DAVID EVANS AND ASSOCIATES INC.
MARINE SERVICES

Oregon GNSS User Group
2023 Winter Meeting
January 20, 2023

Improving Maritime Safety using Real-Time GNSS Networks

Presented by Jon Dasler, PE, PLS, CH
David Evans and Associates, Inc.
Senior Vice President, Director of Marine Services

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- Current navigation charts are not of sufficient resolution for inland and harbor piloting

Maritime Commerce is Pressing the Limits of our Inland Waterways

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- Current navigation charts are not of sufficient resolution for inland and harbor piloting

- Container and Cruise Ships are pushing the limits of our inland waterways in draft (under keel clearance) and vertical clearance (air draft).

Maritime Commerce is Pressing the Limits of our Inland Waterways

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- Current navigation charts are not of sufficient resolution for inland and harbor piloting

- Container and Cruise Ships are pushing the limits of our inland waterways in draft (under keel clearance) and vertical clearance (air draft).

- Efforts are underway for precision charting of key infrastructure on inland waterways and marine terminals to improve maritime safety with GNSS playing a key role. (Columbia Resurvey in 2025).

Maritime Commerce is Pressing the Limits of our Inland Waterways

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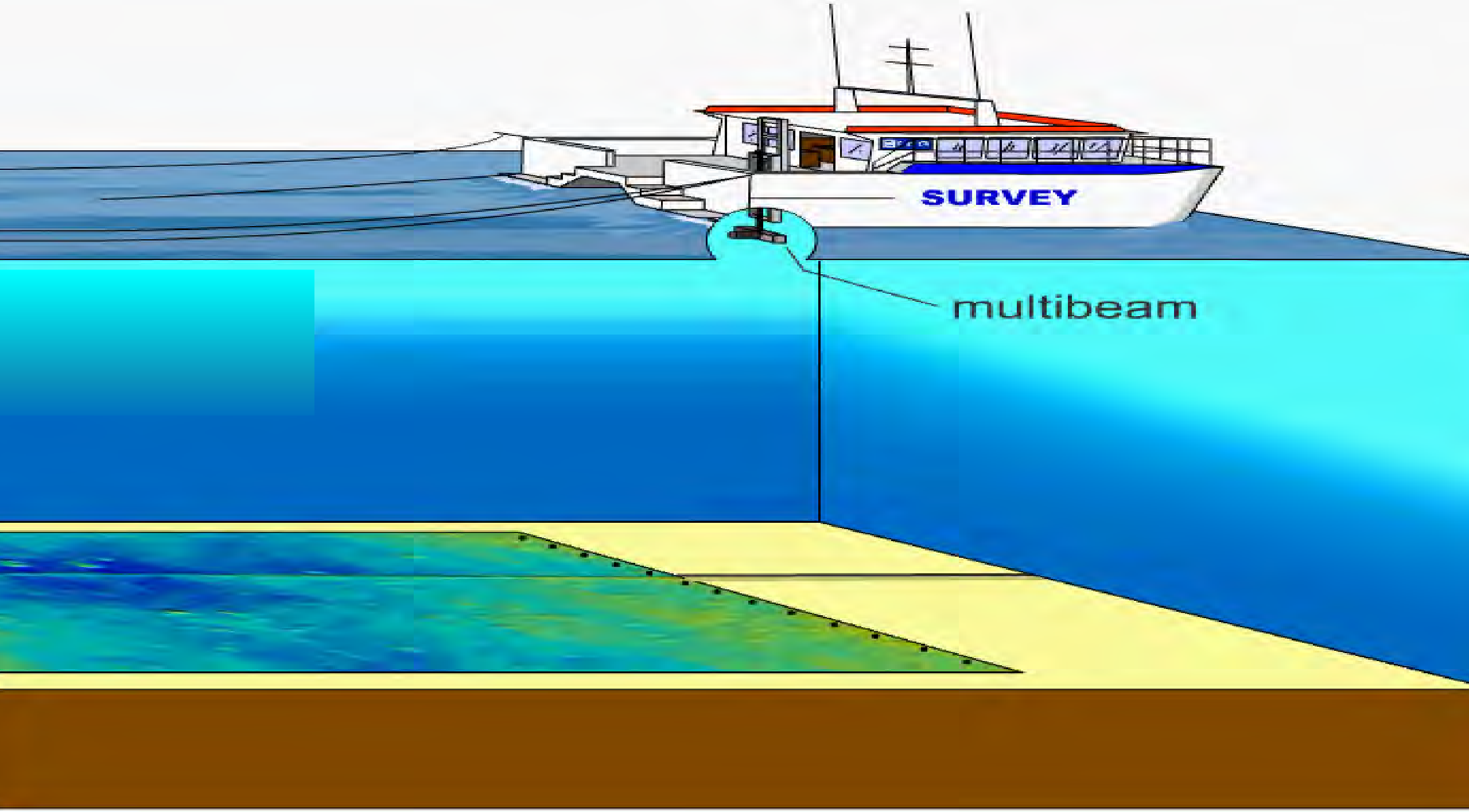
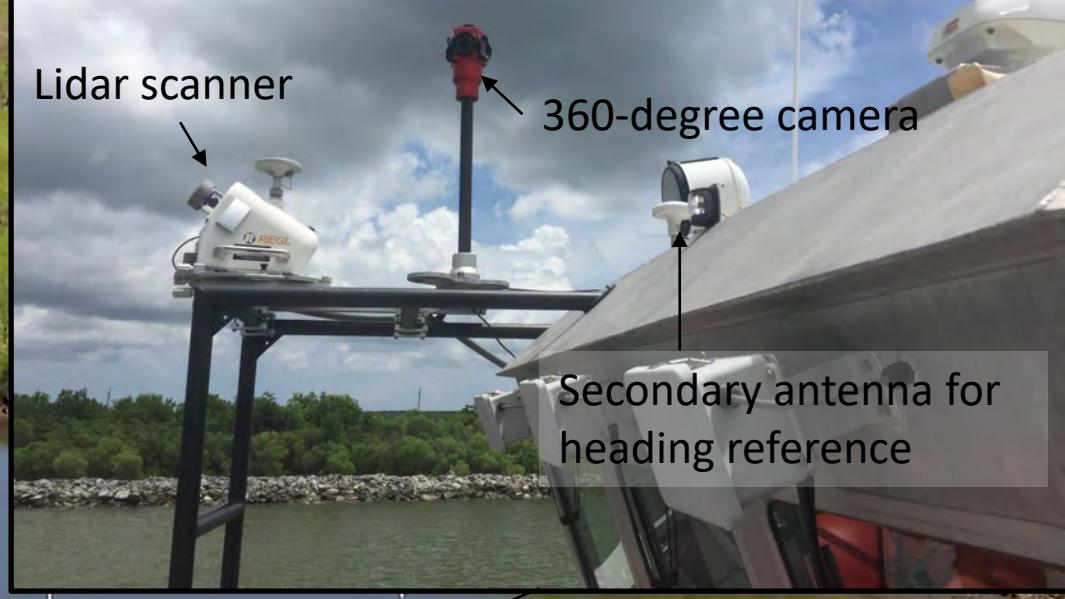

SURVEY
multibeam


Mobile Mapping System (MMS) RIEGL VMQ-1HA
coupled with Ladybug5 360-degree camera and
integrated Applanix POS/LV

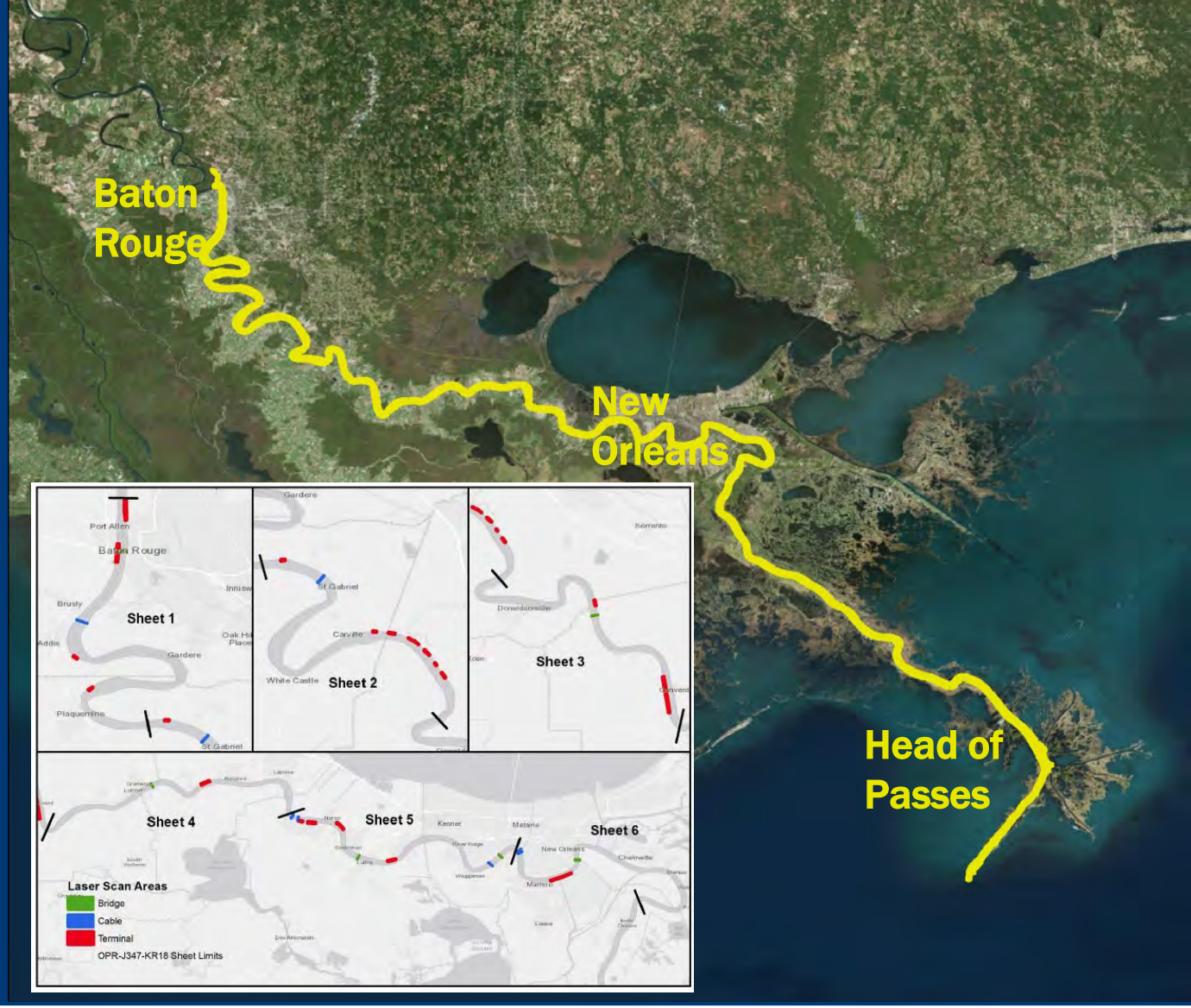
Road and Highway Asset Management using an MMS

MMS aboard DEA Survey Vessel *Blake*



Lower Mississippi River

- 250 miles of the Lower Mississippi River
- Vertically controlled by Louisiana State University Center for Geoinfomatics (C4G) real-time network
- NOAA Object Detection multibeam
- Laser scan terminals, bridges, overhead cables
- Low Water Reference Plane Gradient Vertical Datum using custom separation model



Overview of hydrographic surveys to support precision navigation

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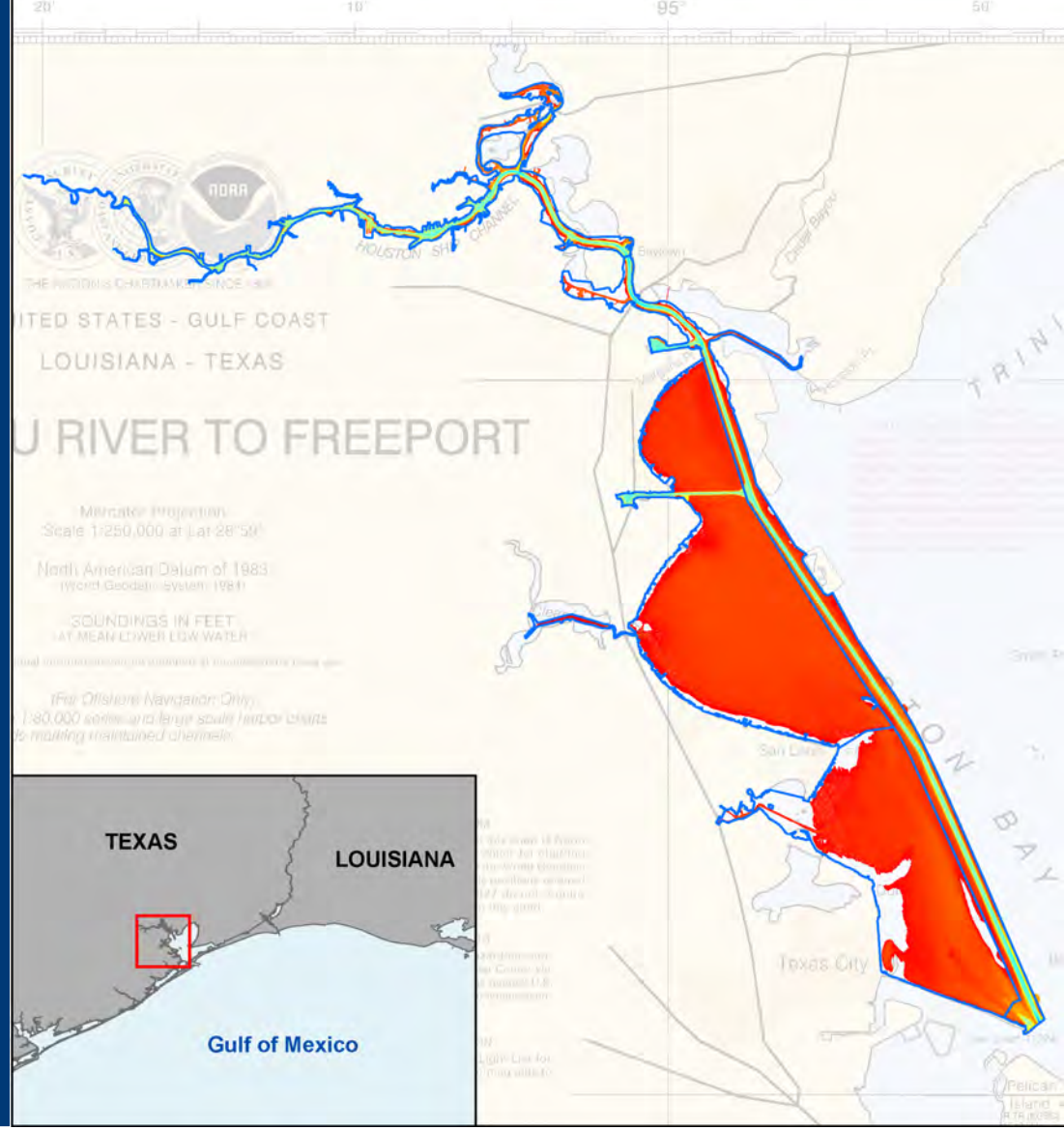
Houston Ship Channel

- Houston Ship Channel and Western Galveston Bay
- Vertically controlled and positioning using Texas DOT (TxDOT) real-time network
- NOAA Object Detection multibeam
- Laser scan terminals, bridges, overhead cables
- Mean Lower Low Water Vertical Datum using custom separation model



Overview of hydrographic surveys to support precision navigation

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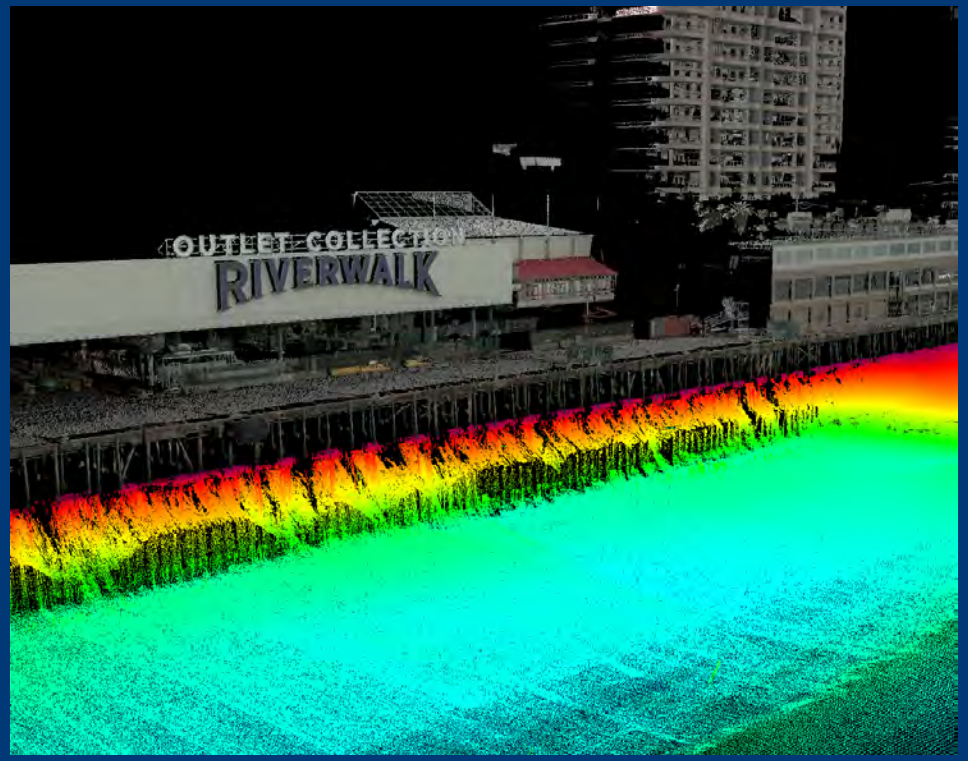

Overview of hydrographic surveys to support precision navigation

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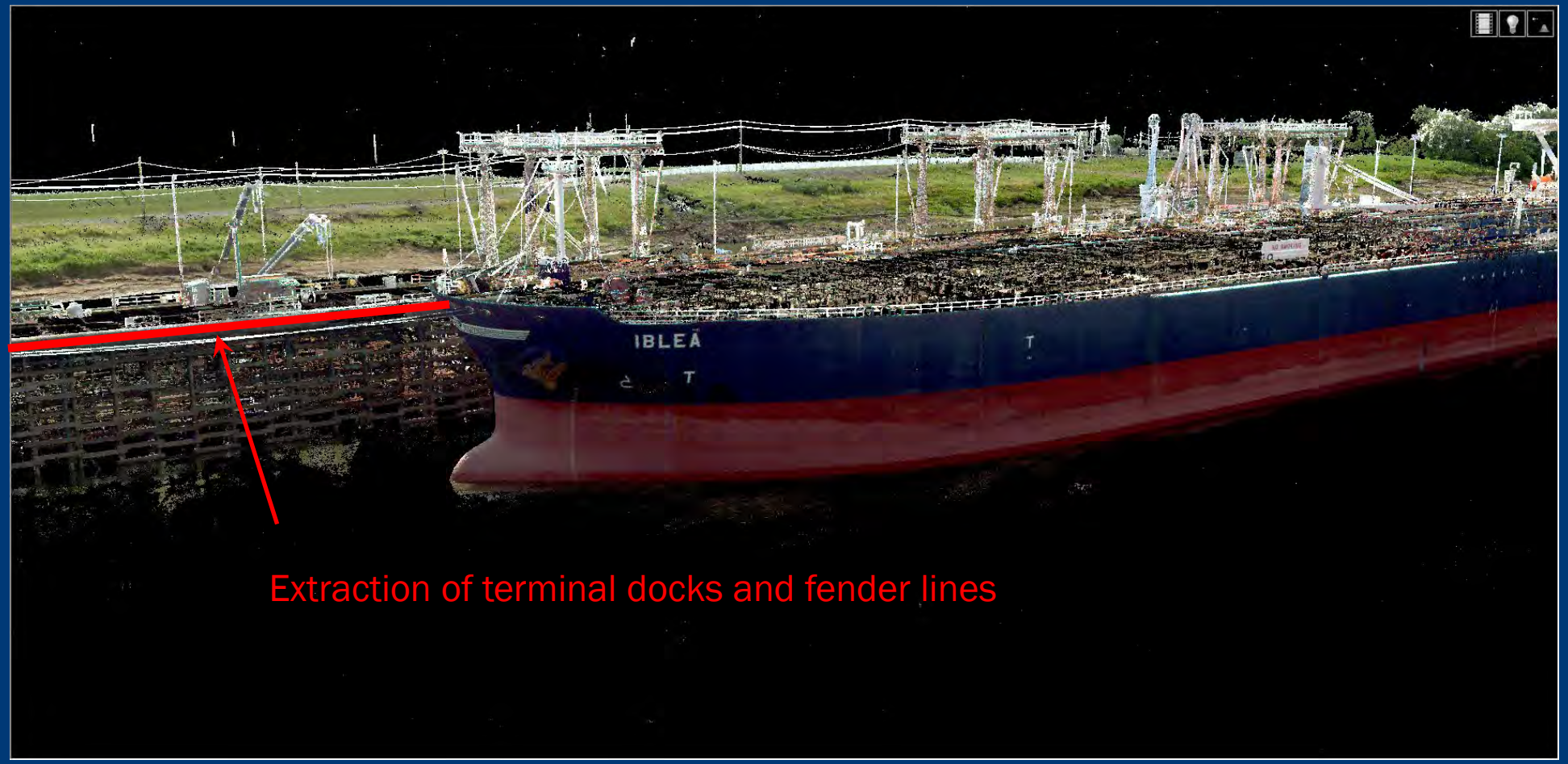

Products include terminal outlines, overhead wire clearances, bridge clearances, detailed outline of bridge piers, aids to navigation, mooring and fleeting buoys, piling, and any other in-water features for development of 1:12,000 charts of the Mississippi from Baton Rouge to Head of Passes.

Mobile Mapping for NOAA Mississippi Precision Navigation Project

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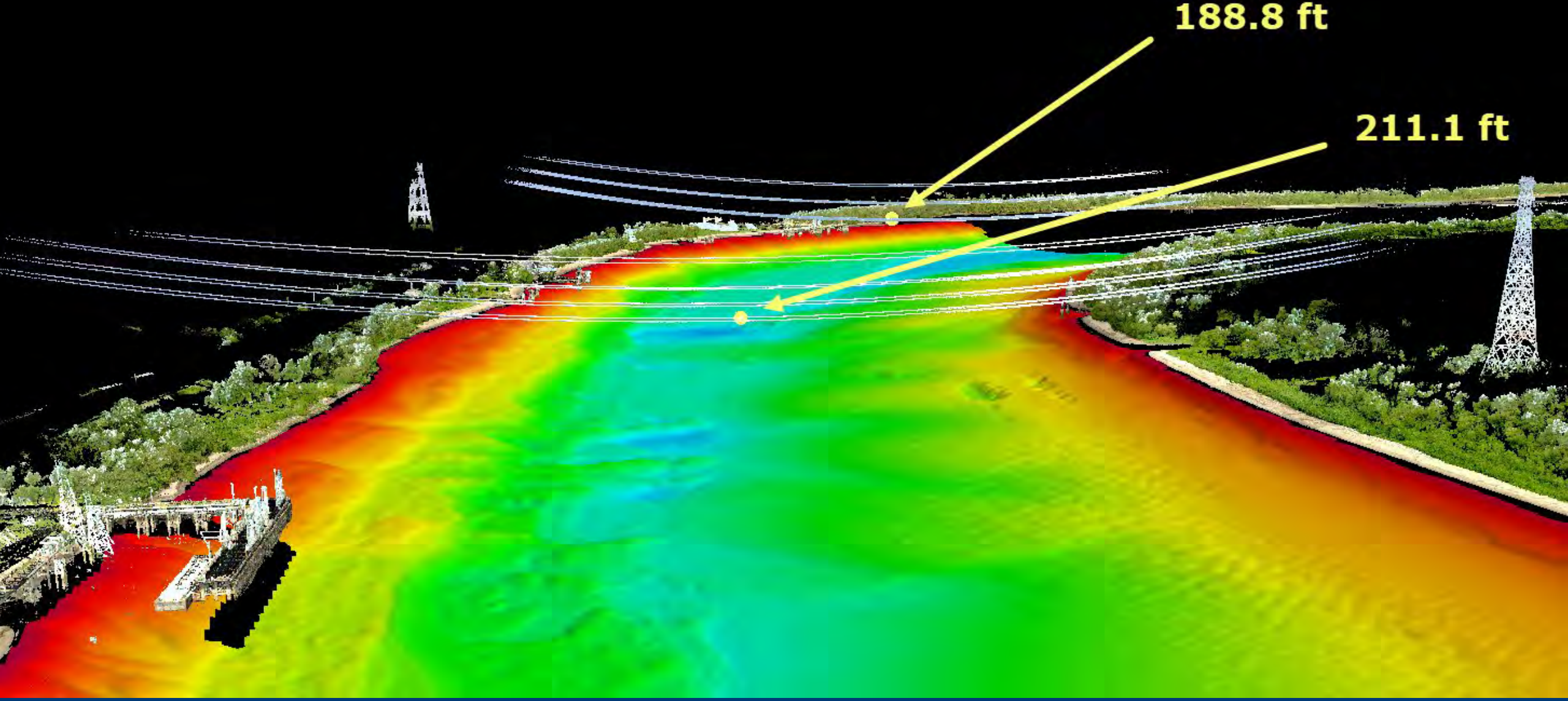

Transmission Line Clearance from Vessel Laser Scanning

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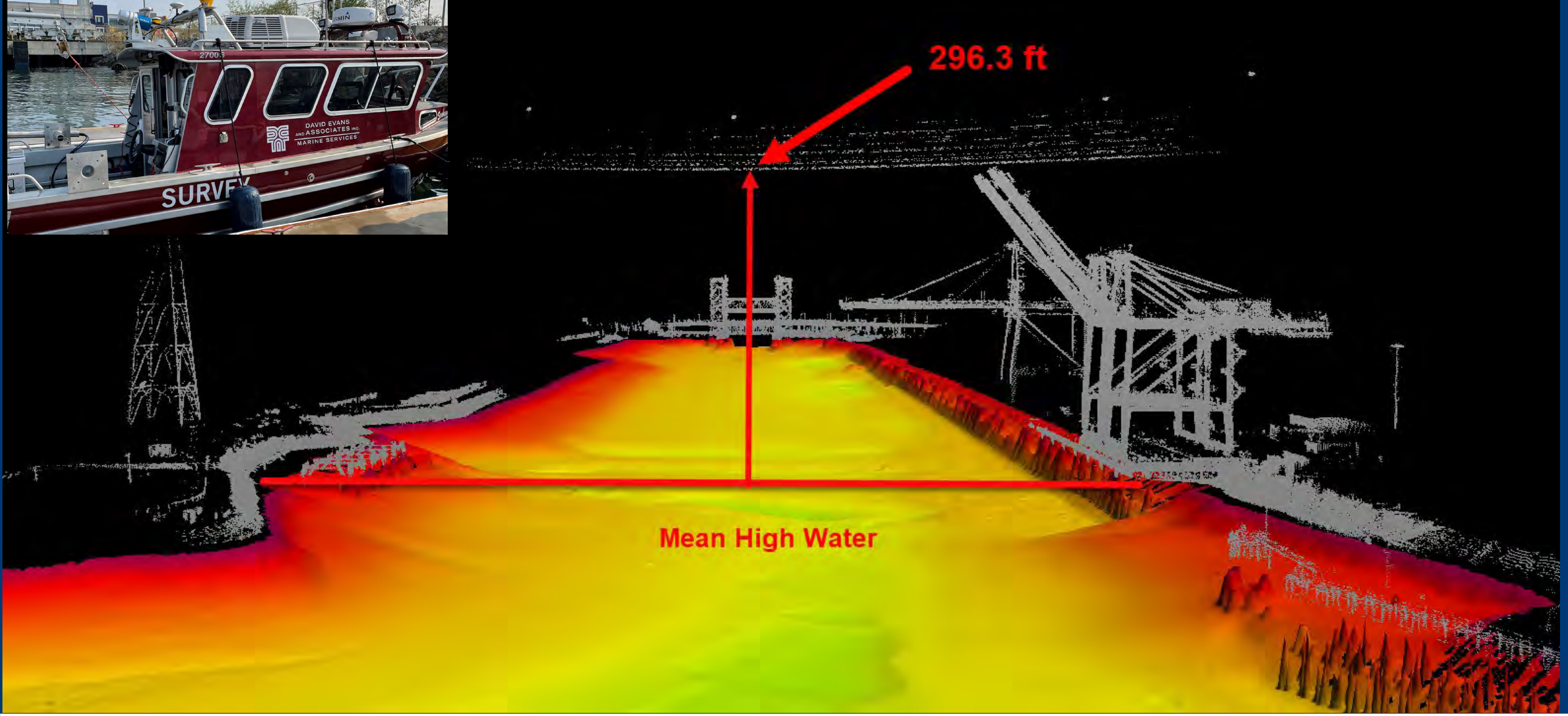

Transmission Lines at Port of Long Beach

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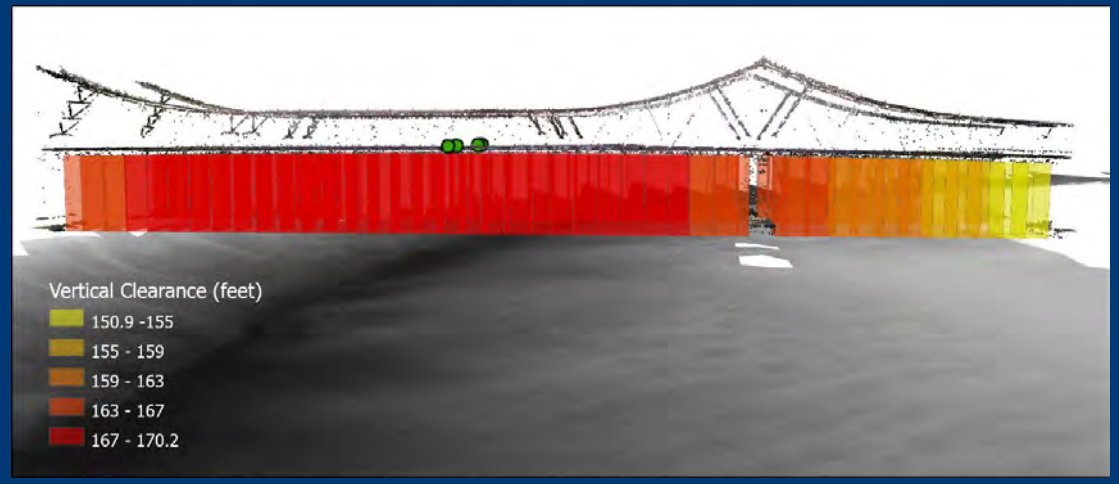
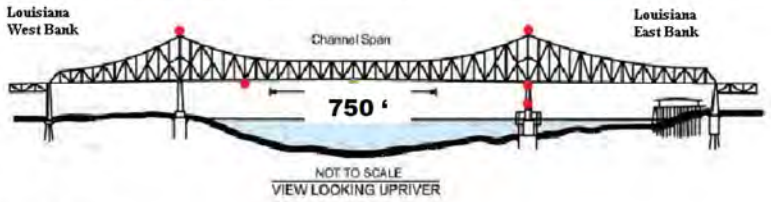
Crescent City Connection/ GNO Twin Span Bridges Clearance



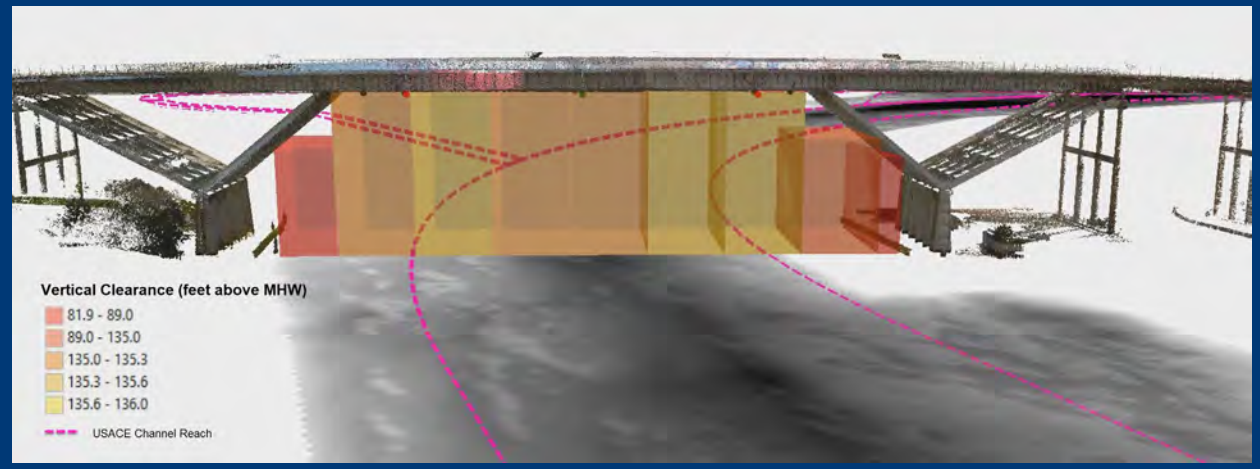
Crescent City Connection/GNO Twin Spans:
(Lower span 95.7 AHP Upper Span 95.8 AHP)

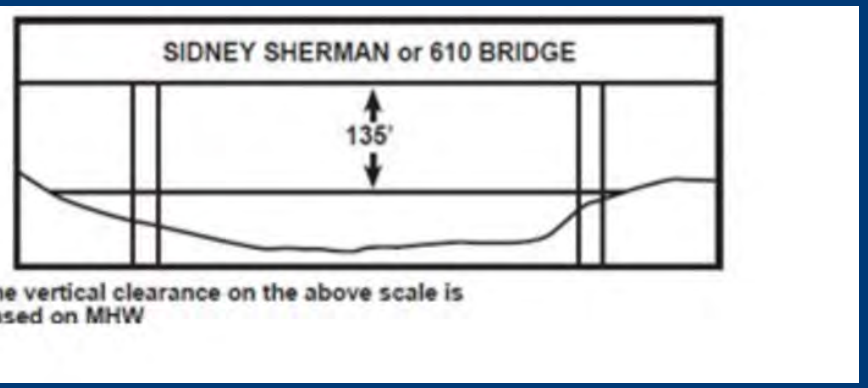


Channel Span:
- Vertical Channel Clearance 170 ft. minus the Carrollton gage
- Horizontal Channel Clearance 750 ft.
- There is a total of 1564 ft. of horizontal clearance in the channel span. The center 750 ft. has the 170 ft. of vertical clearance minus the Carrollton gage. On either side of the channel the vertical clearance is reduced to 166.2 ft. minus the Carrollton gage.

East Span:
- Vertical Clearance 155 ft. minus the Carrollton gage
- Horizontal Clearance 505 ft.

Sidney Sherman Bridge Clearance





Bridge Clearance

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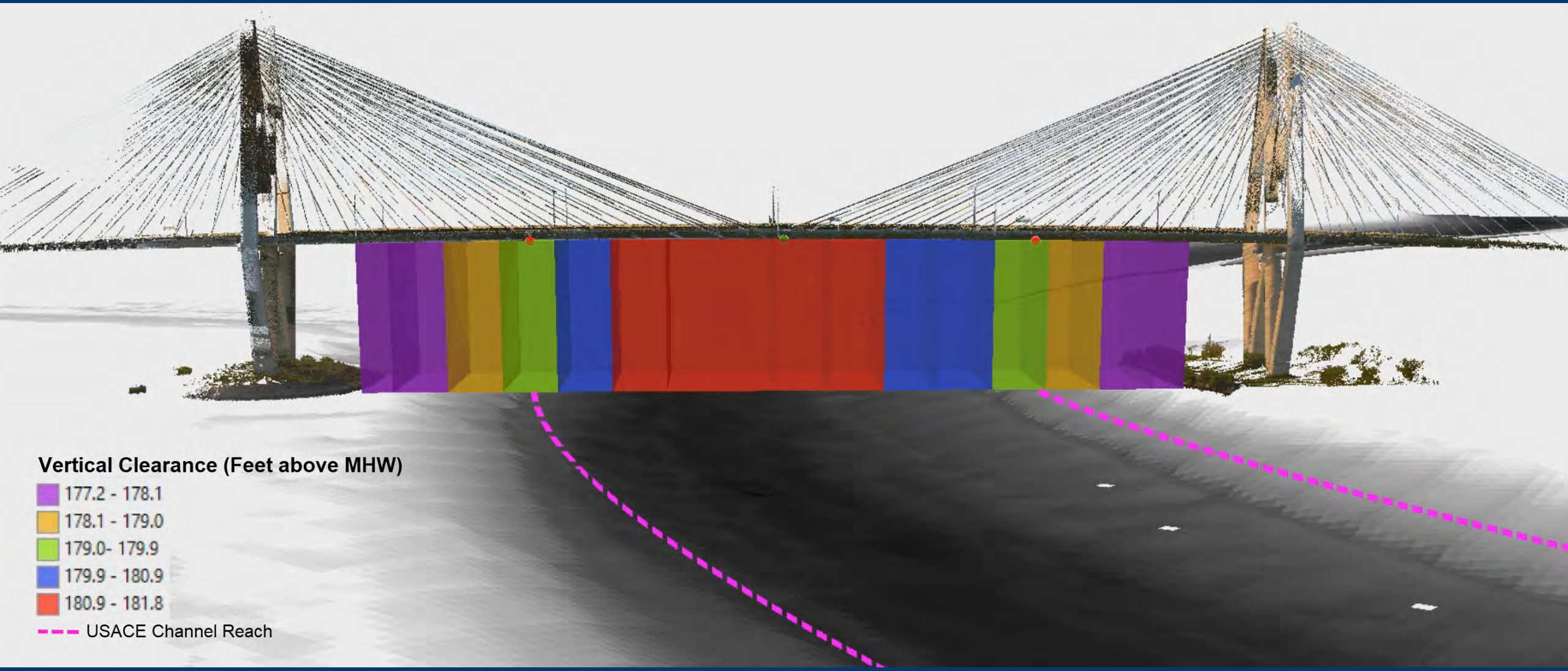

Fred Hartman Bridge, Houston Ship Channel
From DEA Vessel Laser Scanning for NOAA

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High Resolution data supports many uses

- Navigation
- Modelling
- Training and Simulation
- Research and Development

Overview of hydrographic surveys to support precision navigation

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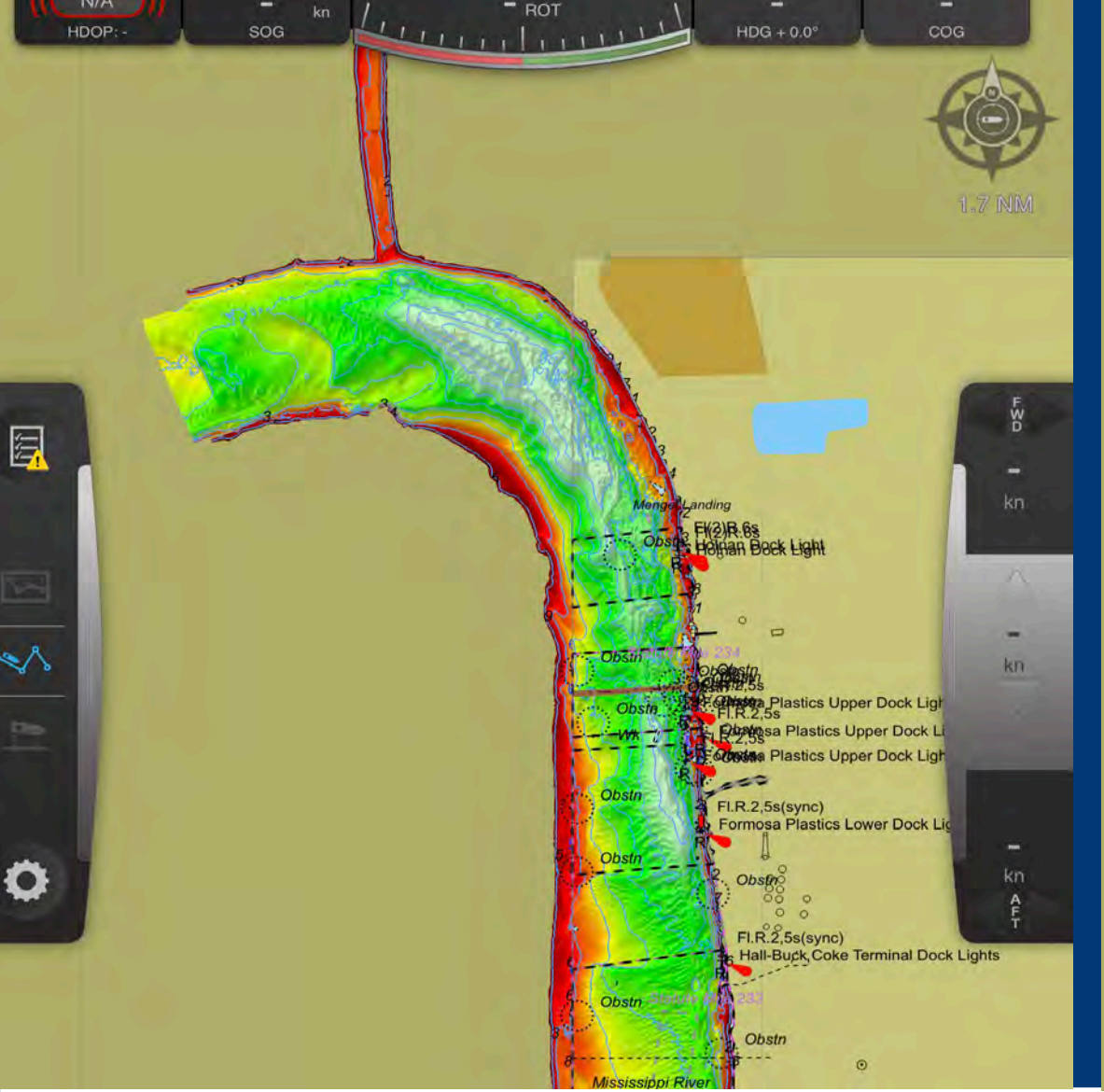

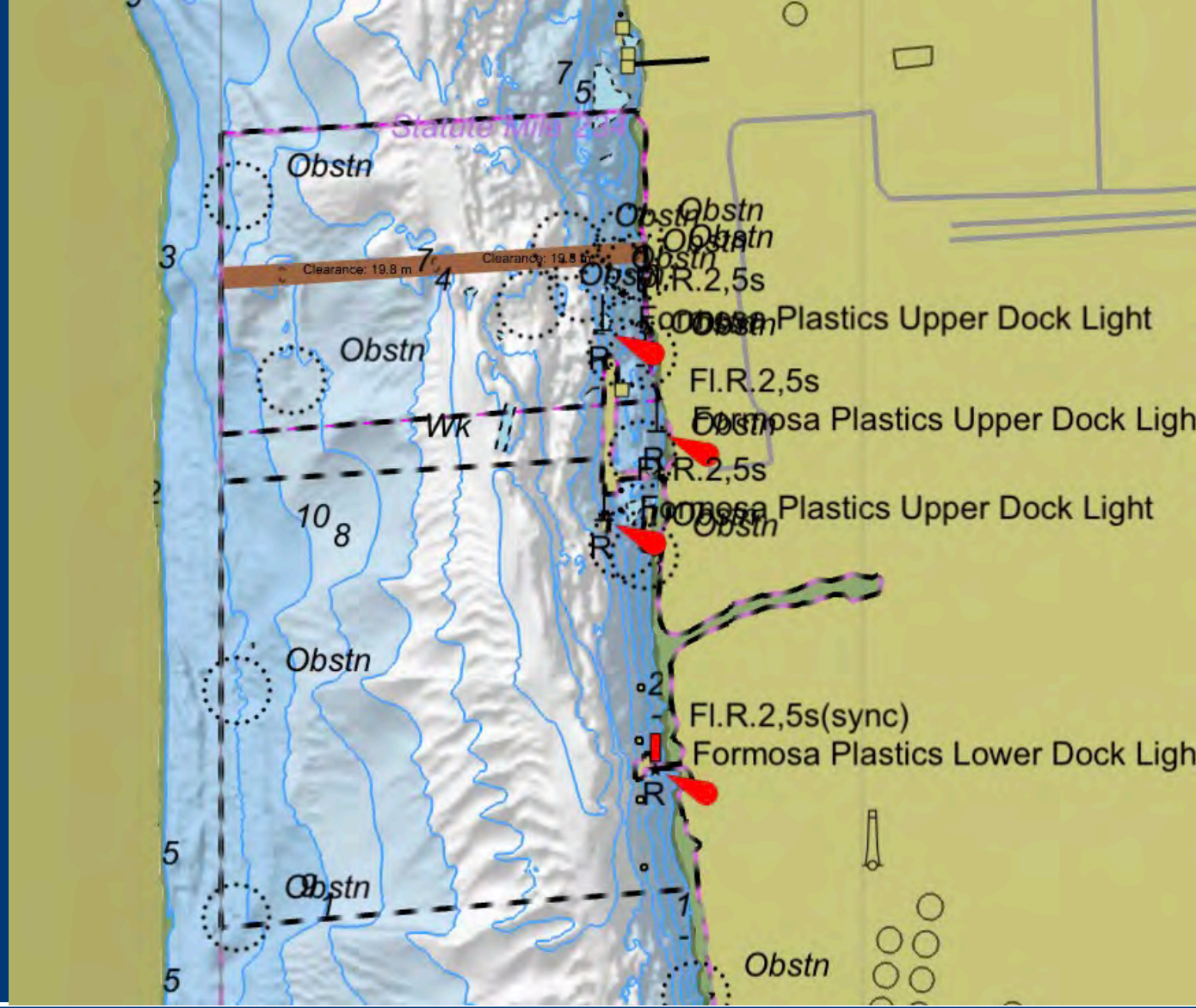

High Resolution Multibeam in Trelleborg Safe Pilot Software

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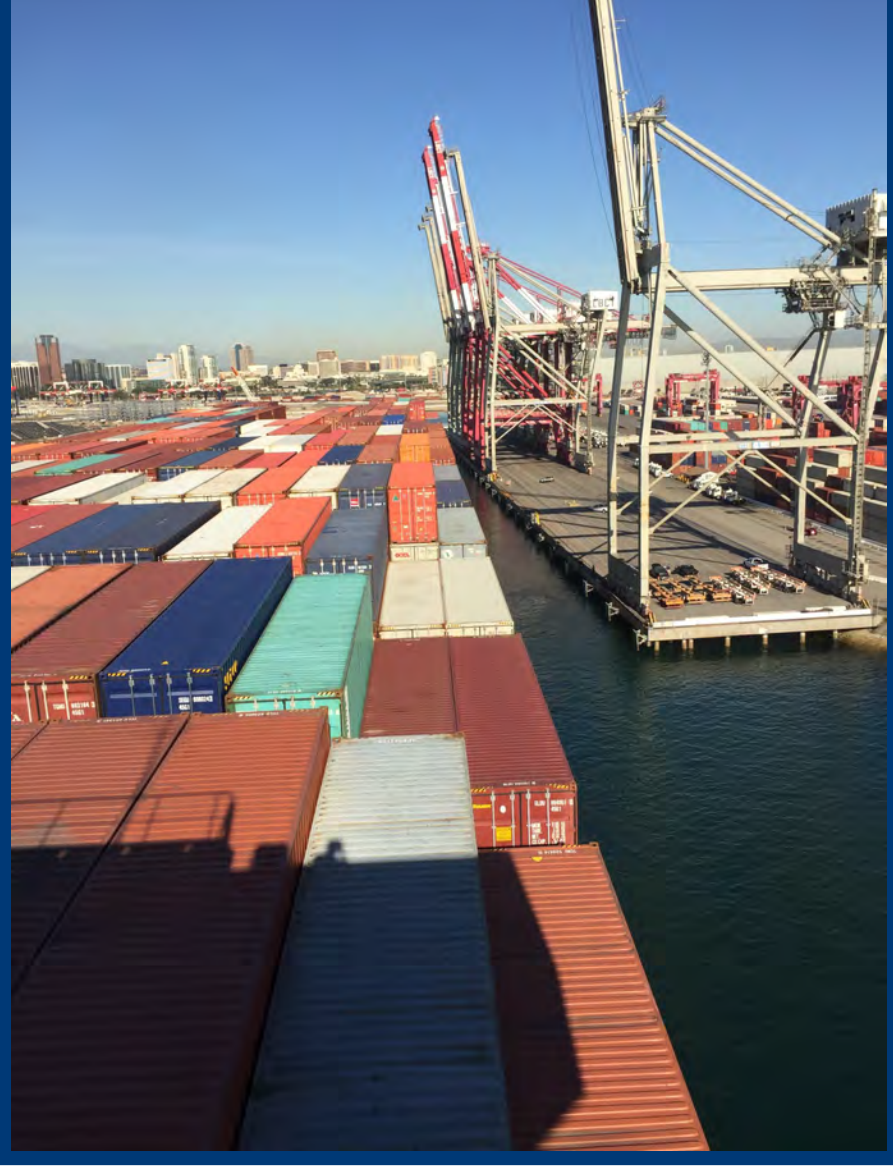

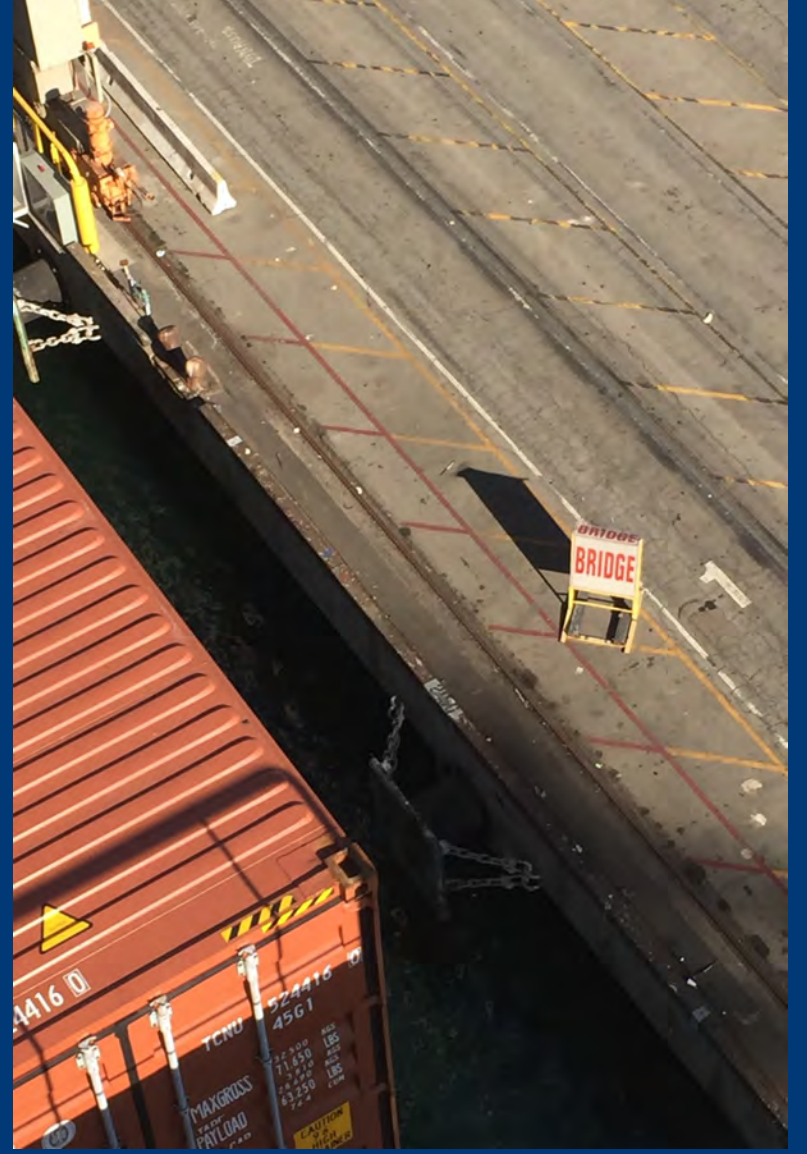

Docking large container ship at Port of Long Beach

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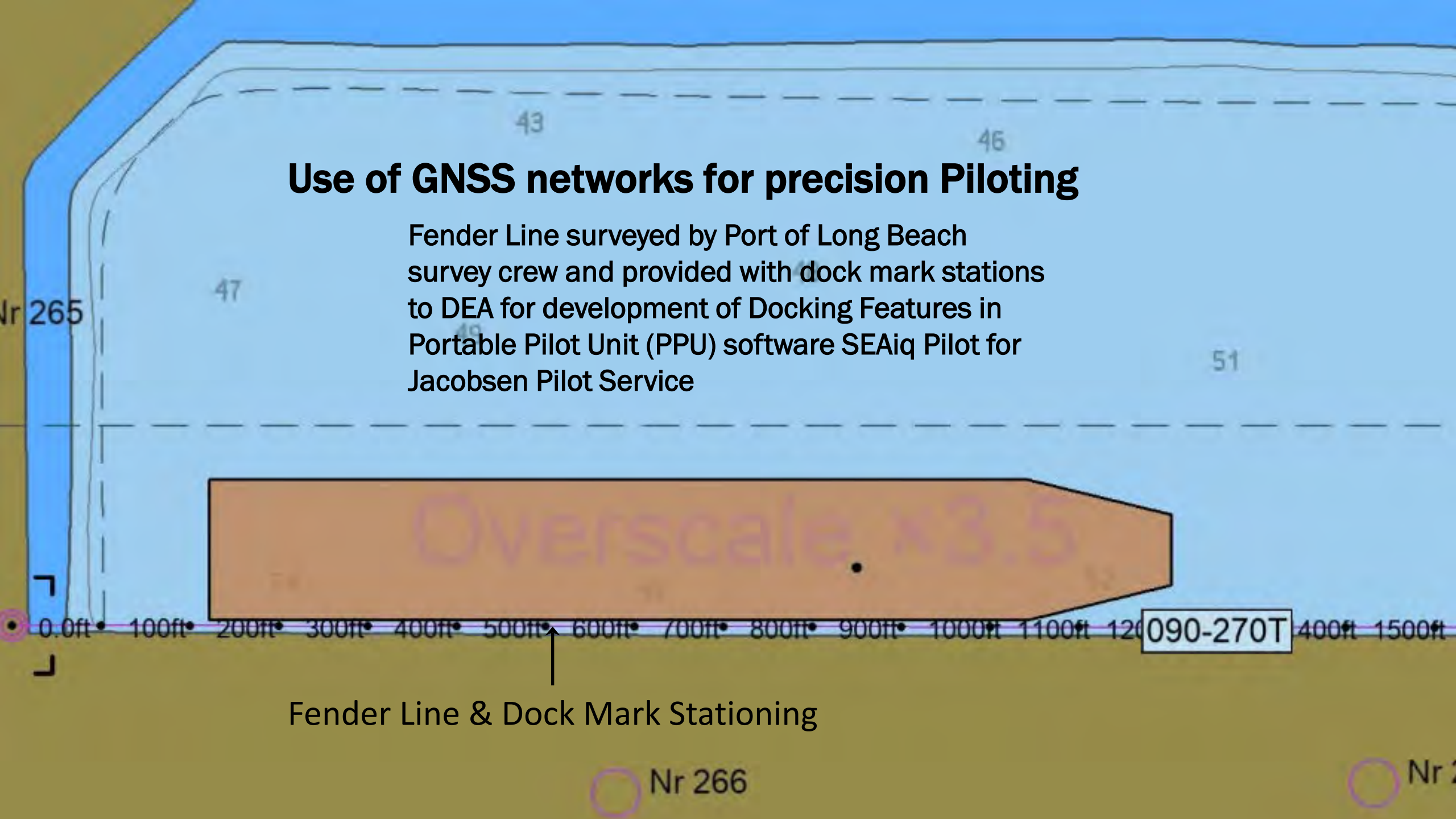
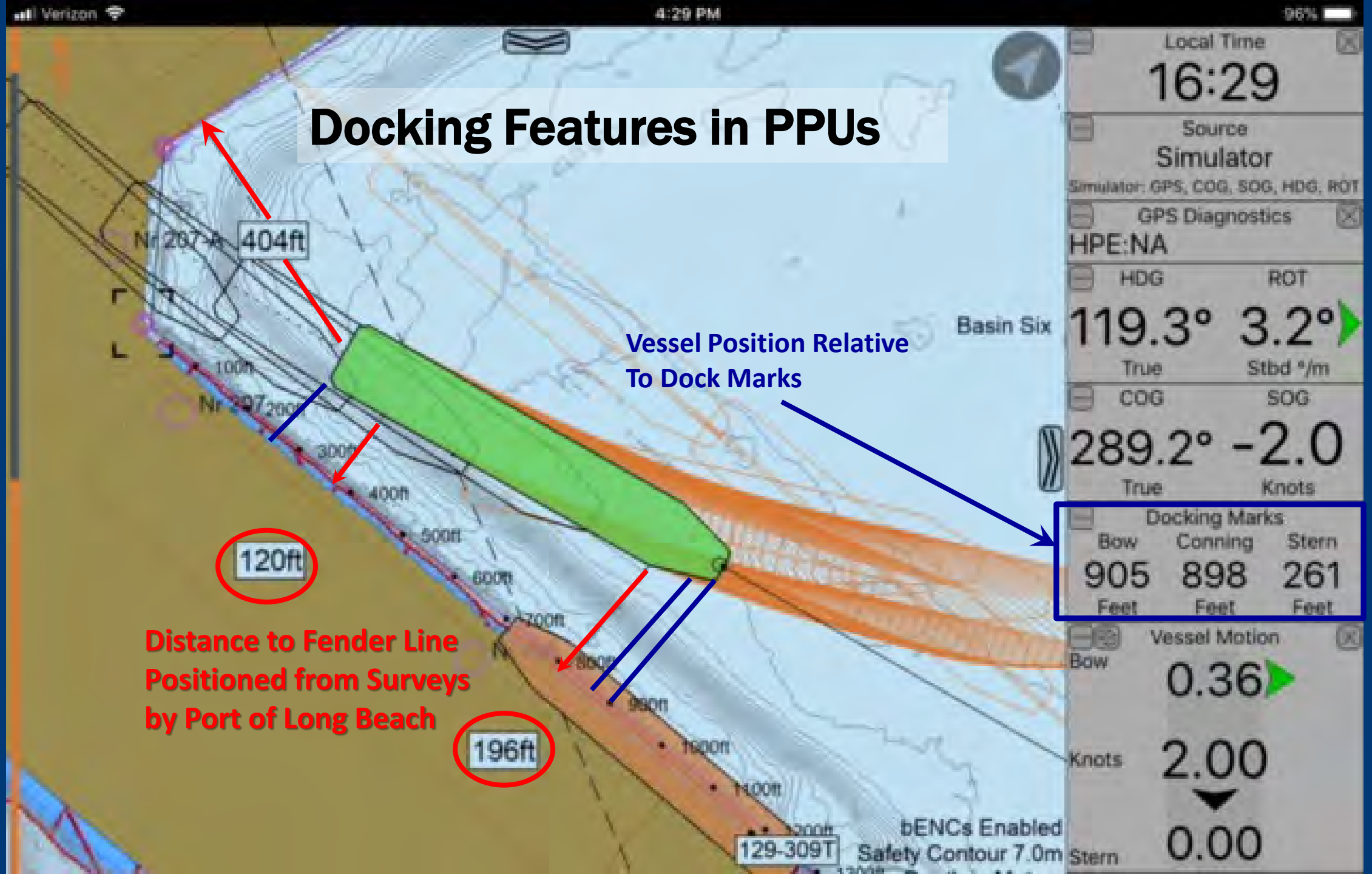
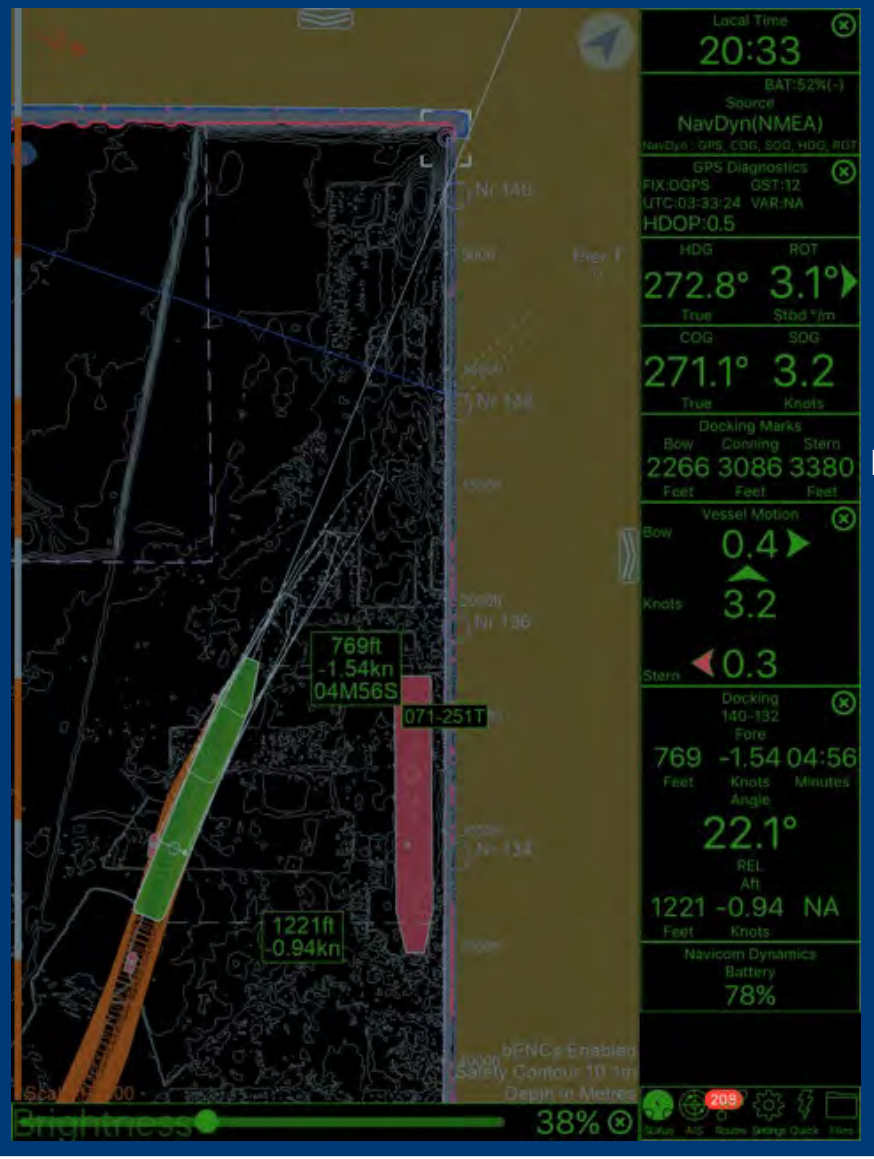

Use of GNSS networks for precision Piloting
Fender Line surveyed by Port of Long Beach survey crew and provided with dock mark stations to DEA for development of Docking Features in Portable Pilot Unit (PPU) software SEAiq Pilot for Jacobsen Pilot Service
Overscale x3.5
0.0ft
100ft
200ft
300ft
400ft
500ft
600ft
700ft
800ft
900ft
1000ft
1100ft
090-270T
400ft
1500ft
Fender Line & Dock Mark Stationing
Nr 266


Verizon
4:29 PM
96%
Docking Features in PPUs
404ft
120ft
196ft
Distance to Fender Line
Positioned from Surveys
by Port of Long Beach
Vessel Position Relative
To Dock Marks
Basin Six
129-309T
bENCs Enabled
Safety Contour 7.0m
Local Time
16:29
Source
Simulator
Simulator: GPS, COG, SOG, HDG, ROT
GPS Diagnostics
HPE:NA
HDG
ROT
119.3°
3.2°
True
Stbd °/m
COG
SOG
289.2°
-2.0
True
Knots
Docking Marks
Bow
Conning
Stern
905
898
261
Feet
Feet
Feet
Vessel Motion
Bow
0.36
Knots
2.00
0.00
Stern

Ships' agents provide Pilot bridge (Conning) marks or Stern marks, which are painted on the berths but difficult to see at a distance, particularly at night.

Image courtesy of Jacobsen Pilot Service.



Dock Station

Distance from Fender Line & Speed of Approach

Night Application of Fender Line and Dock Marks in SEAiq Pilot

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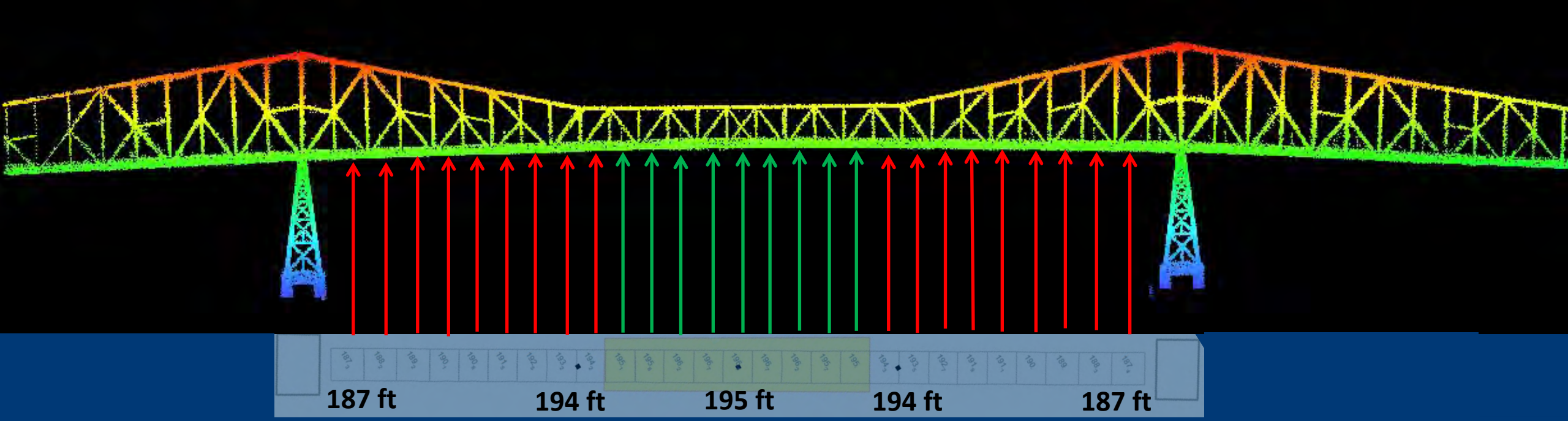

DEA performed a vessel-based laser scan of the Lewis and Clark Bridge to chart clearances relative to the water level reported at the NOAA water level gauge in Longview.

The objective is to provide real-time clearance at intervals across the span relative to actual water level observations at the time of passing.

Air Gap Survey of Lewis and Clark Bridge over Columbia River
Longview, WA

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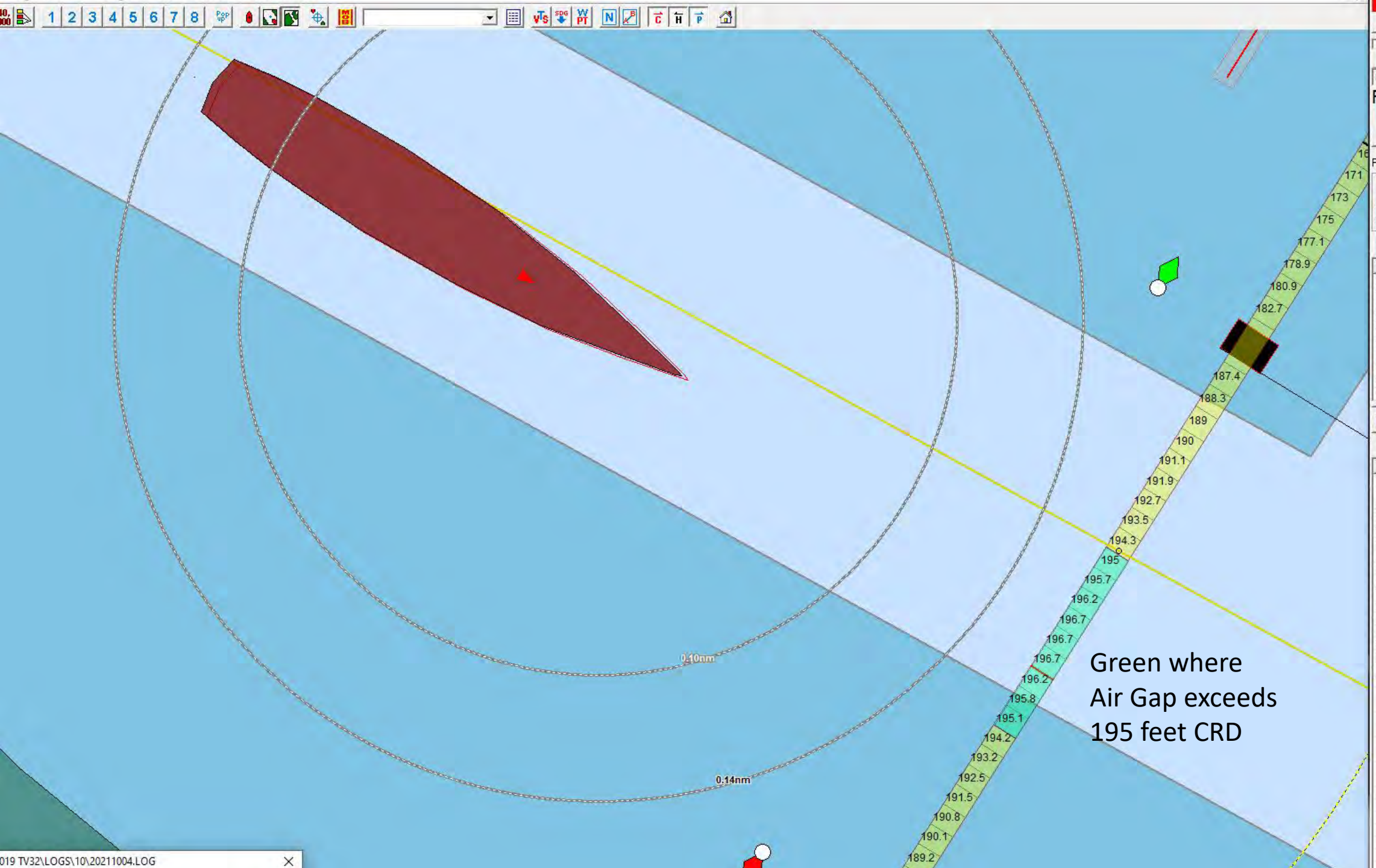

SOG 8.1 kt
spkr
HDG 122.0°T
ROT R 0°/m
ROTI
XTrk R 82 ft
From: center line sailline 0 ft
Next WPT 53 - Longview Bridge
This
Next > Course 118.8°T

Status | Rng/Brg | ETA's | Tides

Station	Tide	Wind
003160...	9.1' unk [21:...	12...
Cape Di...	6.4' /\ [22:12]	
Astoria-...	6.3' /\ [22:12]	4 (...
Skamok...	4.5' /\ [22:12]	
Wauna	4.2' /\ [22:18]	
Westwa...	2.6' /\ [22:10]	
Longview	1.9' /\ [22:18]	
Saint H...	0.9' \/ [22:18]	
Vancou...	1.0' \/ [22:18]	
Morrison...	1.2' \/ [21:35]	

Options... 22:31:54
Standard Times Cur SOG

Waypoin...	Dist	ETA
Pillar Rock		
Three Tre...		
Skamokawa		
Bugby Hole		
Waterford ...		
Erueka Lt ...		
Abernathy...		
Stella		
Millenium		
Longview ...	1115 ft	22:33
Coffin Rock	6.2 nm	23:18
Kalama Elev	9.7 nm	23:44
Columbia ...	15.8 nm	00:30
Warrior R...	18.8 nm	00:52
Morgan T...	29.0 nm	02:08
Kelley Pt	30.7 nm	02:21
Vanc Bert...	33.1 nm	02:39

019 TV32\LOGS\10\20211004.LOG

Real-Time Air Draft Monitoring of *Ruby Princess*

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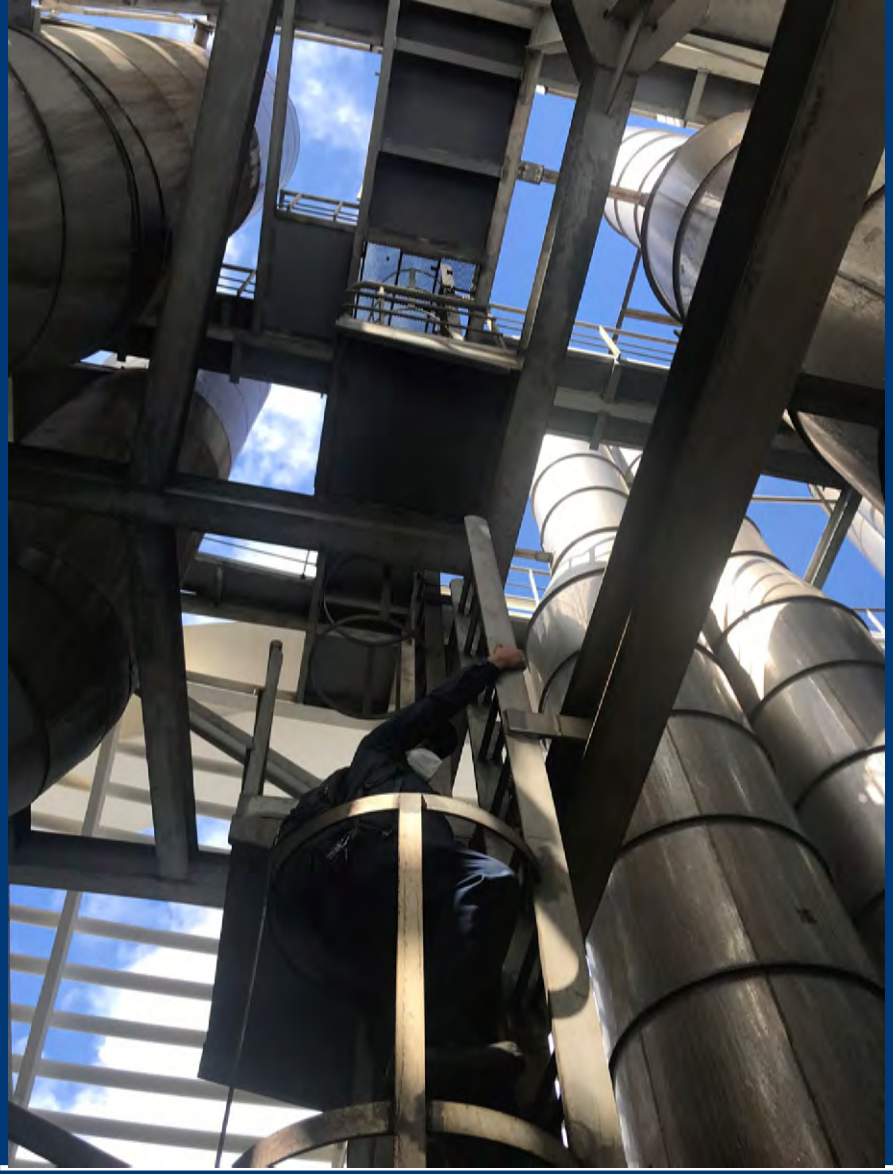

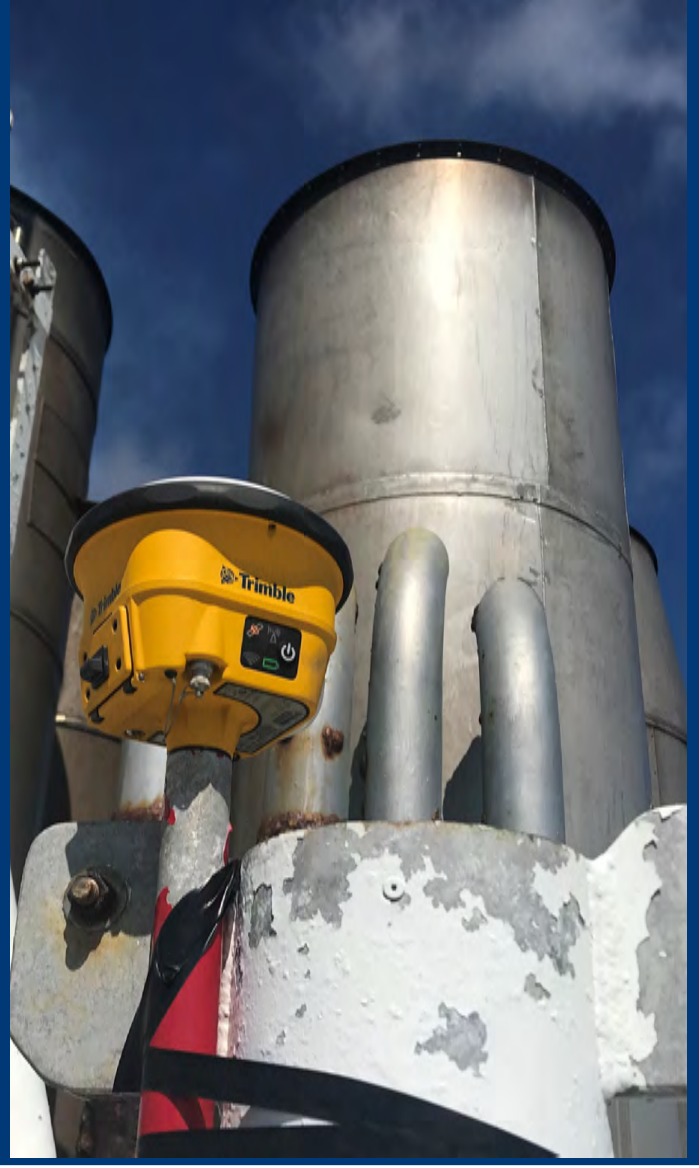

RTK GNSS Static Air Draft Survey of *Caribbean Princess*

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GNSS base station provided corrections for precise height measurements.

Measurements to the water line were observed every 6-minutes to compute water level heights.

Time tagged water levels were compared to a NOAA tide station data.

Static Air Draft Measurement of *Caribbean Princess*

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Air Draft Monitoring of *Caribbean Princess*

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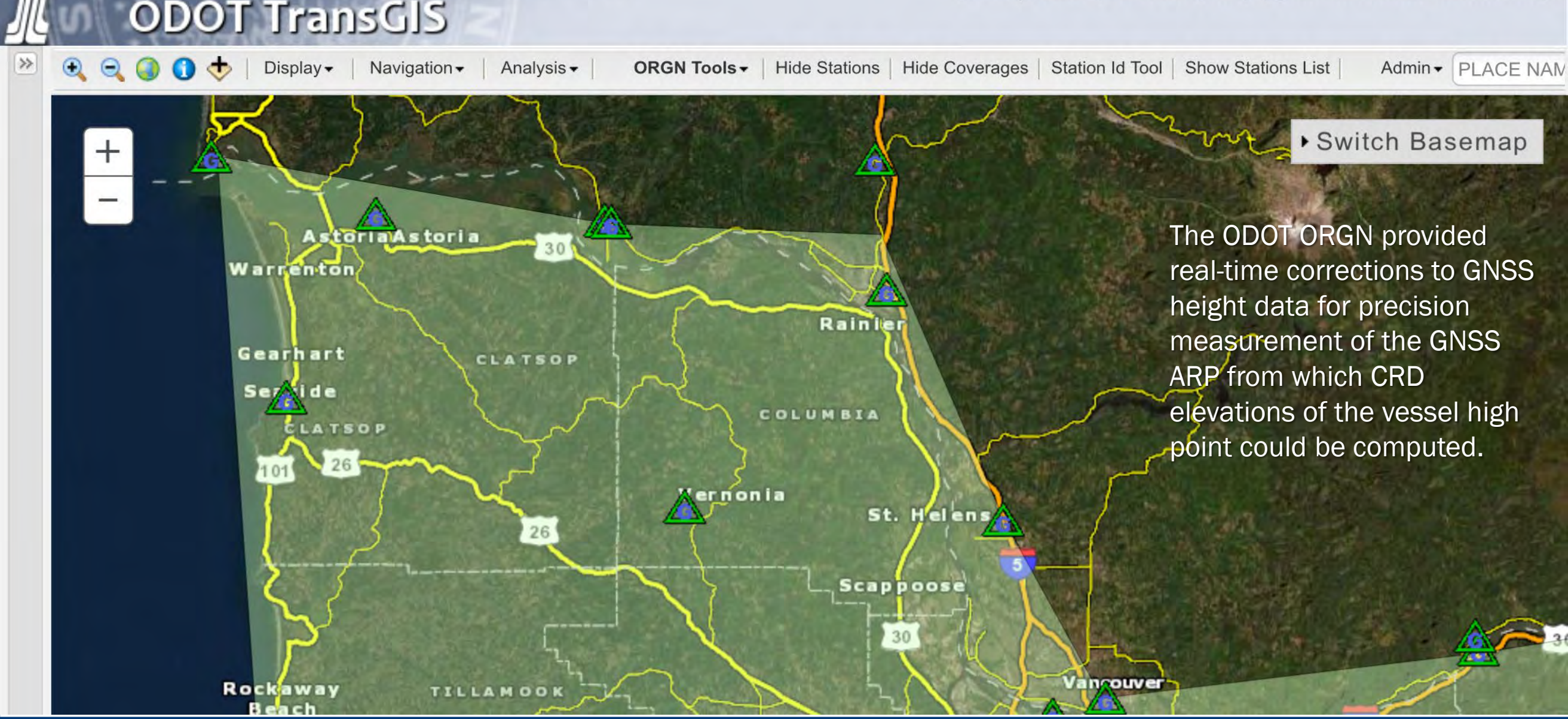

NAVD88 heights using Oregon Realtime GNSS Network

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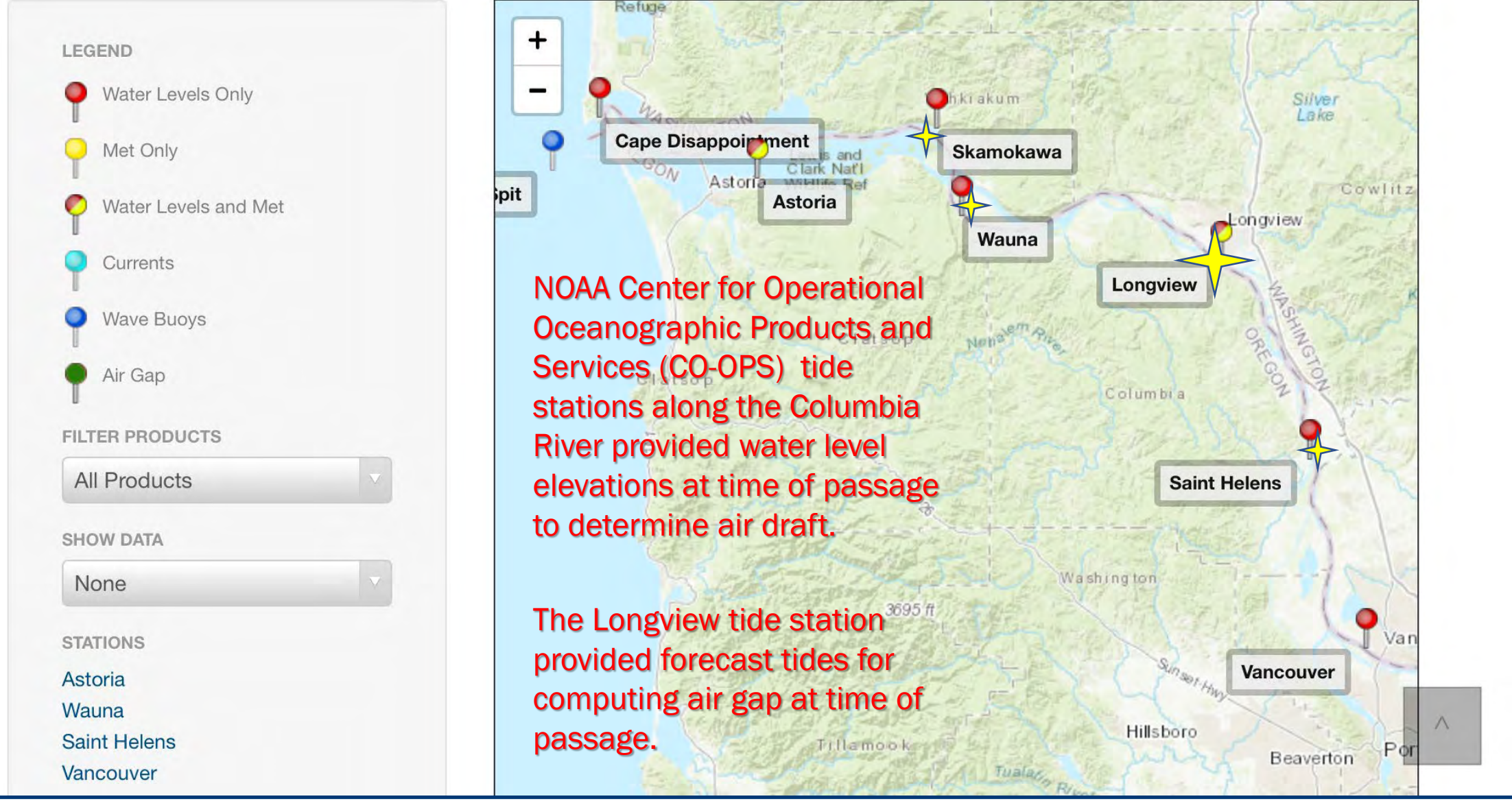

Measuring Dynamic Air Draft at NOAA Tide Stations

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GNSS system with real-time kinematic corrections from Oregon Real-Time Network.

Air Draft computed by taking GNSS height relative to CRD using DEA model, adding height to top of mast, and subtracting tide from NOAA tide stations at Skamokawa, Wauna, and Longview.

Real-Time Air Draft Monitoring of *Ruby Princess*

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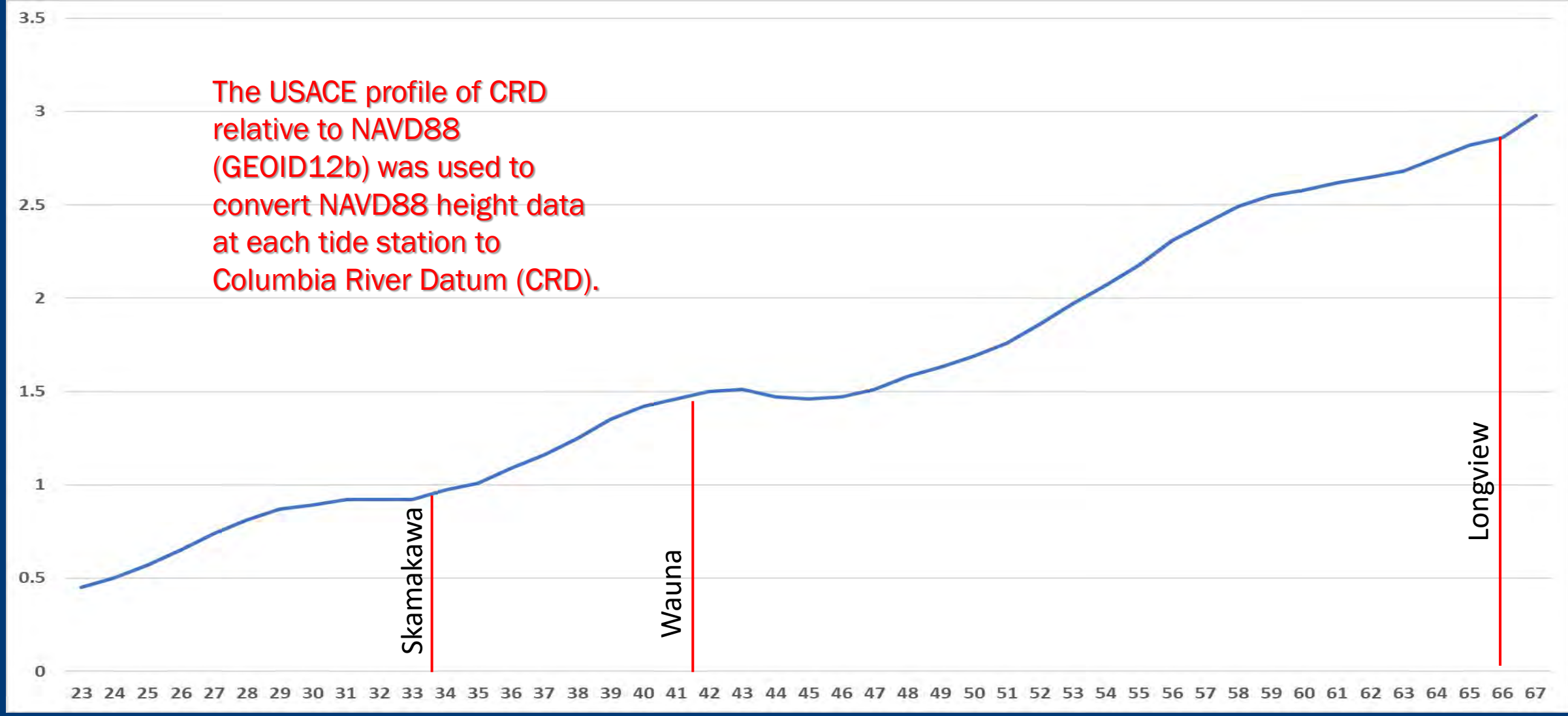

Columbia River Datum Profile Relative to NAVD88

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Skamokawa Air Draft

182.6 feet at 12 kts SOG

Wauna Air Draft

183.5 feet at 9 kts SOG

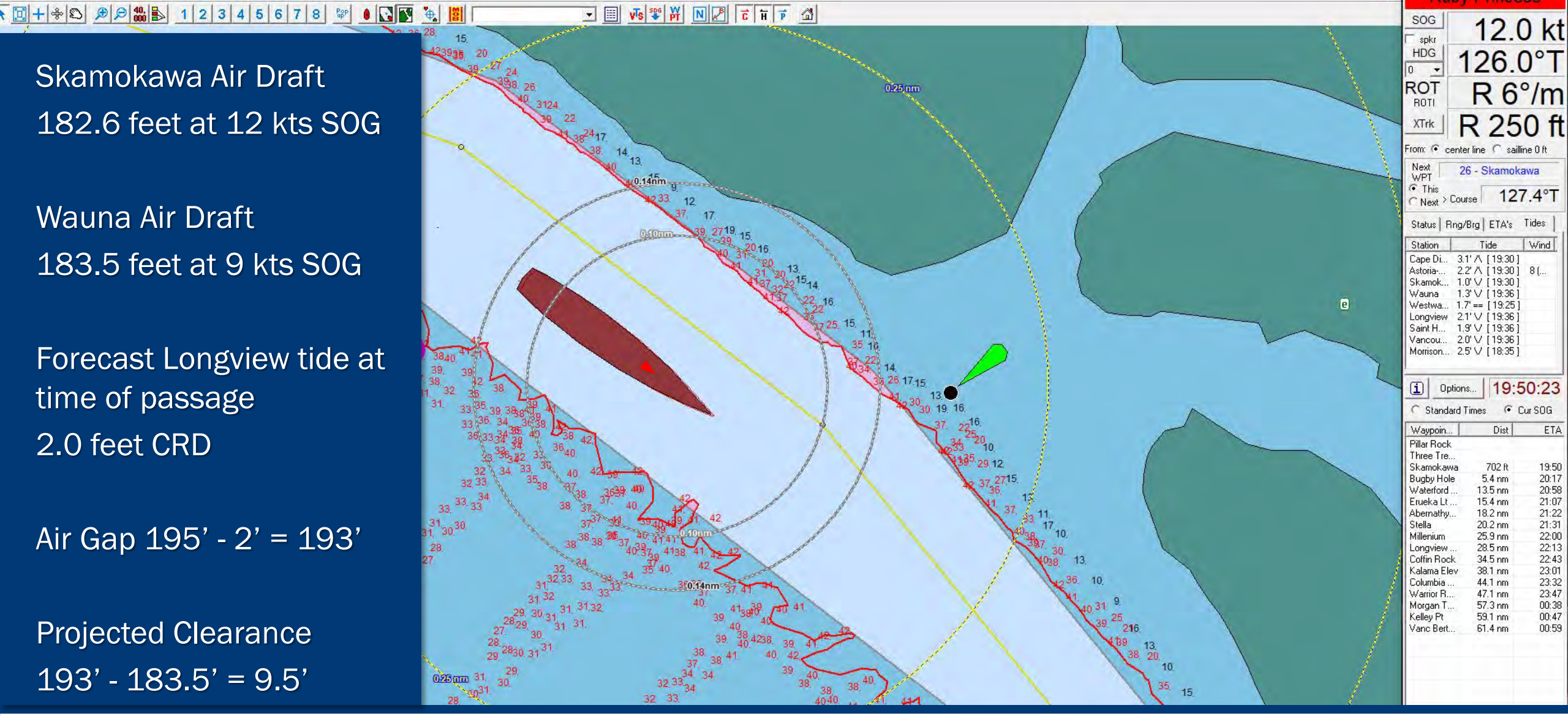
Forecast Longview tide at time of passage

2.0 feet CRD

Air Gap 195’ - 2’ = 193’

Projected Clearance

193’ - 183.5’ = 9.5’



Real-Time Air Draft Monitoring of *Ruby Princess*

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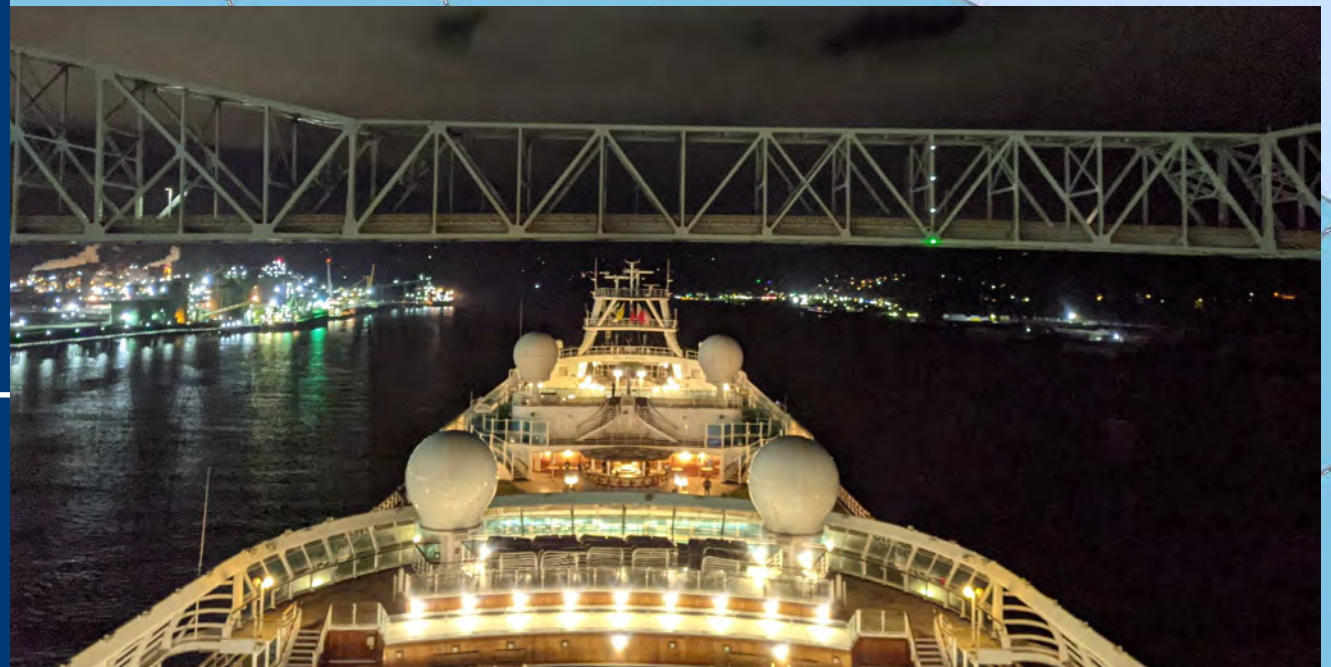
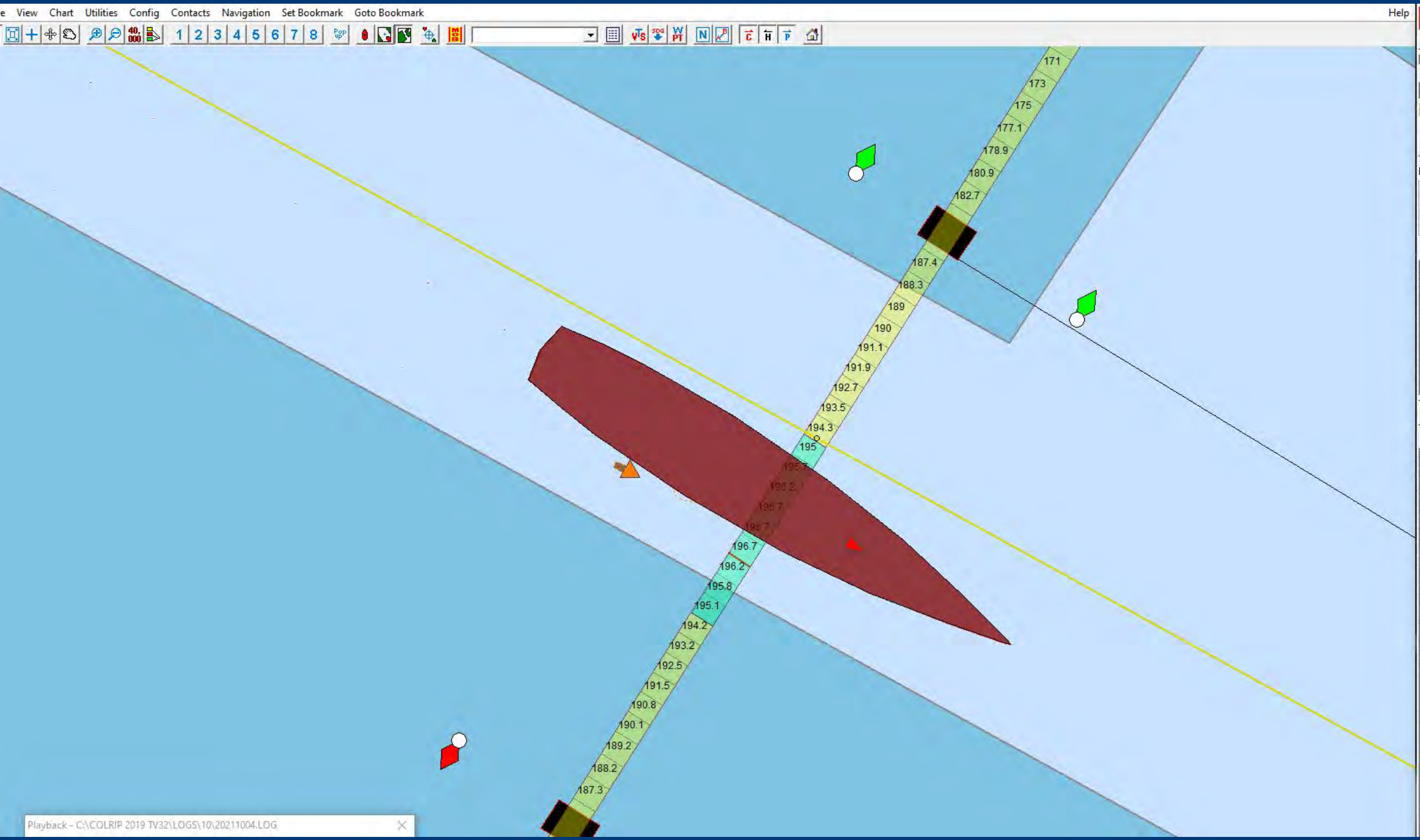
Longview Tide = 2.1’ CRD

Bridge Air Gap 195’ – 2.1’=192.9’

Ruby Air Draft 184.38’ at 8 kts SOG

Clearance = 8.5’





Ruby Princess

SOG 8.4 kt

spkr

HDG 122.0°T

0

ROT R 1°/m

ROTI

XTrk R 131 ft

From: center line sailline 0 ft

Next WPT 54 - Unnamed

This

Next > Course 118.8°T

Status | Rng/Brg | ETA's | Tides

Station	Tide	Wind
003160...	9.1' unk [21:...	12...
Cape Di...	6.4' /\ [22:12]	
Astoria-...	6.3' /\ [22:12]	4 (...
Skamok...	4.5' /\ [22:12]	
Wauna	4.2' /\ [22:18]	
Westwa...	2.6' /\ [22:10]	
Longview	1.9' /\ [22:18]	
Saint H...	0.9' \/ [22:18]	
Vancou...	1.0' \/ [22:18]	
Morrison...	1.2' \/ [21:35]	

Options... 22:33:26

Standard Times Cur SOG

Waypoin...	Dist	ETA
Pillar Rock		
Three Tre...		
Skamokawa		
Bugby Hole		
Waterford ...		
Erueka Lt ...		
Abernathy...		
Stella		
Millenium		
Longview ...		
Coffin Rock	6.0 nm	23:16
Kalama Elev	9.5 nm	23:42
Columbia ...	15.6 nm	00:25
Warrior R...	18.5 nm	00:47
Morgan T...	28.8 nm	02:01
Kelley Pt	30.5 nm	02:13
Vanc Bert...	32.9 nm	02:30

Caribbean Princess Columbia River Transit April 6, 2022													
Time (PDT)	Location	Top of Mast (Feet CRD)	Tide (Feet CRD)	Air Draft (Feet)	SOG (Knts)	Predicted Current (Ebb Positive)	Speed thru Water	Speed Change (Knts)	Air Draft Change (Feet)	Longview Bridge (Feet CRD)	Tide (Feet CRD)	Bridge Air Gap (Feet)	Clearance (Feet)
1233	Skamokawa	182.56	0.62	181.94	11.7	1.00	12.7						
1311	Wauna	184.72	1.06	183.66	6.0	1.6	7.6	-5.1	1.72				
1508	Longview	186.32	2.80	183.52	6.5	2.00	8.5			195.00	2.80	192.20	8.68

Ruby Princess Columbia River Transit October 3, 2021													
Time (PDT)	Location	Top of Mast (Feet CRD)	Tide (Feet CRD)	Air Draft (Feet)	SOG (Knts)	Predicted Current (Ebb Positive)	Speed thru Water	Speed Change (Knts)	Air Draft Change (Feet)	Longview Bridge (Feet CRD)	Tide (Feet CRD)	Bridge Air Gap (Feet)	Clearance (Feet)
1953	Skamokawa	183.70	1.07	182.63	12.0	1.00	13						
2028	Wauna	185.09	1.59	183.50	9.0	1.3	10.3	-2.7	0.87				
2233	Longview	186.18	2.09	184.09	8.4	0.50	8.9			195.00	2.09	192.91	8.82

Air Draft Relative to Vessel Speed

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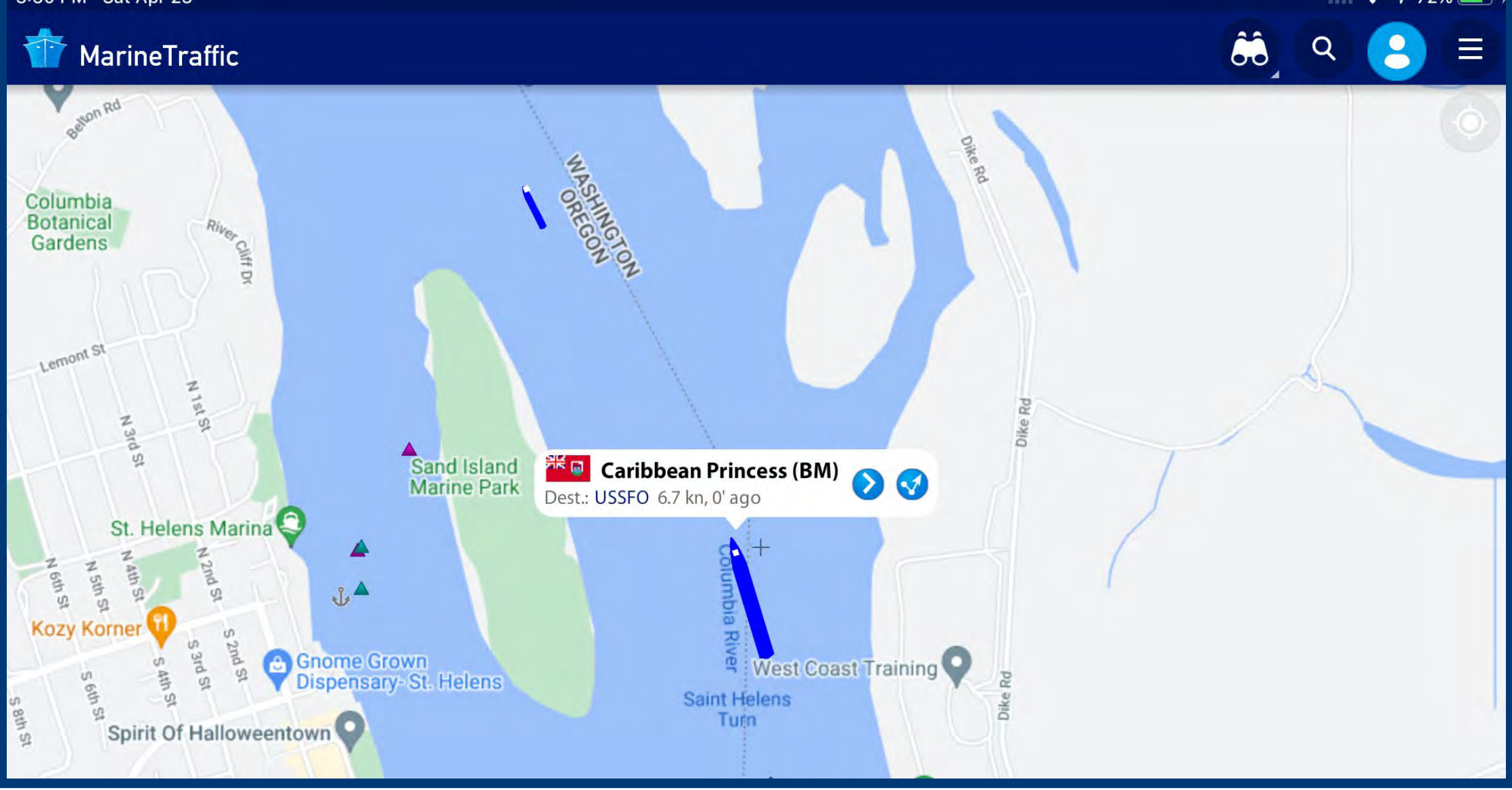
Medallion Net
Medallion Net



St. Helens outbound air draft measurement with 2 knot ebb current (4.7 knots through the water)

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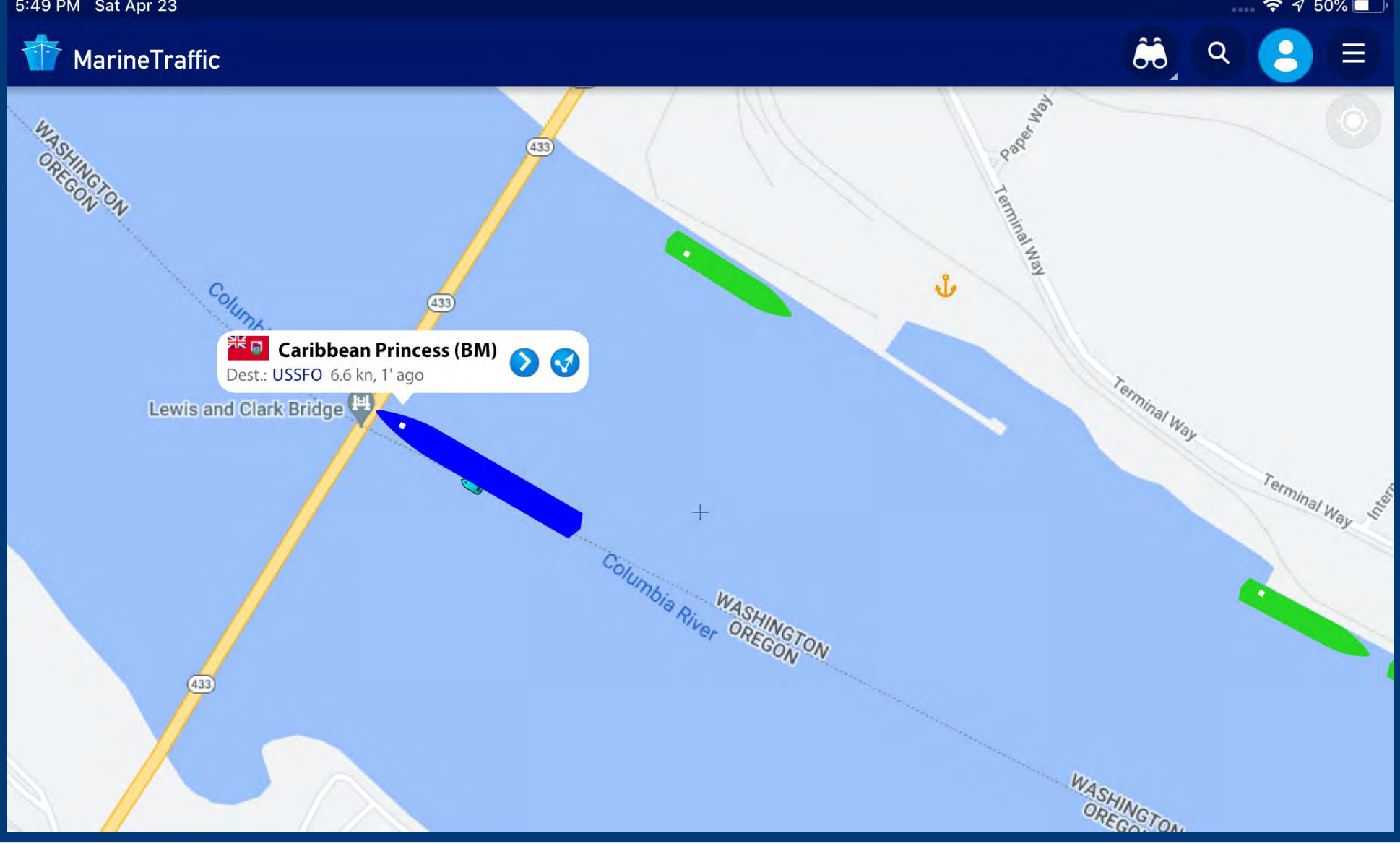

Longview outbound clearance 6.5 feet with 2 knot ebb current (4.6 knots through the water)

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CARIBBEAN PRINCESS

DAVID EVANS AND ASSOCIATES INC.
MARINE SERVICES


Celebrity ECLIPSE

DAVID EVANS AND ASSOCIATES INC.
MARINE SERVICES

Thank You

Jon Dasler, PE, PLS, CH
jld@deainc.com

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AND ASSOCIATES INC.

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