



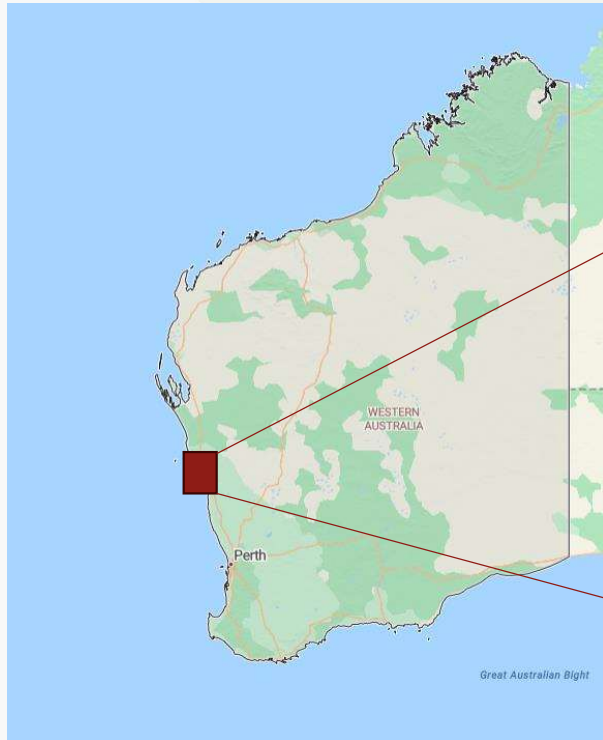
New Berth Selection - Geraldton Port

Adam Bartle

PIANC APAC 2024, Sydney

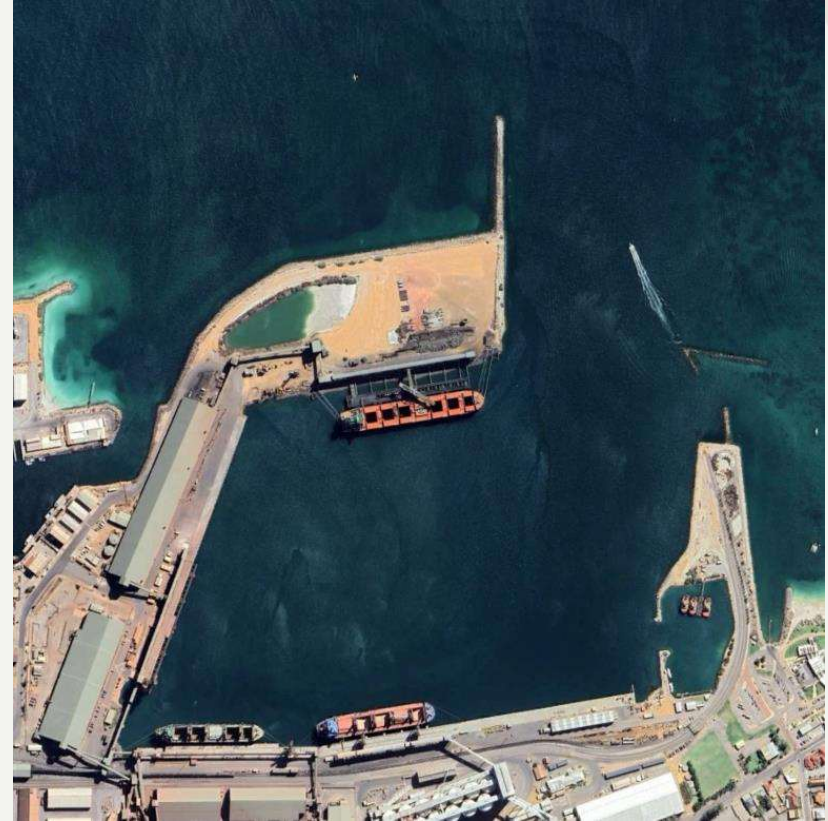


Geraldton, Western Australia



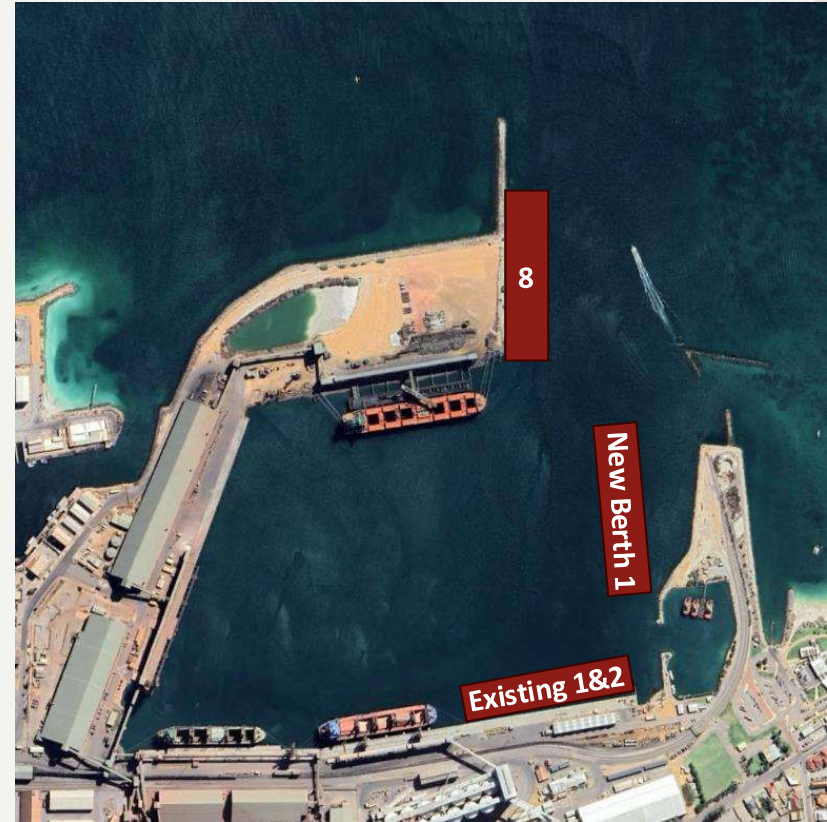
Geraldton Port - PMaxP

- The Port Maximisation Plan (PMaxP) is a major infrastructure project at the Geraldton Port
- BG&E Resources (BGER) has been awarded the Engineering, Procurement, Construction and Management (EPCM) contract for PMaxP.
- PMaxP key target to increase trade at Geraldton Port from 15MT to around 25MT per annum over the next 10 years
- The project includes several port layout changes, including addition of a new dry bulk export berth



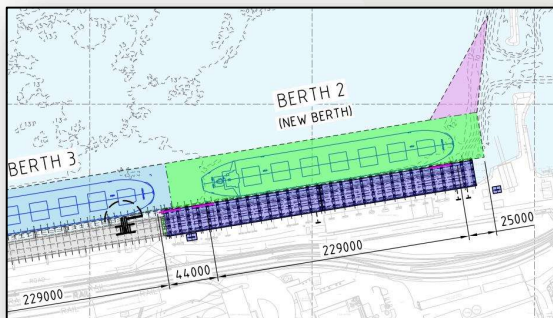
Geraldton Port – LPW's

- Geraldton Port is impacted by both swell and long period waves (LPW) resulting in broken mooring lines, berthing constraints, and operational downtime.
- Existing Berth 1/2 location has the lowest operability at the Port
- Previous studies completed indicate engineering solutions such as alternative fendering and Shore Tension Units are unlikely to achieve the target operability thresholds.

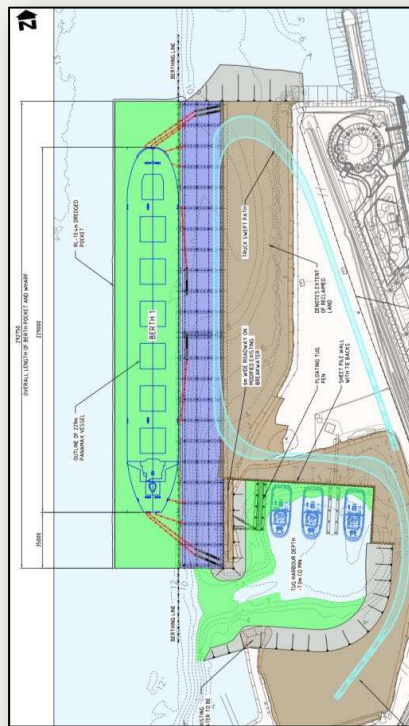


Option Development

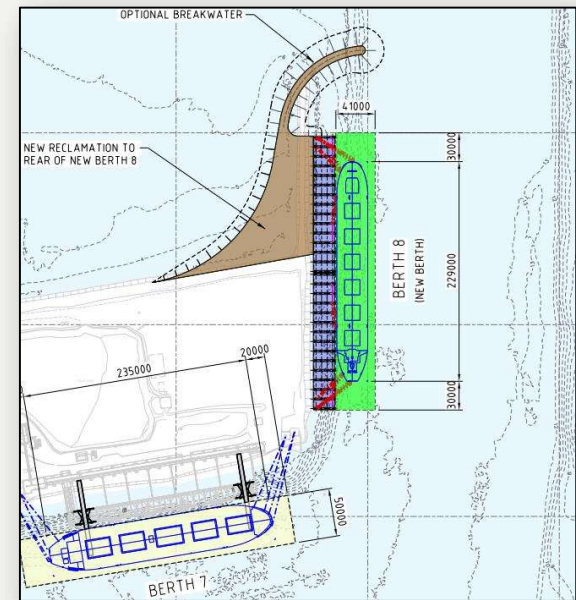
New Berth 2 (Option 1)



New Berth 1 (Option 2)



New Berth 8 (Option 3)



Basis of Design – New Berth Concept

Functional Requirements

- Berth operability to be equal to or better than existing Berths 4-7 (i.e. LPW threshold of 12cm)
- No adverse impact to existing Berths 3-7 operability

**Berth 3 -4 Recorded Data -
12 Years from 28th May 2010 to 23rd Jan 2022**

Wave Height (m)	Long Wave Period Tp (s)																	Total	
	25-40	40-55	55-70	70-85	85-100	100-115	115-130	130-145	145-160	160-175	175-190	190-205	205-220	220-235	235-250	250-265	265-280		280-295
0-0.04	2.4%	1.2%	4.4%	0.0%	0.3%	0.0%	0.1%	0.0%	6.5%	9.4%	1.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.9%
0.04-0.08	3.8%	1.5%	7.3%	0.0%	0.4%	0.0%	0.1%	0.0%	10.5%	18.9%	2.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	45.3%
0.08-0.12	1.6%	0.5%	2.4%	0.0%	0.2%	0.0%	0.0%	0.0%	3.3%	7.1%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	15.9%
0.12-0.16	1.1%	0.3%	0.9%	0.0%	0.1%	0.0%	0.0%	0.0%	1.1%	2.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.3%
0.16-0.2	0.8%	0.2%	0.4%	0.0%	0.1%	0.0%	0.0%	0.0%	0.5%	1.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%
0.2-0.24	0.5%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
0.24-0.28	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
0.28-0.32	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
0.32-0.36	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
0.36-0.4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.4-0.44	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.44-0.48	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
>0.48	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	10.7%	3.8%	15.7%	0.0%	1.1%	0.0%	0.2%	0.0%	22.2%	39.4%	4.4%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%

Berth	Long Period Wave Height (Surge limit)
1 & 2	5cm
3	15cm
4	12cm
5	12cm
6	12cm
7	12cm

Berth Option Analysis Approach

Harbour Wave Modelling

- FUNWAVE Boussinesq model
- 20 representative events from long term data record
- Validation against measured data



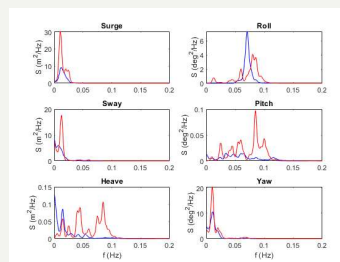
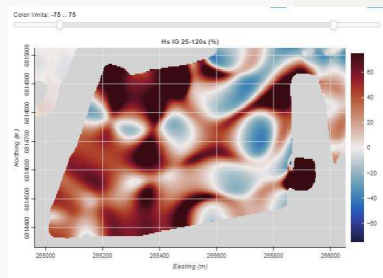
Dynamic Mooring Analysis

- Baird extensive experience in harbour dynamics
- Harberth – wave loads directly coupled to FUNWAVE surface elevations and velocities
- Quaysim – Ship motions
- Detailed validation against measured data

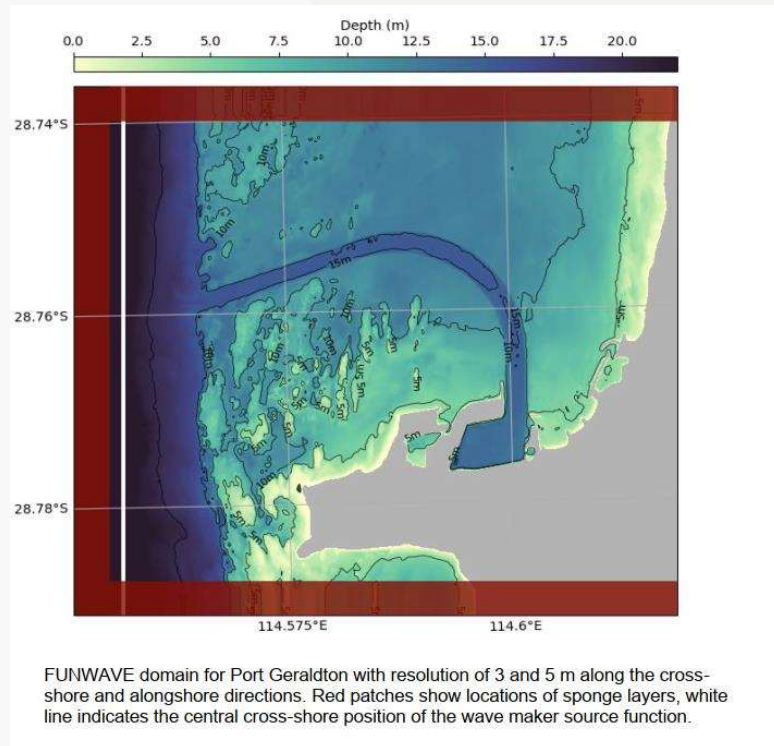


Project Decision

- Extensive Stakeholder Engagement
- Independent Reviews
- Multi Criteria Assessment with MWPA and Project Team



Harbour Wave Modelling



A representative subset of 20 events was selected from measured offshore wave climate.

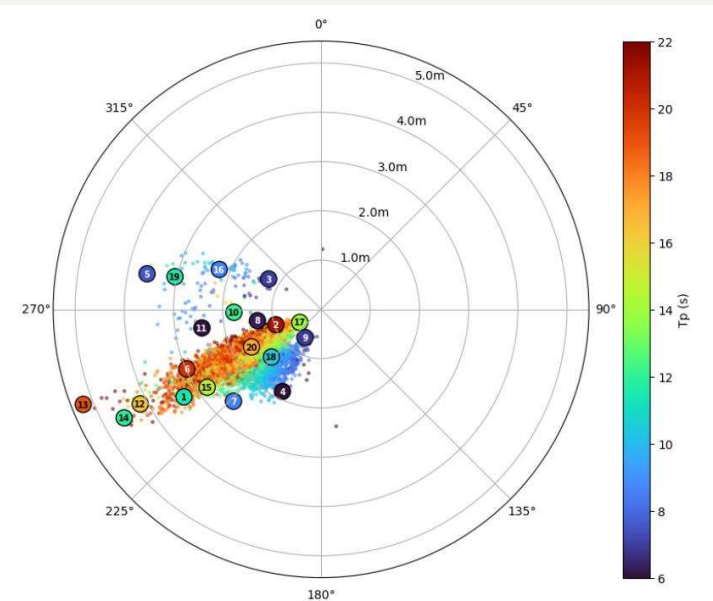
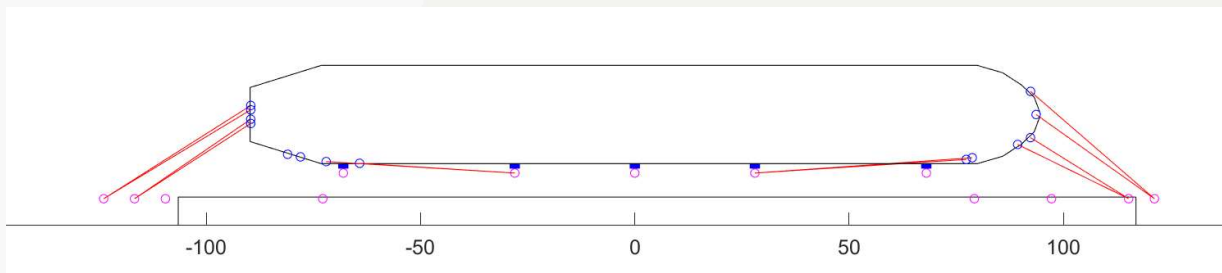


Figure 2.2 Representative subset of the offshore wave climate defined from the MDA on the measured spectral data. The polar scatter shows the spread of the measured data (dots) and the 20 selected events (circles) with the polar radius and directions representing H_s and D_{pm} , and colours indicating T_p .

Dynamic Mooring Analysis

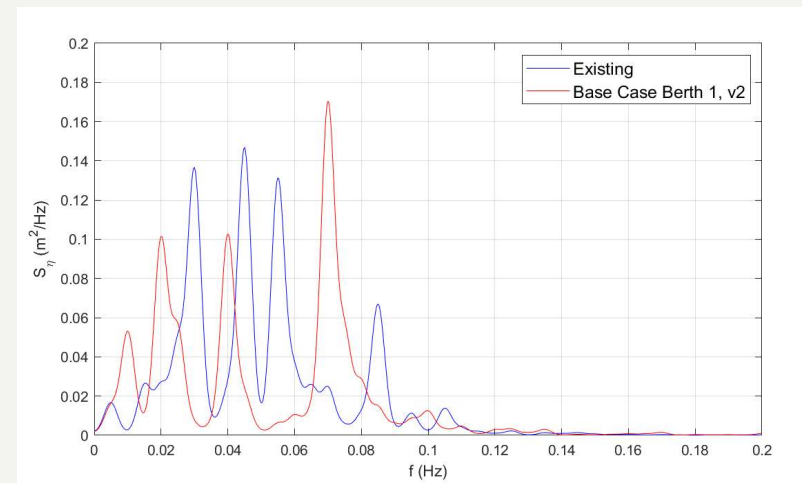
- Directly coupled approach with full wave model output at each berth used to determine forces on the vessel.
- Detailed comparison against measured data at Berth 3/4.
- Inclusion of STU's (60t max, 4.3m cylinder stroke)
- Key events selected for comparison.



Berth 1 Impact on Other Berths

Overview

- Modelling for the New Berth 1 option showed an impact to both LPW and swell conditions at other berths.
- The relative impact was generally greater for LPW than swell waves. For typical LPW conditions the impact was relatively minor.
- Impacts to both amplitudes and node positions.
- Optioneering with Berth 1 orientation to mitigate impacts.



New Berth Selection

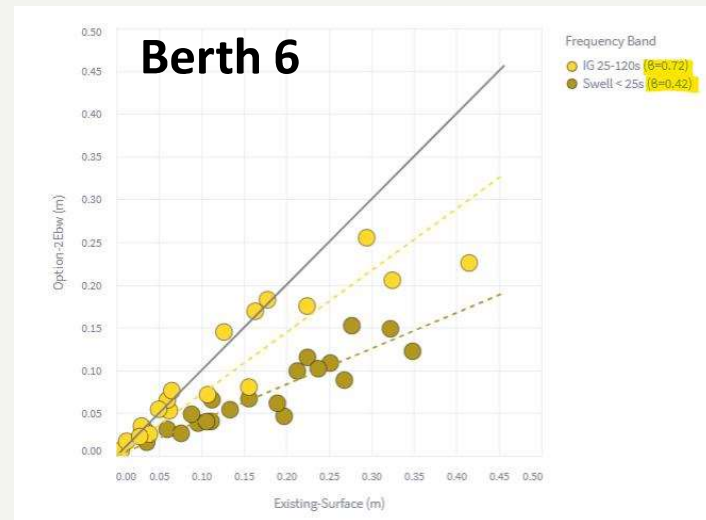
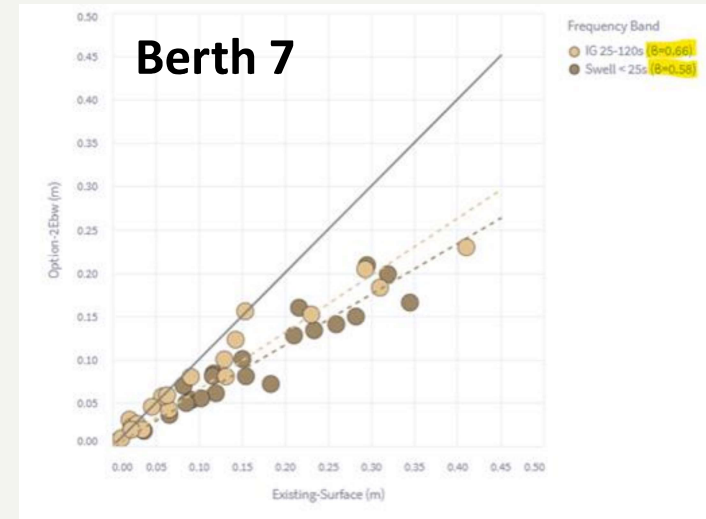
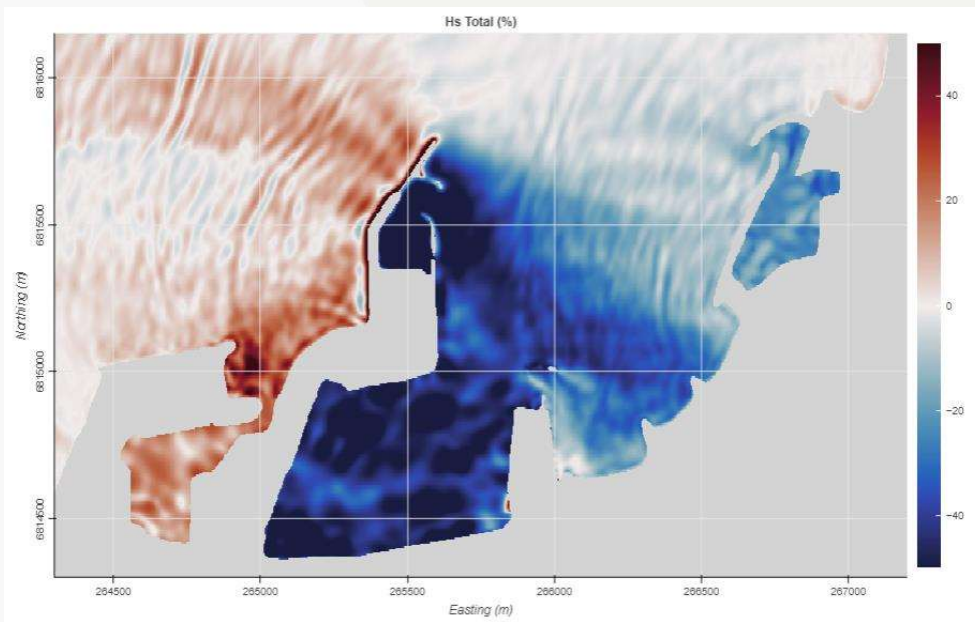
- Berth 1 with optimised alignment selected as preferred.
- Selected through MCA process involving multiple stakeholders.
- Final operability study ongoing based on modelled layout and Dynamic Mooring Analysis



Ongoing Work – New Tug Harbour



Ongoing Work

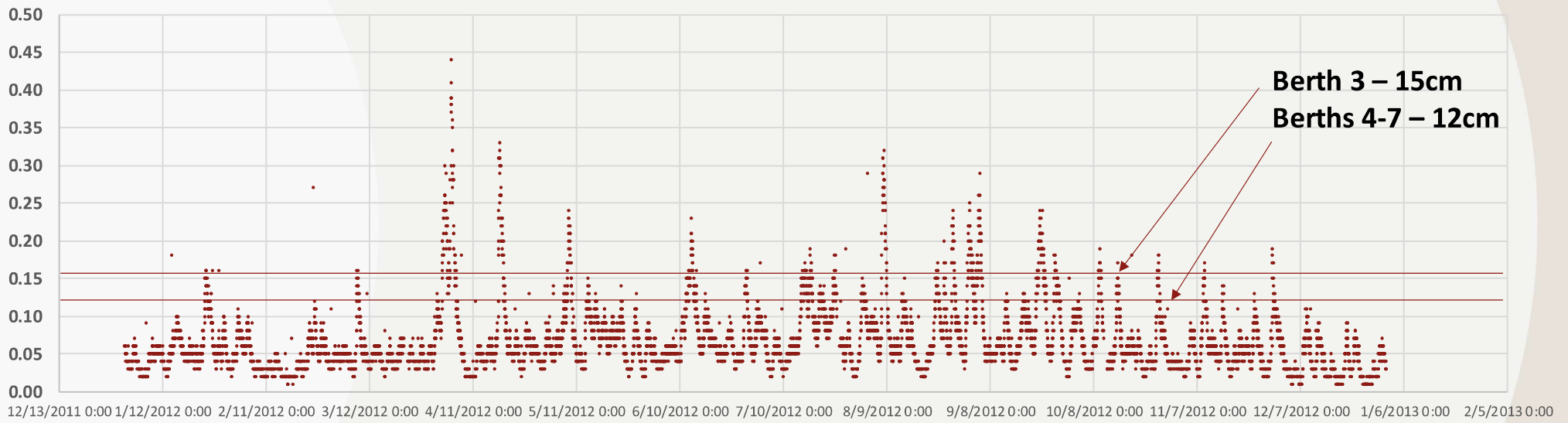


Berth 3-4 Recorded LPW

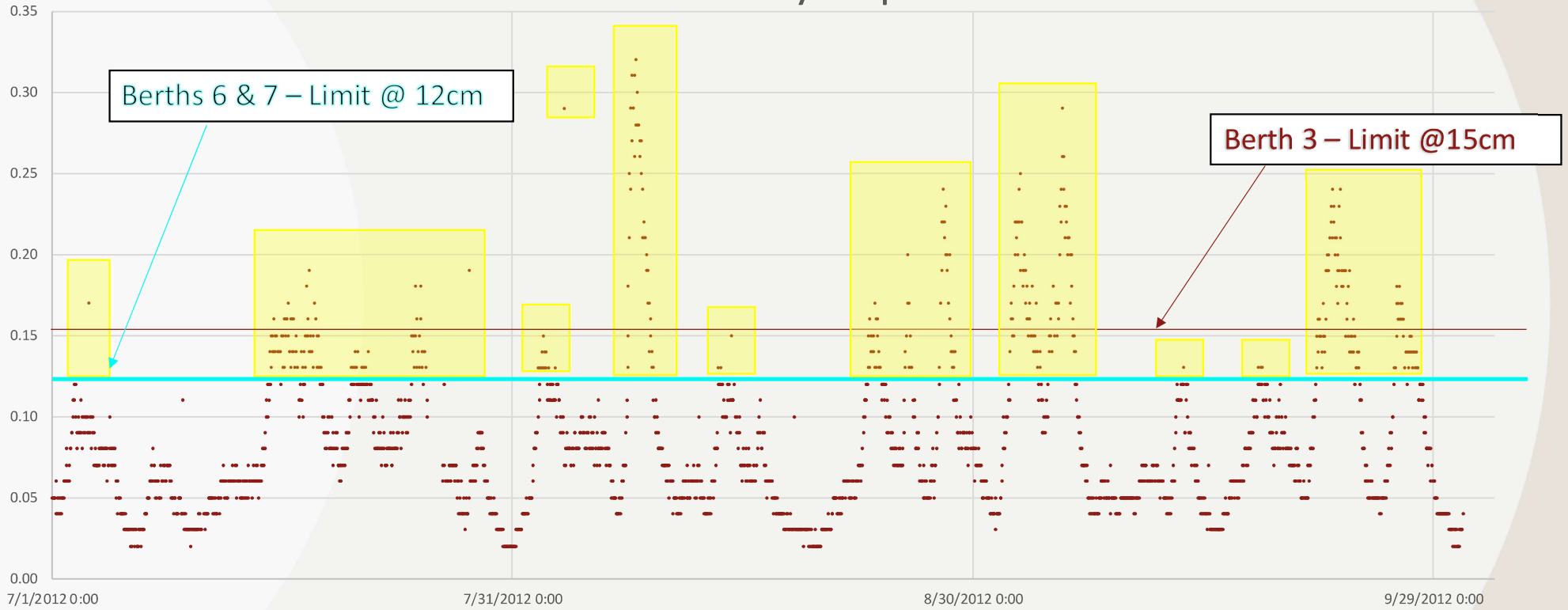
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12 Years from 28th May 2010 to 23rd Jan 2022

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Wave Height (m)	0-0.04	2.4%	1.2%	4.4%	0.0%	0.3%	0.0%	0.1%	0.0%	6.5%	9.4%	1.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.9%
	0.04-0.08	3.8%	1.5%	7.3%	0.0%	0.4%	0.0%	0.1%	0.0%	10.5%	18.9%	2.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	45.3%
	0.08-0.12	1.6%	0.5%	2.4%	0.0%	0.2%	0.0%	0.0%	0.0%	3.3%	7.1%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	15.9%
	0.12-0.16	1.1%	0.3%	0.9%	0.0%	0.1%	0.0%	0.0%	0.0%	1.1%	2.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.3%
	0.16-0.2	0.8%	0.2%	0.4%	0.0%	0.1%	0.0%	0.0%	0.0%	0.5%	1.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%
	0.2-0.24	0.5%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
	0.24-0.28	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
	0.28-0.32	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.32-0.36	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	0.36-0.4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.4-0.44	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.44-0.48	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
>0.48	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Total		10.7%	3.8%	15.7%	0.0%	1.1%	0.0%	0.2%	0.0%	22.2%	39.4%	4.4%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%

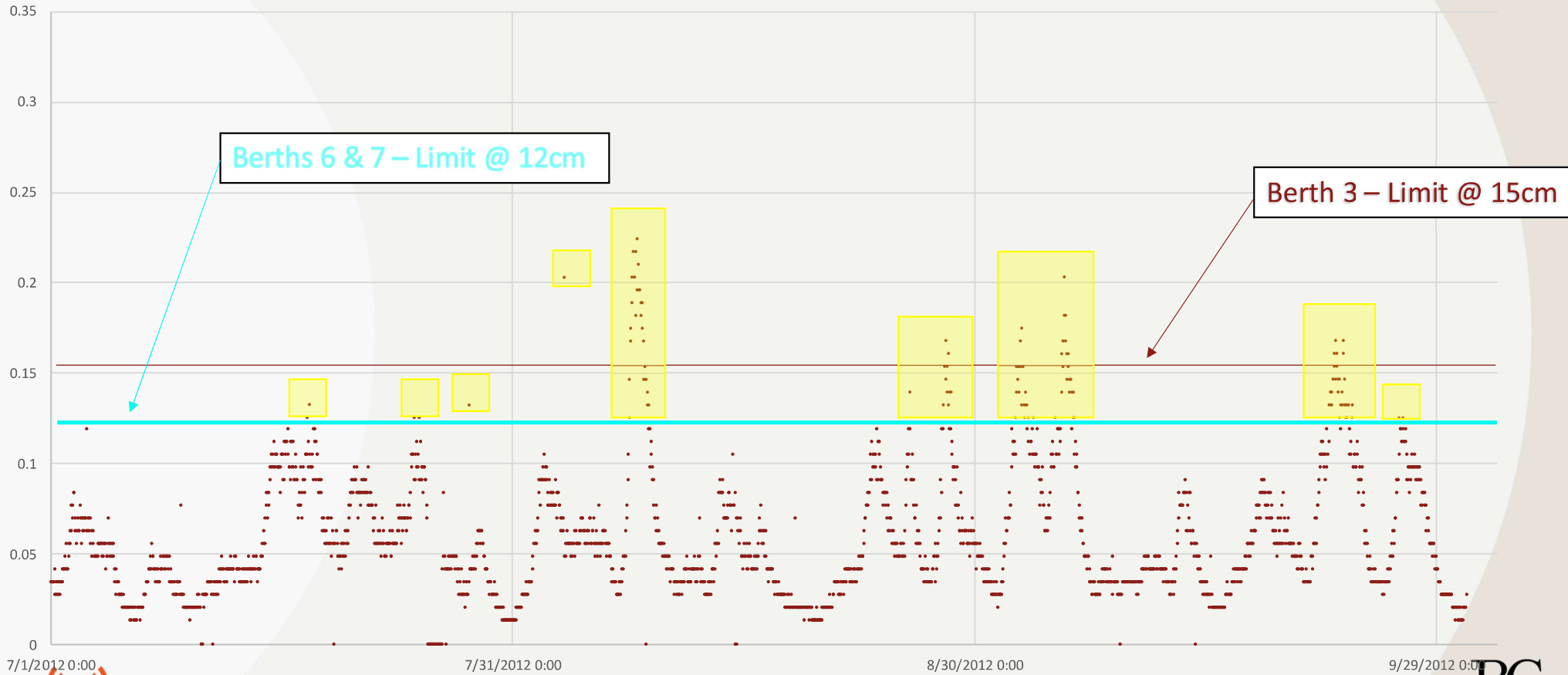
Berth 3-4 - 2012 Recorded Tp 25s - 300s



Berth 3-4 - Tp 25s - 300s 2012 July to Sept



Berth 3-4 - 2012 Recorded – Average 30% reduction applied Tp 25s - 300s



Thank You.

