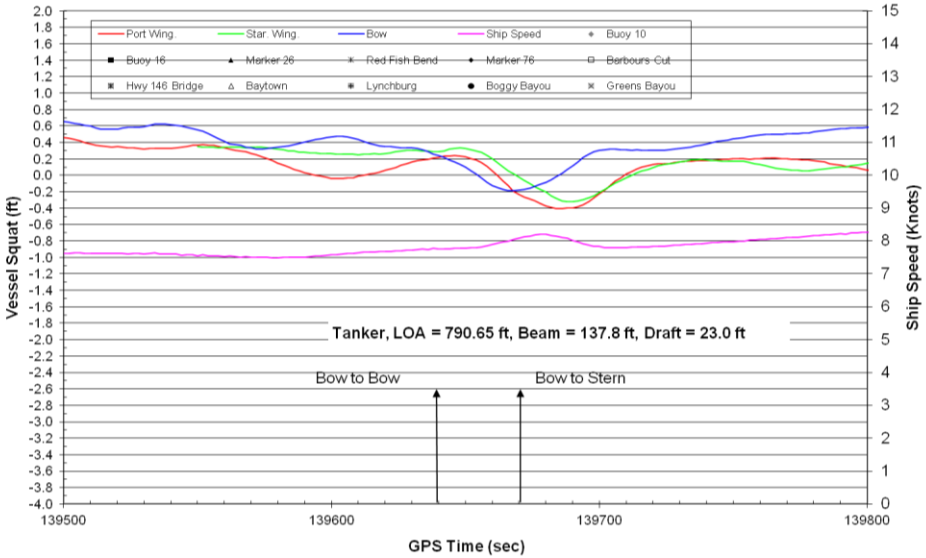


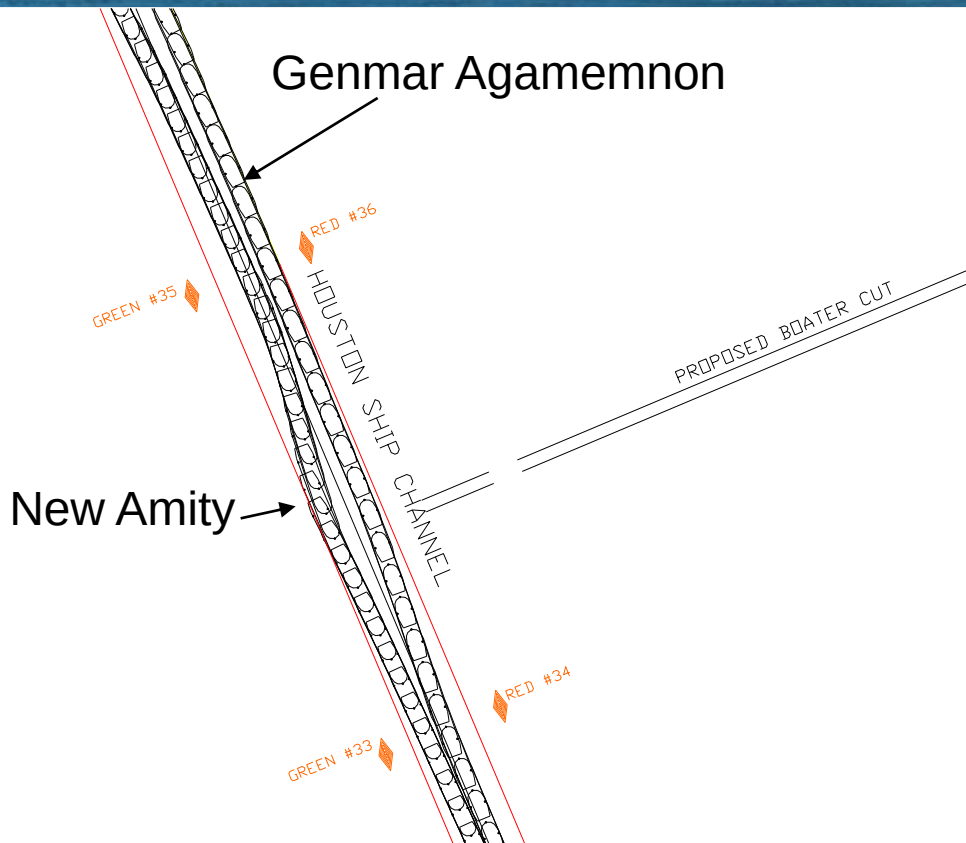
Real Scale in Calm Water

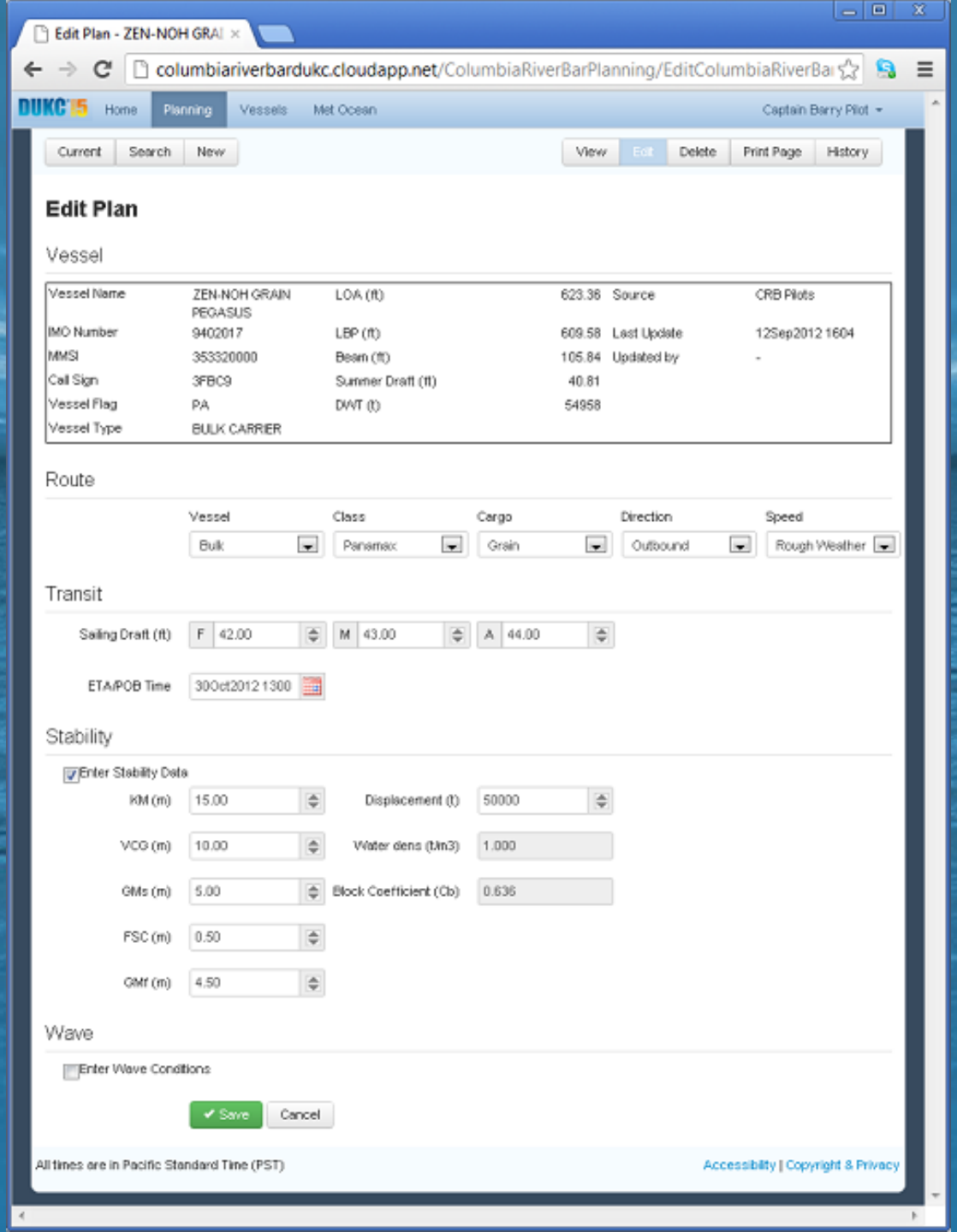


Genmar Agamemnon Inbound Meeting *New Amity* Outbound- July 23, 2001





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Print Page
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Edit Plan
Vessel
Vessel Name
ZEN-NOH GRAIN PEGASUS
IMO Number
9402017
MMSI
353320000
Call Sign
3FBC9
Vessel Flag
PA
Vessel Type
BULK CARRIER
LOA (ft)
623.36
LBP (ft)
609.58
Beam (ft)
105.84
Summer Draft (ft)
40.81
DWT (t)
54958
Source
CRB Pilots
Last Update
12Sep2012 1604
Updated by
-
Route
Vessel
Bulk
Class
Panamax
Cargo
Grain
Direction
Outbound
Speed
Rough Weather
Transit
Sailing Draft (ft)
F 42.00
M 43.00
A 44.00
ETA/POB Time
30Oct2012 1300
Stability
Enter Stability Data
KM (m)
15.00
VCG (m)
10.00
GMs (m)
5.00
FSC (m)
0.50
GMf (m)
4.50
Displacement (t)
50000
Water dens (t/m3)
1.000
Block Coefficient (Cb)
0.636
Wave
Enter Wave Conditions
Save
Cancel
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DUKC'15 Home Planning Vessels Met Ocean Captain Barry Pilot

Met Ocean Data Service

Summary

Tide
- Astoria (9439040)
- RM0

Wave
- CRB (46029)
- AC (46248)
- CS (46243)

Tidal Stream
- RM0 Depth Avge
- RM0 Surface
- RM18 Depth Avge
- RM18 Surface

Tide

Astoria (9439040)	RM0
29Oct2012 1900	29Oct2012 1912
0.0 ft Tide	0.4 ft Tide
+0.3 ft Residual	

Wave

CRB (46029)	AC (46248)	CS (46243)
29Oct2012 1800	29Oct2012 1826	29Oct2012 1813
Sea 3.3 Height ft	Sea 6.6 Height ft	Sea 3.6 Height ft
Swell 7.2 Height ft	Swell 4.3 Height ft	Swell 5.8 Height ft
5.3 s Period	9.9 s Period	5.6 s Period
8.3 s Period	11.8 s Period	9.5 s Period

Tidal Stream

RM0 Depth Avge	RM0 Surface	RM18 Depth Avge	RM18 Surface
29Oct2012 1912	29Oct2012 1912	29Oct2012 1912	29Oct2012 1912
0.9 kn Rate	3.0 kn Rate	2.3 kn Rate	2.6 kn Rate
283 ° Direction	264 ° Direction	257 ° Direction	257 ° Direction

External Links

- Port of Portland LOADMAX
- NOAA CREOFS Model
- Astoria Tide Gauge
- Hammond Tide Gauge

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ZEN-NOH GRAIN PEGASUS 9402017

1068.2 - 29Oct2012 1500

Deepest Draft: 44 ft ETA/POB: 30Oct2012 1300 Route: Outbound Rough Weather Captain Barry Pilot

2012-10-30 16:00 Passage Commencement Time

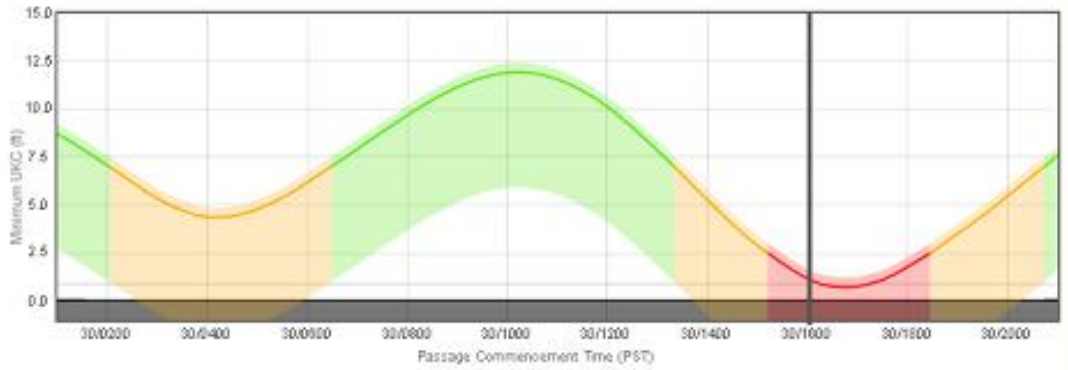
1.2 ft Bar Best Estimate UKC

-4.8 ft BF-HA Bar Cautious Estimate UKC

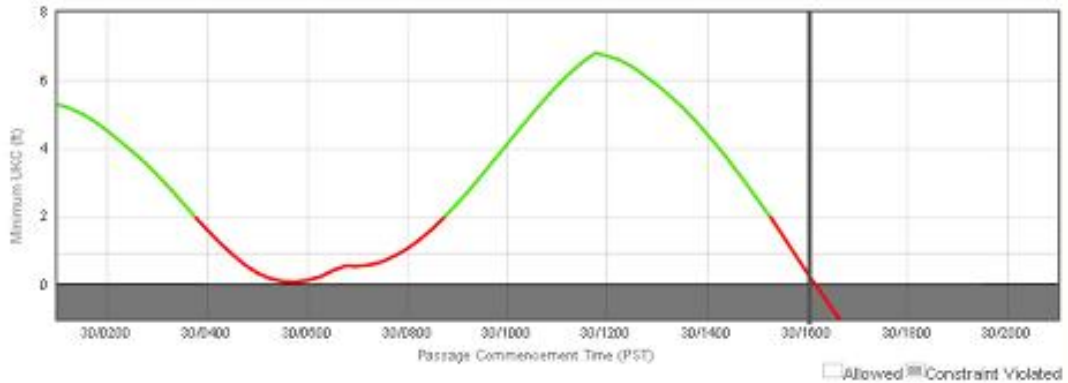
0.3 ft BS2-HA River Minimum UKC

PLANNING Plan Status

BAR



RIVER



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1.2 ft Bar Best Estimate UKC

-4.8 ft BF-HA Bar Cautious Estimate UKC

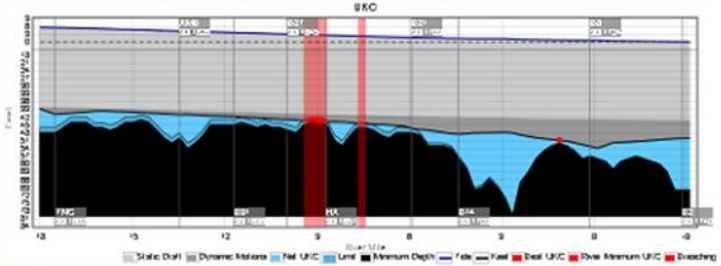
0.3 ft BS2-HA River Minimum UKC

PLANNING Plan Status

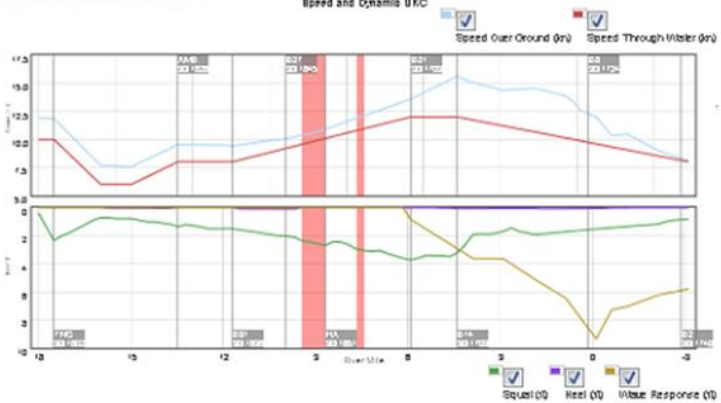
UKC

Edit Speeds

	TWO	AMS	B21	B27	HA	B21	B14	B2	B2
STW (kn)	10	8	8	9.2	10.1	12	12	9.7	8.1
Time (PST)	30/1602	30/1626	30/1636	30/1645	30/1651	30/1703	30/1709	30/172+	30/1743
Squat (ft)	2.3	1.4	1.6	2.0	2.7	3.7	3.2	1.6	0.8
Heel (ft)	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Tide (ft)	5.5	+.2	3.6	3.0	2.5	1.7	1.3	0.6	0.1
WR (ft)	0.0	0.0	0.0	0.0	0.0	0.2	2.9	2.6	5.5
UKC (ft)	7.2	9.0	3.3	+.1	1.1	2.4	9.5	3.2	19.9



Hide Speed and Dynamic UKC Charts



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ZEN-NOH GRAIN PEGASUS 9402017

1068.0 - 29Oct2012 1351

Deepest Draft: 42 ft | ETA/POB: 30Oct2012 1400 | Route: Outbound Fair Weather | Captain Barry Pilot

2012-10-30 14:00 — Passage Commencement Time

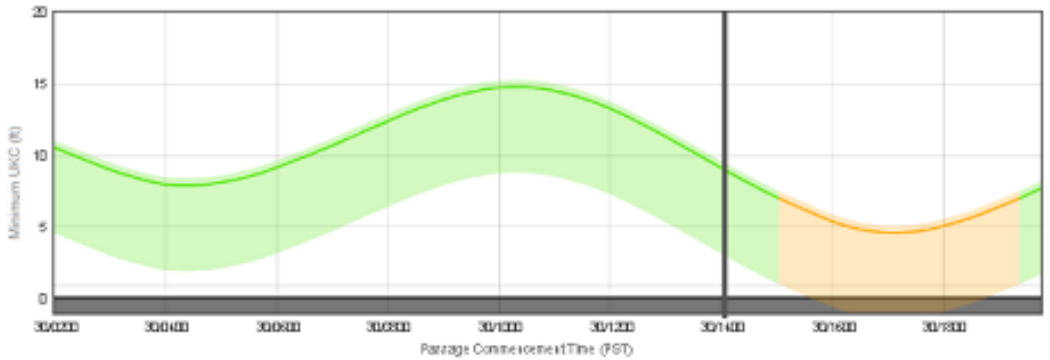
9.1 ft — Bar Best Estimate UKC

3.1 ft — Bar Cautious Estimate UKC

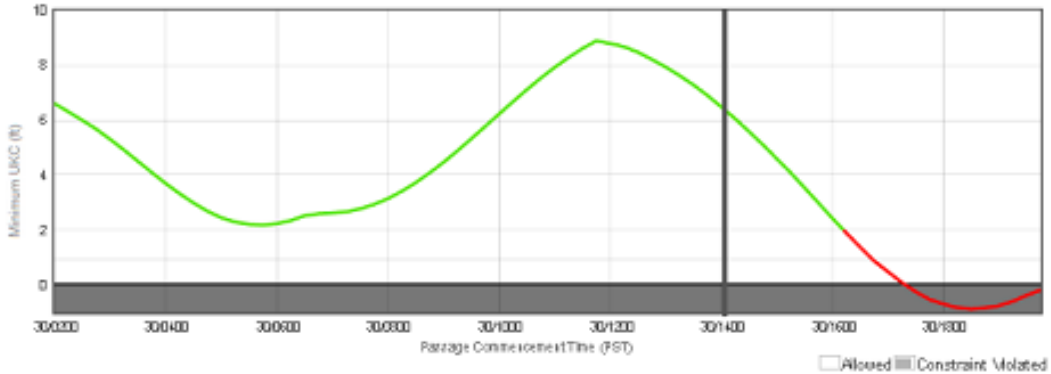
6.5 ft — River Minimum UKC

PLANNING — Plan Status

BAR



RIVER



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ZEN-NOH GRAIN PEGASUS 9402017

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9.1 ft — Bar Best Estimate UKC

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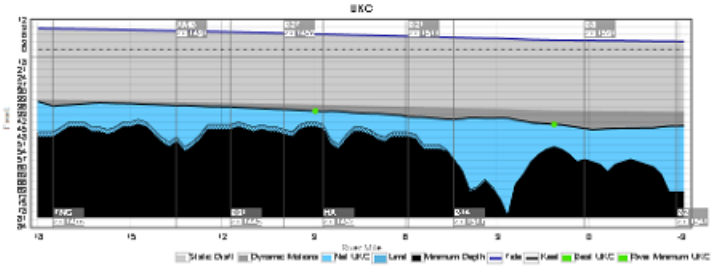
PLANNING — Plan Status

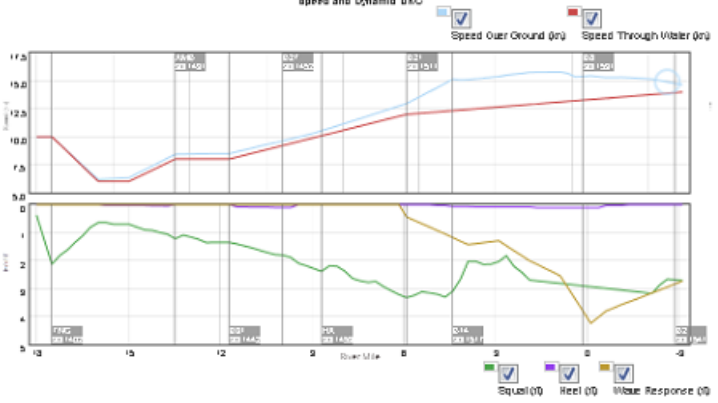
UKC

Edit Speeds

	TNG	AMB	B21	B27	HA	B21	B14	B8	B2
STW (kn)	10	8	8	9.2	10.1	12	12.3	13.3	13.9
Time (PST)	30/1402	30/1431	30/1442	30/1452	30/1459	30/1511	30/1517	30/1531	30/1541
Squat (ft)	2.1	1.2	1.4	1.8	2.4	3.3	3.1	2.9	2.7
Heel (ft)	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Tide (ft)	8.5	7.6	7.1	6.6	6.2	5.4	4.9	3.7	3.4
WR (ft)	0.0	0.0	0.0	0.0	0.0	0.4	1.2	3.8	2.8
UKC (ft)	12.5	14.7	9.2	10.1	7.3	8.6	17.1	12.5	26.4



Hide Speed and Dynamic UKC Charts



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Big Ships in Small, Shallow Channels

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Safer Ports

don’t come about by accident