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Sample Motion and Load Measurements of the RAstar Tug “Svitzer North” at Geraldton

Tug Svitzer North with bulk carrier Xiang Ming Yang

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1. Introduction

Tug observations were done on the 30m RAstar tug “Svitzer North” (70 tonne bollard pull), shown in Figure 1.

Figure 1: Svitzer North, 4th December 2025

The 28m TRAktor tug sisterships “Svitzer Abrolhos” and “Svitzer Wilu” were also in attendance. These are shown in Figure 2.

Figure 2: Svitzer Abrolhos and Svitzer Wilu, 4th December 2025

The following ship transits were undertaken:

- Bulk carrier “Crimson Wyoming”
  - 4th December 2025
  - 179.9 x 28.4m, inbound to Berth 4
  - Pilot Shannon Nicholson
  - Svitzer North at centre lead aft
- Bulk carrier “Xiang Ming Yang”
  - 5th December 2025
  - 229.2 x 38.0m, outbound from Berth 7
  - Pilot Scott Beevers
  - Svitzer North at centre lead aft
- Bulk carrier “Yu Shun”
  - 5th December 2025
  - 229.9 x 36.0m, inbound to Berth 7
  - Pilot Warren Sharpe
  - Svitzer North on port shoulder.

The Geraldton channel is shown in Figure 3. The numbered beacons will be used to show location in the channel.

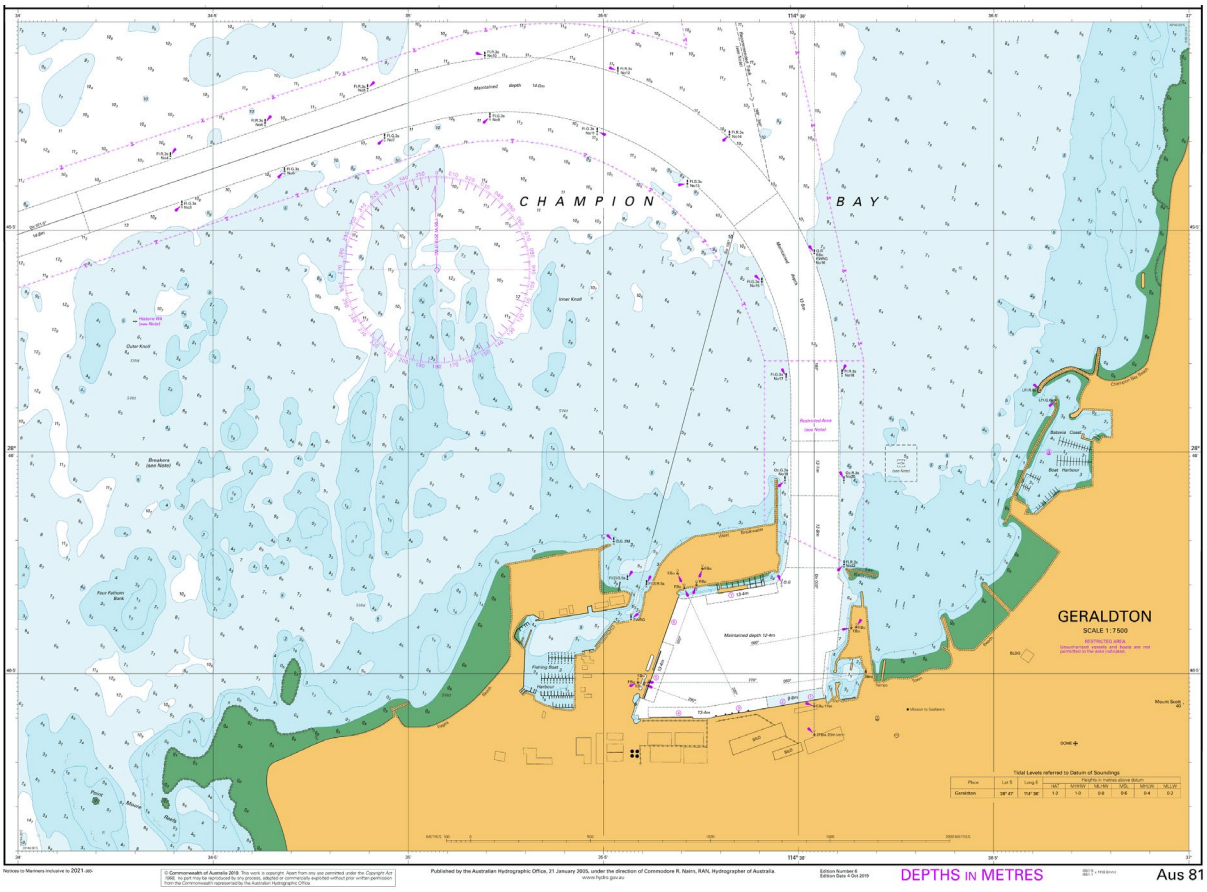


Figure 3: Extract from chart AUS81

2. Test case

Here we show sample results for the outbound transit of Xiang Ming Yang on 5th December. Motions were measured at 2 Hz using the SensorLog app on an iPhone 12. The phone was oriented fore-aft, as shown in Figure 4.

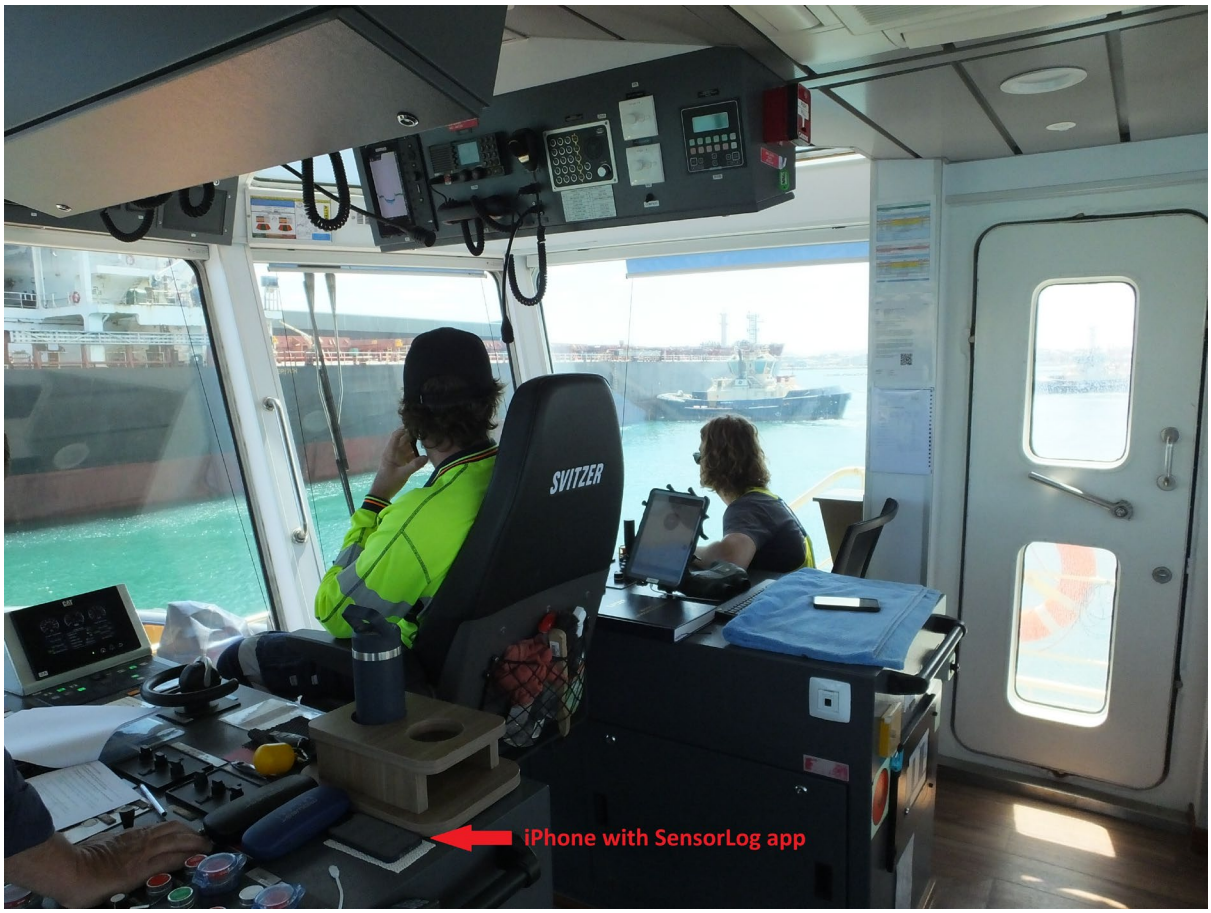


Figure 4: Showing iPhone on the tug bridge, aligned fore-aft to measure position, accelerations, and roll, pitch and yaw motions.

The iPhone 12s is well-suited to motion measurements of small-to-medium size boats, as it includes a 3-DoF linear accelerometer and 3-DoF angular gyrocompass, synchronized to GPS time, giving 6-DoF high-frequency motions. Published roll/pitch data for an older iPhone 5s shows RMS roll and pitch error of 0.15° while stationary, and 0.3 – 0.4° at typical small-to-medium size boat rotation rates of 10 – 20°/s (Mourcou et al. 2015, Tables 3 – 5). Published accelerometer data for Samsung Galaxy S5 and S6 shows RMS accelerometer error of around 0.02 g at typical small-to-medium size boat motion periods of above 1 second. Grouios (2022) showed similar performance of the iPhone 12s accelerometer compared to the Samsung Galaxy accelerometers. For the roll and pitch measured during these trials, the RMS errors may be expressed as a percentage of the measured values as shown in Table 1.

Expected percentage error in motion measurements			
	Typical measured value	*Expected error value*	*Expected error percent*
Roll angle	~7°	0.35°	5%
Pitch angle	~2.5°	0.35°	15%

Table 1: Expected measurement error

Svitzer North was operating in escort mode, using the towline from the forward staple, as shown in Figure 5.

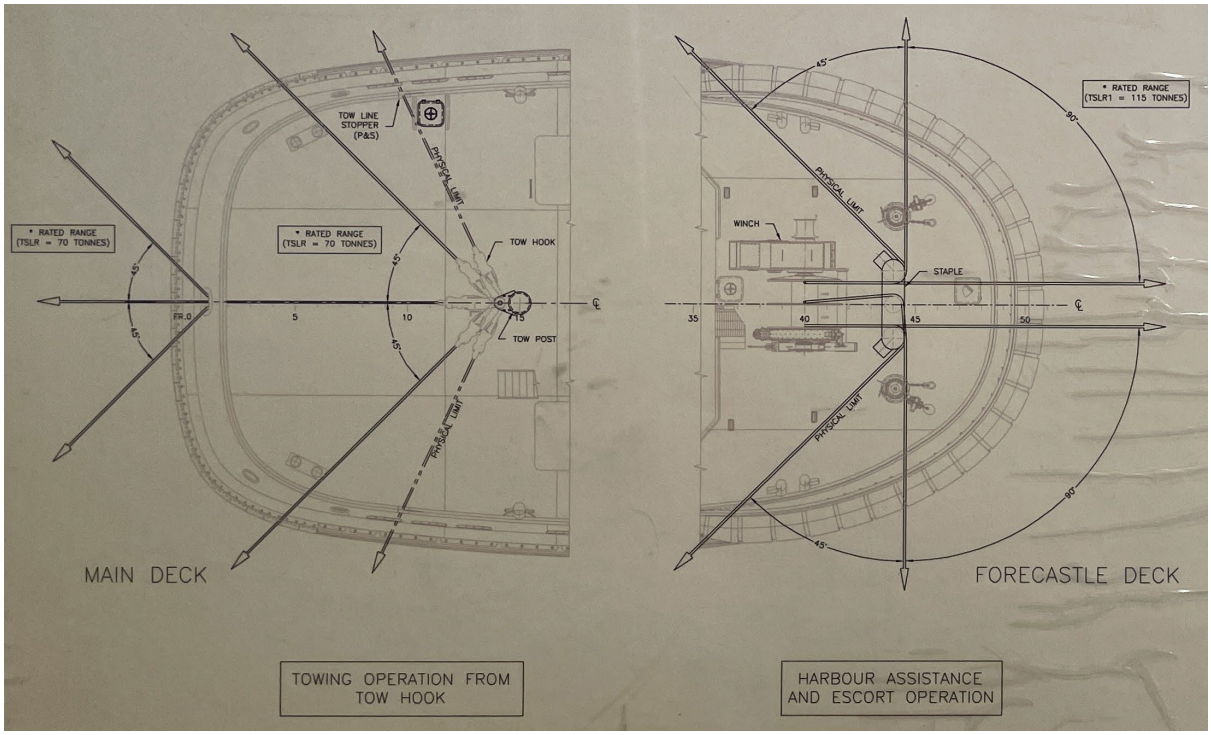


Figure 5: Towing modes for Svitzer North. These measurements were done in escort mode, as shown on right of image.

Svitzer North has a large skeg to generate side force during indirect tow, as shown in Figure 6. The towing pennant is shown in Figure 7.

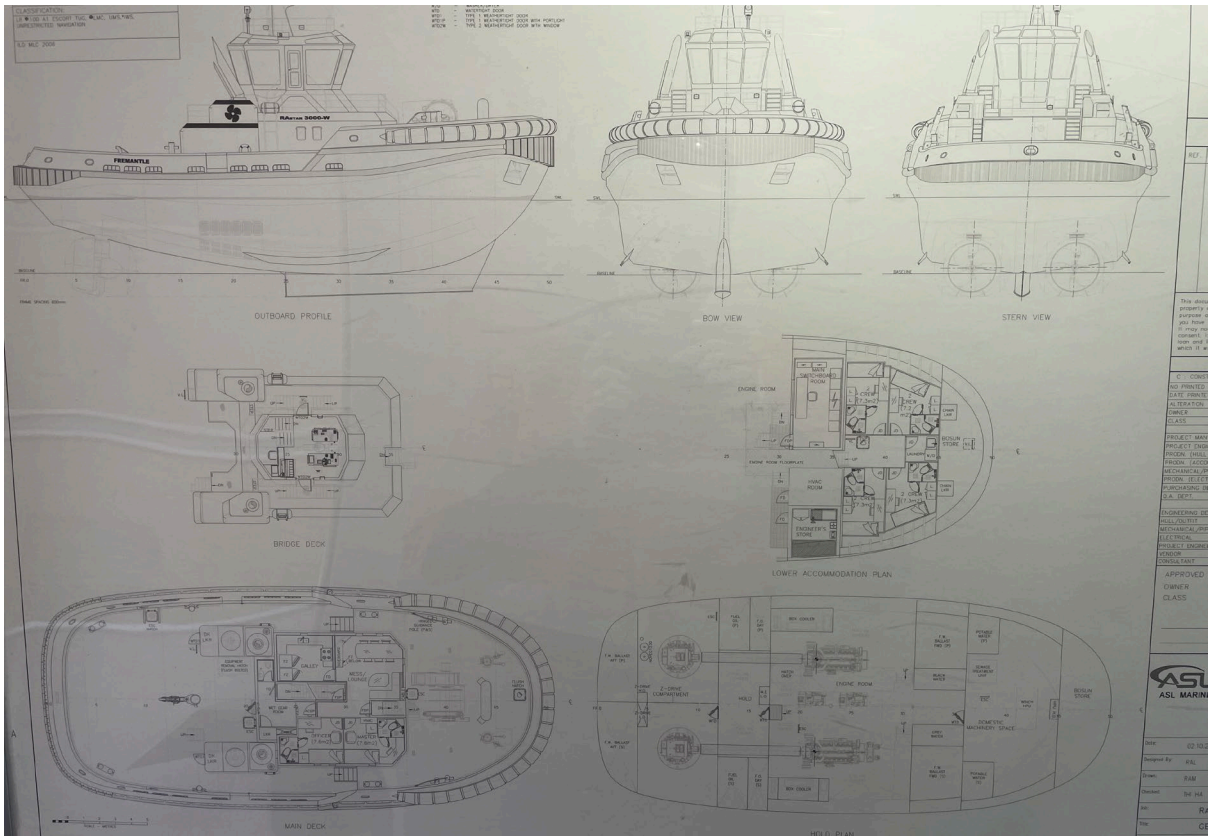


Figure 6: Hull shape of Svitzer North, showing large forward skeg for developing transverse forces

Figure 7: 24m towing pennant (purple plasma rope)

Winch specifications are shown in Figure 8.

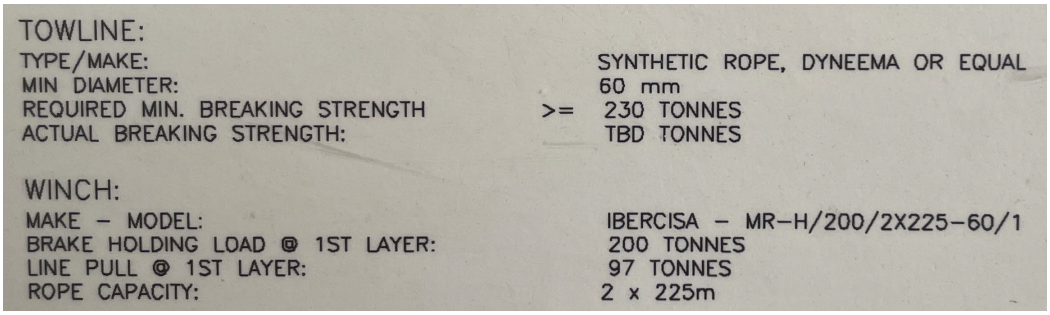


Figure 8: Svitzer North winch specifications

Towline specifications are shown in Figure 9.

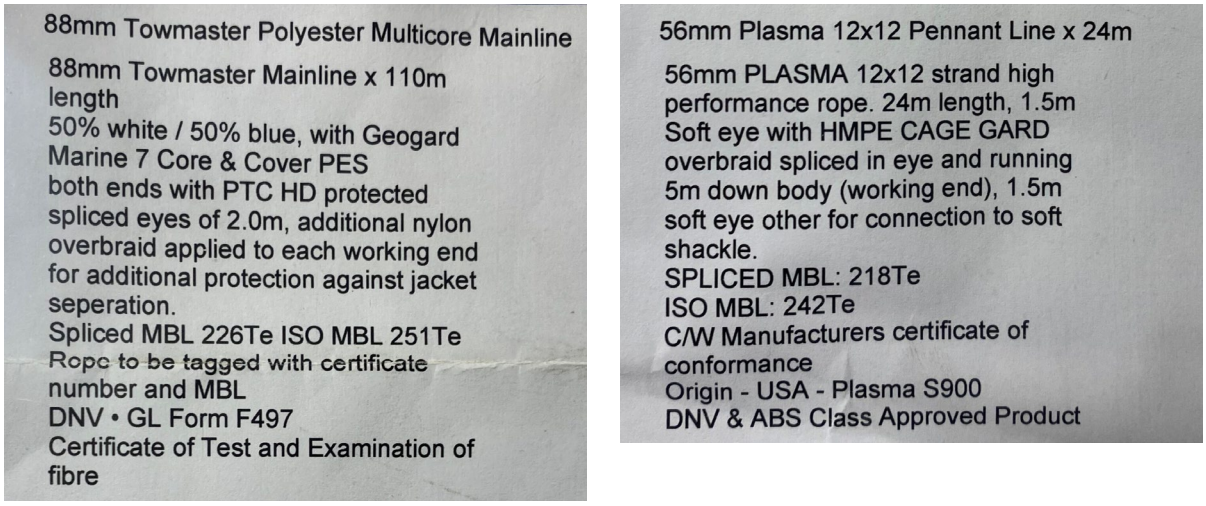


Figure 9: Svitzer North towline specifications for main line (left) and plasma pennant (right)

Line tensions were measured by the winch load cell, as shown in Figure 10.

Figure 10: Svitzer North bridge display, showing line tension and length

Measured tug motions are shown in Figure 11. Motion snapshots are shown in Figure 12 to Figure 17.

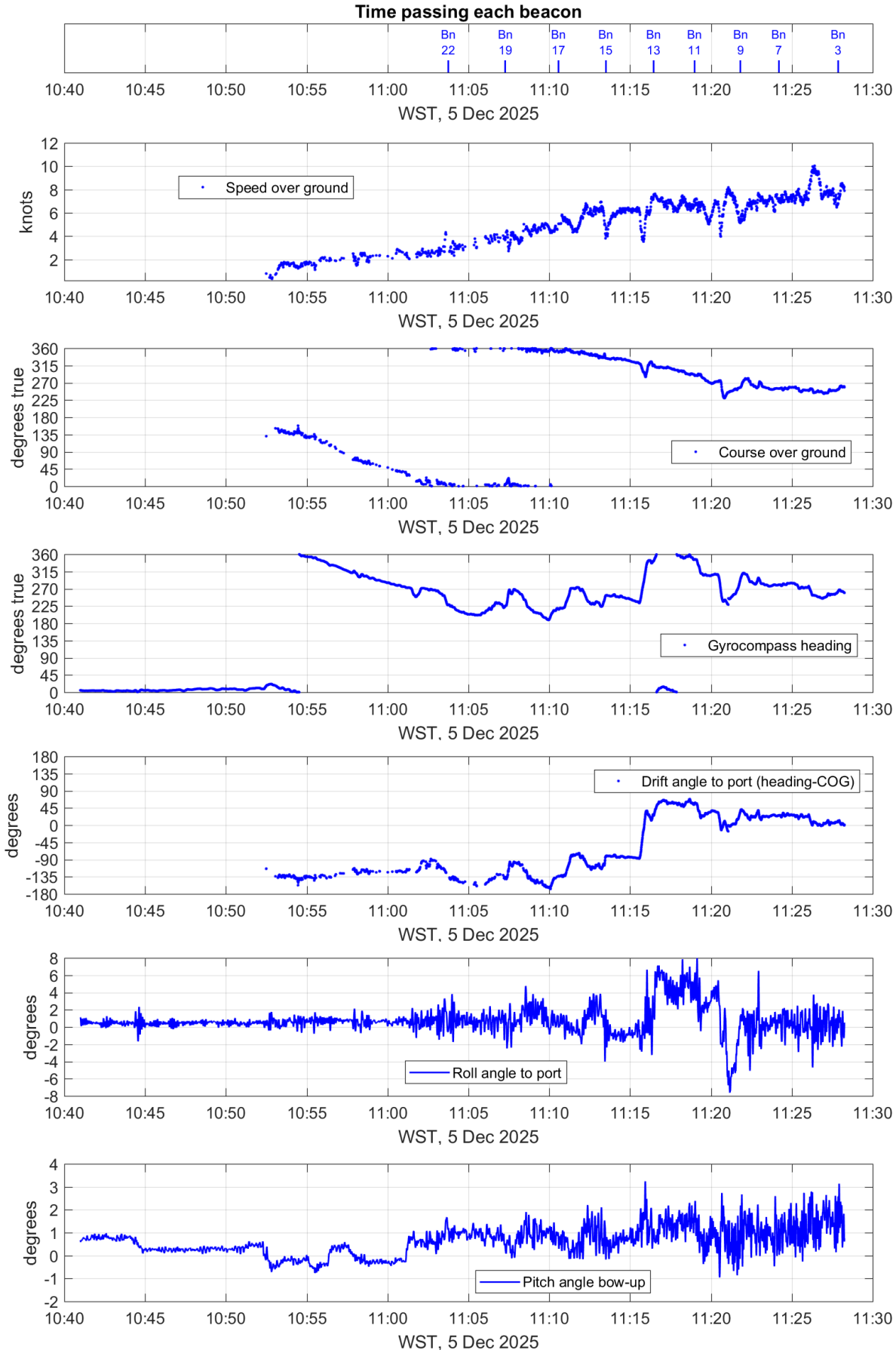


Figure 11: Measured tug motions during outbound transit of Xiang Ming Yang

Figure 12: IMG_5321, taken 10:56, direct tow, speed 2 knots, line tension 40 tonnes, pitch 0.5° bow-up

Figure 13: IMG_5331, taken 11:05, direct tow, speed 3 knots, line tension minimum

Figure 14: IMG_5339, taken 11:12, Bn 15-17, direct tow, speed 5 knots, line tension 30 tonnes, heel 2° to starboard, drift angle 90° to starboard

Figure 15: IMG_5347, taken 11:19, Bn11, indirect tow, speed 6 knots, line tension 20 tonnes, heel 6° to port, drift angle 45° to port

Figure 16: IMG_5350, taken 11:22, Bn9, speed 7 knots, line tension briefly 30 tonnes to arrest ship rate of turn, heel briefly 8° to starboard

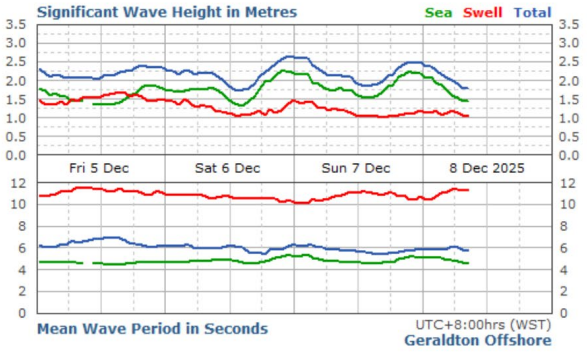
Figure 17: Image 5354, taken 11:25, Bn7-5, speed 8 knots, reeling in to disconnect.

3. Wave measurements

Sea and swell at the time of the Xiang Ming Yang transit, were each around 1.5 m, as shown in Figure 18. Wind was southerly 10-15 knots.

Geraldton Wave significant wave height graph

The significant wave height is the average height of the highest one third of waves recorded. It is often the wave height reported by an experienced observer.



Geraldton Wave historical wave direction graph

The coloured circles indicate the changes in sea and swell direction over time.

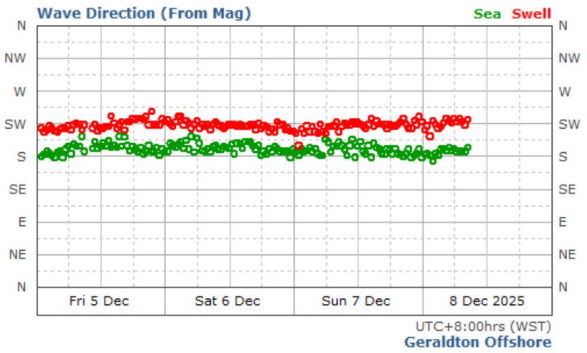


Figure 18: Measured wave data during Xiang Ming Yang test case on 5th December 2025. Data from www.transport.wa.gov.au

4. Acknowledgements

The author acknowledges the assistance of the Svitzer North crew Luke Ritchie, Craig Pike and Reece Towers, and pilot Scott Beevers, in conducting the Xiang Ming Yang measurements; also Ray Pead (Mid West Ports) and Brock Franklin (Svitzer) in arranging the 2 days of tug observations.

5. References

Grouios, G., Ziagkas, E., Loukovitis, A., Chatzinikolaou, K., Koidou, E. (2023) Accelerometers in our pocket: does smartphone accelerometer technology provide accurate data? Sensors, Vol. 23.

Mourcou, Q., Fleury, A., Franco, C., Klopcic, F., Vuillerme, N. (2015) Performance evaluation of smartphone inertial sensors measurement for range of motion. Sensors, Vol. 15.