Assessment of Dredging Requirement for Swan River Ferry Expansion

Applecross and Matilda Bay Terminals

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1 Introduction

The Public Transport Authority (PTA) plans to expand public ferry services within the Swan River between Elizabeth Quay and Applecross via Matilda Bay. This expansion will address the transportation needs of a growing city and support high-density riverside precincts.

The Department of Transport (DoT) commissioned BMT to assess the potential dredging requirement at proposed Applecross and Matilda Bay Terminal locations for the Swan River Ferry Expansion Project.

1.1 Scope of Work

BMT proposes to undertake the following scope of work to assess if dredging is required:

- Assess the most recently captured bathymetric survey data along with updated vessel specifications
- Consider operational speed, transit times, weather and metocean conditions, and safe berthing speeds.
- Evaluate turning basins necessary to support daily ferry operations (desktop assessment based on the engineering guidelines and standards)
- Assessment of the requirement for Dredging at Applecross and Matilda Bay terminal sites and review of design vessel parameters
- Estimate the required volume to dredge (if deemed necessary)
- Provide advice on dredging mitigation possibilities

2 Estimation of the Required Dredge Depth at Ferry Terminals

The following allowances need to be considered for estimating the required dredge depth at ferry terminals in line with AS3962.

1. Half of the wind-induced significant waves and passing vessel wake
2. A minimum Under Keel Clearance of 0.3m or 10% of the vessel draft, whichever is the greater (for the soft seabed)
3. An allowance of overdredge for siltation to reduce the frequency of potential maintenance dredging.

In addition to the above the squat motion for the vessel at the terminal with a speed below the approach speed (8kt) was assessed.

2.1 Basis of Design (BoD)

The following basis of the design was proposed, review and agreed by DoT and PTA (Meeting on 19th May 2025).

Design Life

A design life of 25 years was adopted for estimating the required dredging depth. This aligns with general navigation channels where there is a low risk of loss of human life or environmental damage in the event of an accident, and where soft sediment material is present (PIANC 121°N-2014). It is also consistent with the design life recommended for design of Small Craft Facilities (AS 4997–2005 Guidelines for the Design of Maritime Structures).

Design Storm Event

The return period of design storm event is required to estimate the wind-induced waves which must be considered in the design of dredge channel depth. A 50-year design storm (Annual Recurrence Interval /ARI) was adopted in line with Function Category 1 which impose a low degree of hazard to life or property (AS 4997-2005).

Under Keel Clearnce (UKC) and Overdredge Allowance

UKC allowance of 0.3 m was adopted for estimating the required dredging depth, assuming soft bed material in line with based on the outcome of the recent environmental sampling. This is in line with the recommendation of AS 3962 Guidelines for Design of Marina. An overdredge allowance of 0.3m is used for the allowance for future sedimentation, siltation, etc.

3 Navigation Depth at Terminals

3.1 Vessel Specification

The vessel specification was obtained from the latest Vessel General Arrangement provided by PTA (IC23210-011-00-02-REV-P6-General Arrangement - Electric Vessel) as below.

Table 3.1 Vessel dimensions

Vessel Dimension	Value (m)
Length Overall (L_{oA}) and waterline length	24.95
Overall Length including appendages	26.47
Beam (excluding sponsons)	7.2
Draft	1.1

3.2 Extreme Wind-Induced Waves

Review of Available Information

Seashore engineering estimated the 90 Percentile (876 hours per year) Hs at Matilda Bay and Applecross terminal is less than 0.2m as shown in Figure 3.1 (Seashore Engineering,2025). The report focus was the operational conditions along the route and did not include the extreme conditions.

The ferry tender document specifies a significant wave height of 0.45 m as the Design Environmental Conditions (PTA250023, 2025) which is also attributed to operational conditions. It is noted that the Seashore report indicates that significant wave heights of up to 0.9m were observed over a two-year measurement period, offshore from Como Foreshore. The adopted 0.45 m wind wave is relatively infrequent (less than 88 hours per year) for the route with highest fetch. However, it should be noted that passing vessel wakes above the 0.45 m (specified as Design Environmental Conditions) would be expected along the route and in the vicinity of the terminals (expected passing vessel wake presented in Section 3.3).

Estimation of Extreme Wind-Induced Waves

The 50-year ARI wind-induced waves at the terminals were estimated based on extreme winds presented in AS/NZSs 1170.02 (Structural Design Actions- Wind Actions) and fetch-limited calculations. The estimated extreme wave height at Applecross Terminal is slightly higher (i.e., 0.1m for the 50-year ARI event) than wave height at Matilda Bay Terminal (Table 3.2) and will be used to assess the design depth.

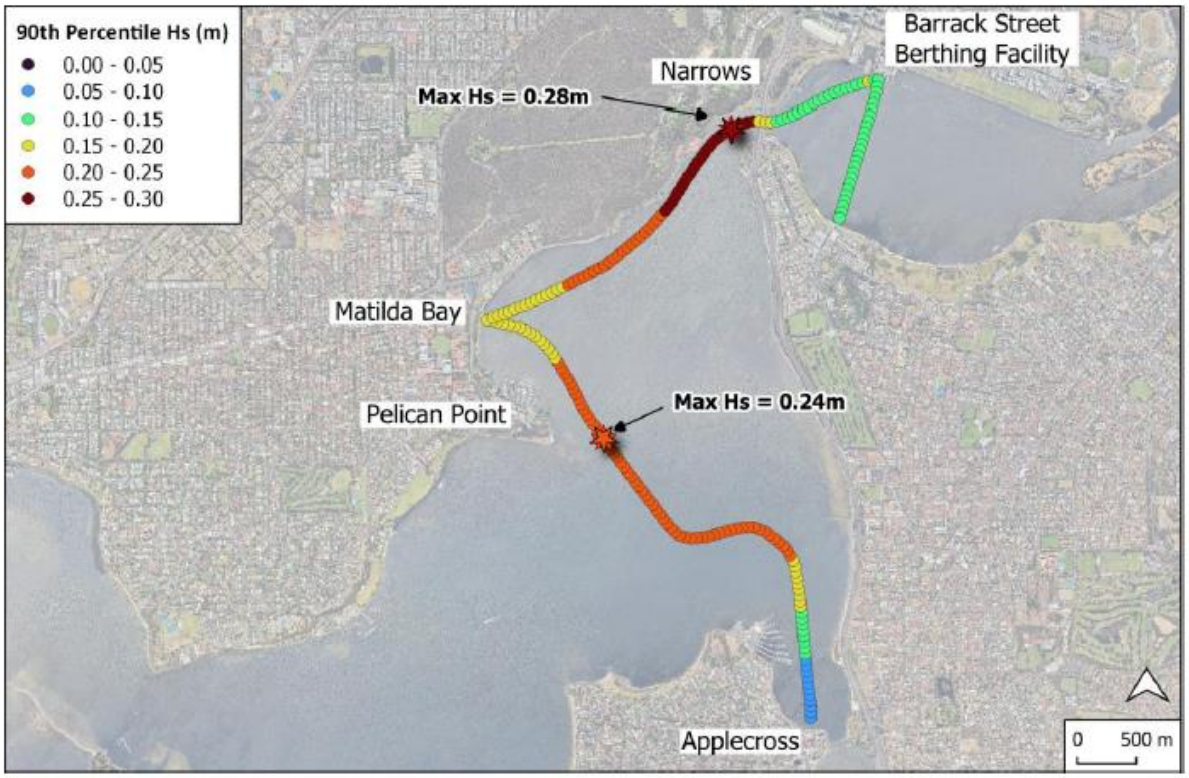

Figure 3.1 Estimated 90 Percentile Hs along the proposed ferry route (Seashore, 2025)

Table 3.2 Extreme wind-induced waves for design storm event (50yr ARI)

Terminal Name	Maximum Fetch(km)	Significant Wave Height- Hs(m)
Applecross	5.3	1.1
Matilda Bay	4.8	1.0

3.3 Passing Vessel Wakes

No site-specific wake study for various passing vessel at the proposed ferry terminals has been carried out. A study of boat wake on the Swan River by Curtin University (Gourlay, 2010) included full scale trials at several locations around Swan River including Quarry Point pylon off Mounts Bay Road.

Quarry point is on the proposed route between the Matilda Bay Terminal and Elizabeth Quay, where the route is constrained by Mount Bay Road on the north side and shallow water on the south (Location shown in Figure 3.2). In the absence of the site-specific study, the measured vessel wake from the trails at Quarry Point was used to gauge the likely vessel wake height at the proposed ferry terminals.

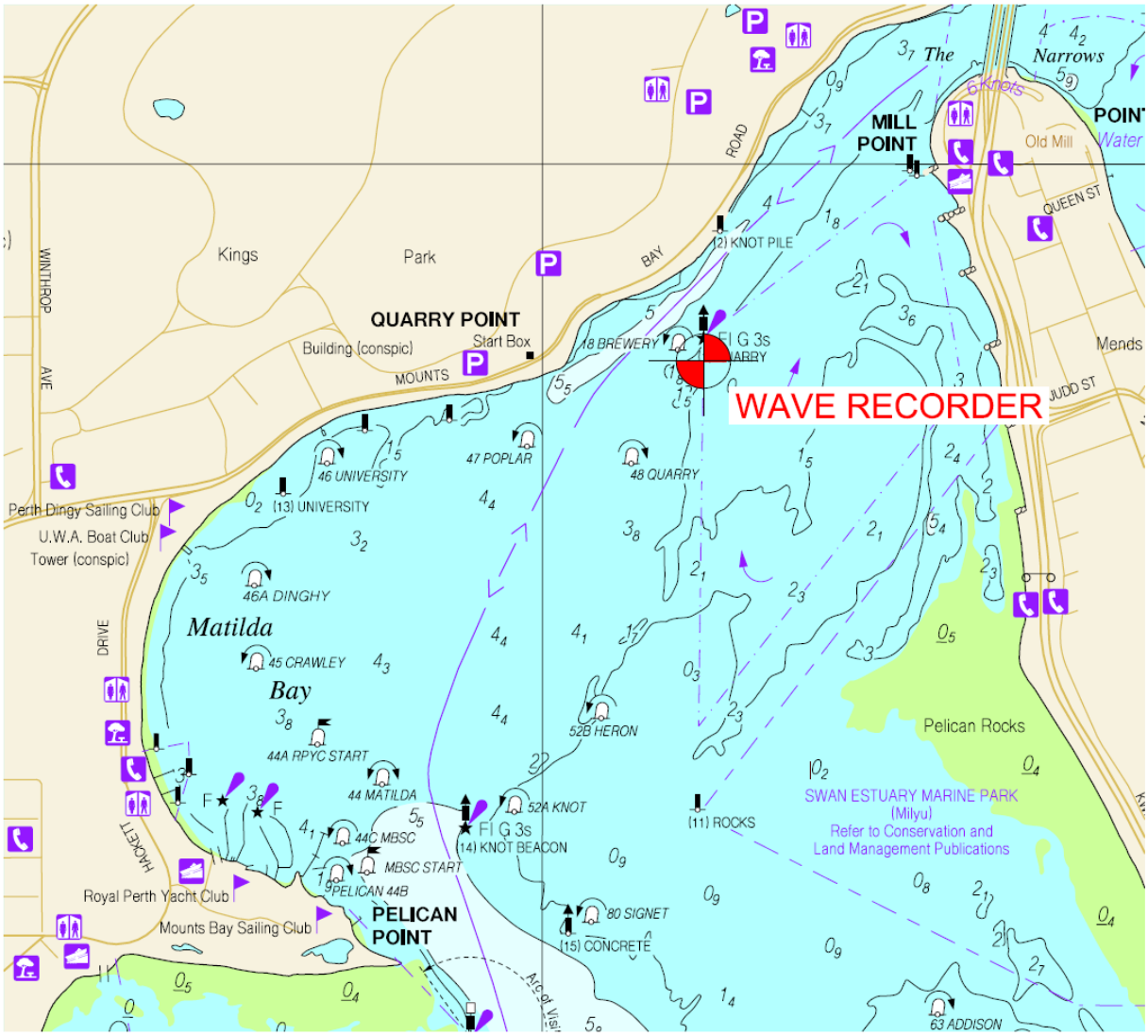

Figure 3.2 Quarry Point Wave Recorder Position for wake measurement study (Gourlay, 2010)

Figure 3.3 Star Flyte Express largest wave height 12 knots speed at Quary Point

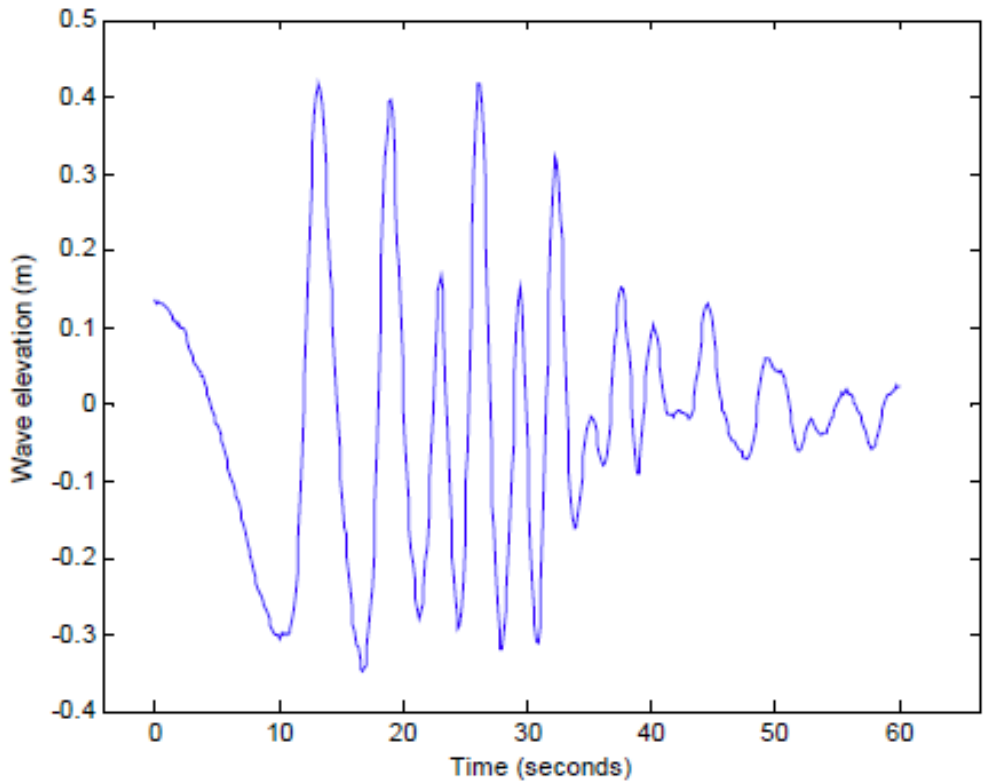

Figure 3.4 Wave profile of Star Flyte Express (largest measured wave height at 12 knots speed)

Figure 3.5 Star Flyte Express Wake hitting Mounts Bay Road shoreline

A 6.8 m Haines Hunter Patriot 680 and 38.9 m Rottnest Island ferry, Star Flyte Express www.rottnestexpress.com.au) were tested at Quarry Point (0). The vessels passed the route at various sailing speeds, and a maximum significant wave height of 0.76m was recorded for Star Flyte Express at

a speed of 12 knots as shown in Figure 3.4. Figure 3.5 shows the Star Flyte Express wake reaching to the shallow bank of the river along the Mounts Bay Road shoreline.

At the proposed terminals the passing vessel wakes are expected to be significantly smaller than the measured wakes in the above trails due to speed limit in the terminal zone (e.g. 8 knots) and fewer site constraints (e.g. available water depth around the proposed jetty, distance to passing large vessel/ ferry routes and to the shore).

3.4 Adopted Wave Height for Estimating the Channel Depth

For determining the design depth, the guidelines require an allowance for wave actions including both wind-induced waves and passing vessel wakes (Section 3). During extreme storm events (e.g., a 50-year ARI storm), large ferries are unlikely to be in operation. For lower ARI events, when larger vessels may still be operating, the combined effects of wind-induced waves and vessel wakes should be considered when estimating the navigable depth. A joint probability analysis of passing vessel wakes and storm events would help identify the governing case across various ARIs. In the absence of joint probability data on passing vessel traffic and the wind-induced waves , given that the 50-year ARI wind-induced wave height (Table 3.2), significantly exceeds expected vessel wakes (Section 3.3), the 50-year ARI wind-induced wave is considered the governing condition for design depth.

3.5 Squat

The squat of vessels depends on vessel speed, hull shape, and water depth. Each vessel has a critical speed at a given depth at which squat is maximised. For catamarans, squat decreases significantly when vessel speed varies by more than 10% from this critical speed. The maximum squat for catamarans typically occurs at the stern. The critical vessel speed and squat at the terminal depth were assessed using empirical methods (Gourlay, 2008). A squat allowance of 0.1 m was adopted for the vessel at the terminal, based on an approach speed of less than 8 knots.

As noted, squat dependants on the vessel speed and available water depth. A review of the squat allowance along the routes where higher speeds (above 8 knots) are likely to be permitted is recommended. This can inform the selection of the upper speed limits in the shallow areas along the route.

3.6 Estimating the Navigable Depth at Terminals

The navigable depth at the Terminals was calculated in line with the Australia Standard for Marina Design (AS 3962) as described in section 2. The vertical datum adopted for this study is Chart Datum (CD).

Table 3.3 Estimation of dredging depth at the terminals

Allowance for navigable depth	Value (m)
Vessel Draft	1.1
Allowance for wave conditions (0.5xH_s)	0.55
UKC (Soft material at channel bed)	0.3
Overdredge allowance (for sedimentation, siltation, etc)	0.3
Squat Allowance (vessel speed <8 knots)	0.1
Design navigable depth (Vertical datum: Chart datum)	**2.35 mCD**

4 Assessment of Required Dredging at Ferry Terminals

4.1 Preliminary Design

The Preliminary Design layouts for Applecross and Matilda Bay ferry terminals were provided by PTA for review of the dredging requirement at the terminals (Figure 4.1 and Figure 4.2)

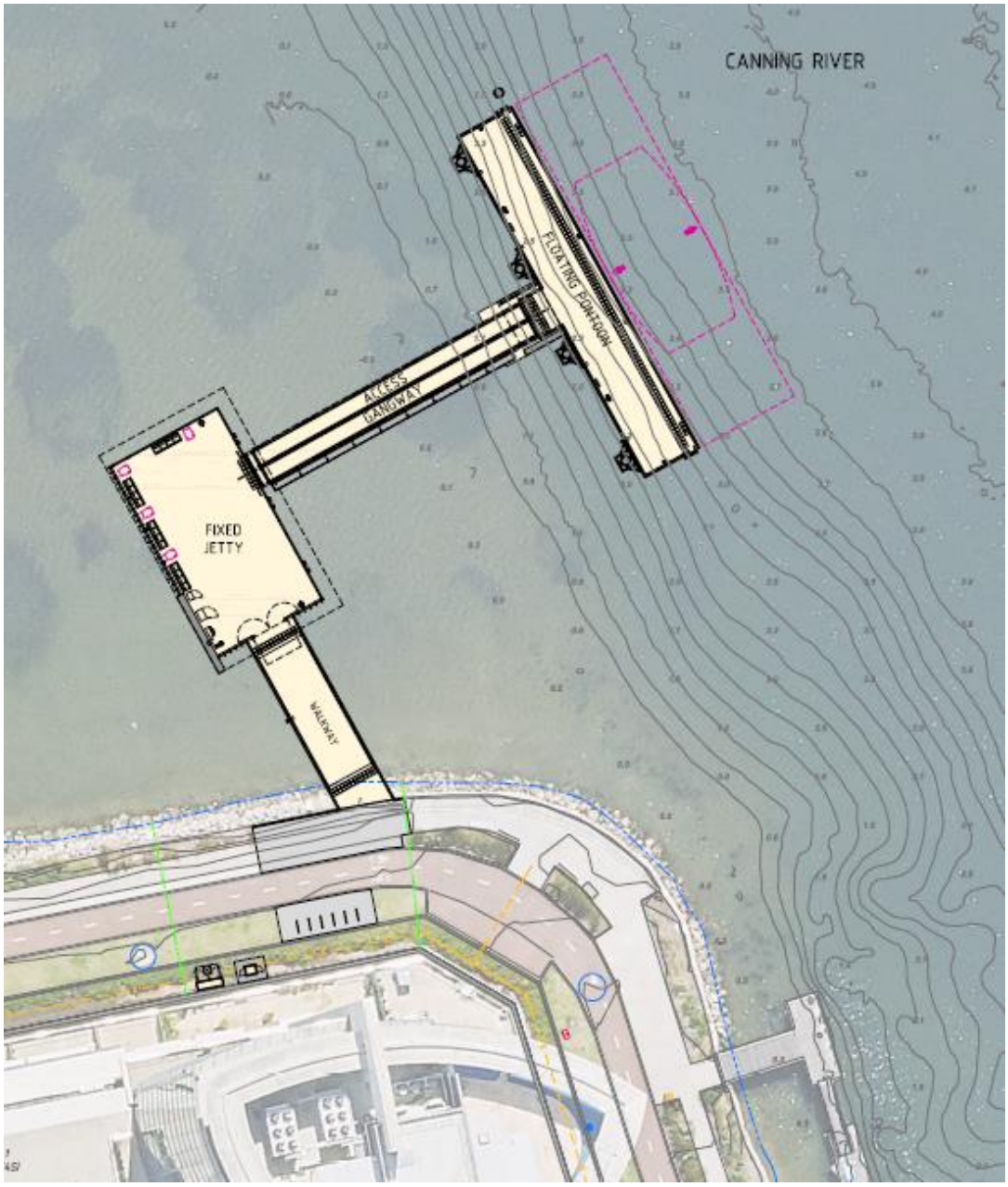

Figure 4.1 Layout of proposed Applecross ferry Terminal (Reference: Applecross Ferry Stop – Overall Site Plan, 24.602-SK03-A)

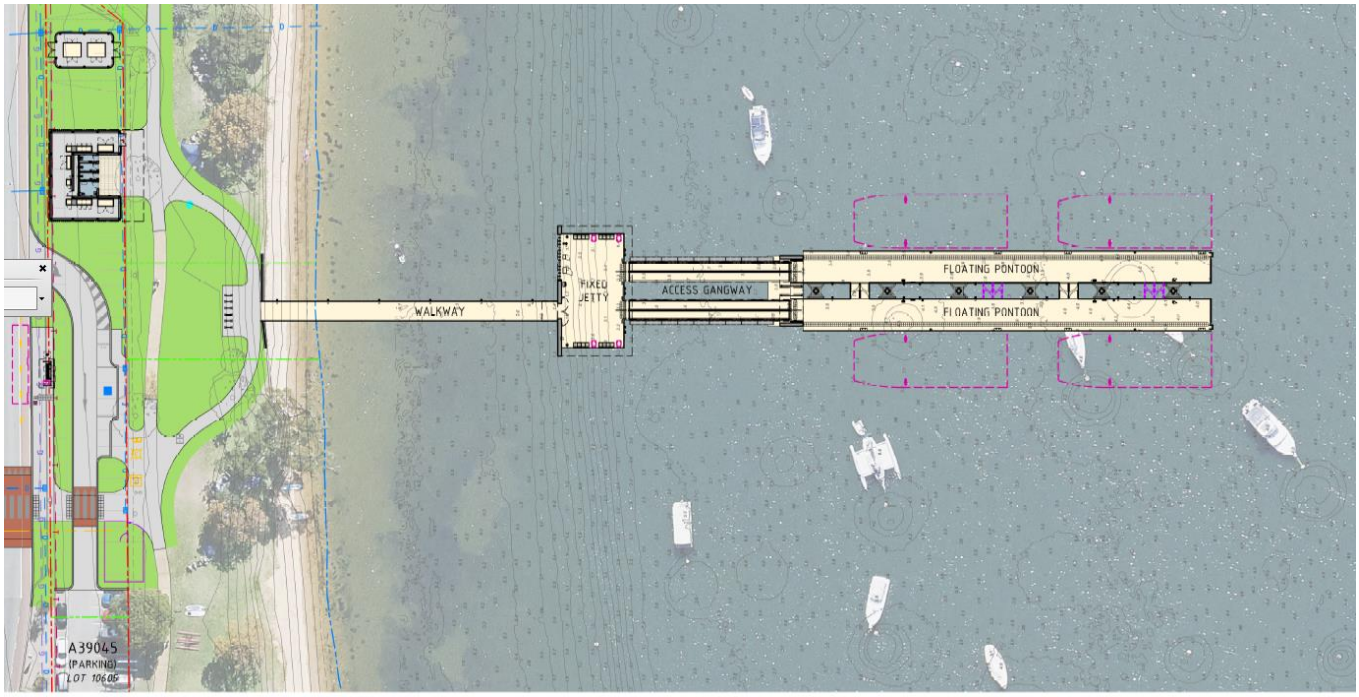

Figure 4.2 Layout of proposed Matilda Bat ferry Terminal (Reference: Matilda Bay Ferry Stop – Overall Site Plan, 24.602-SK03-A)

4.2 Turning and manoeuvring

The proposed ferry will have high level of manoeuvrability and control. The vessel is expected to turn 180° at near zero speed within own length in the most onerous of the Design Environmental Conditions (refer to Section 3.2). In addition, the vessel will include a redundant steering system for emergency situations (PTA250023, 2025).

The preferred width for the fairways in marina is 1.75 times of the vessel length (AS3962). PIANC proposes a minimum turning basin diameter of 2 L_{oa} (PIANC, 2014). For smaller terminals PIANC recommend use of 3 L_{oa} diameter at the concept-level design. For this assessment, the diameter of 3 L_{oa} at terminals is adopted to determine the area and volume of the dredging requirements (if any) for safe berthing. This can be optimised through further development of vessel design, berthing manoeuvres, navigation aids, navigation simulations etc., if deemed necessary.

4.3 Hydrographic survey data

The hydrographic survey was carried out for the noted terminals in October 2024 and high-resolution scatter data (0.25 m resolution) were provided to BMT for review.

4.4 Dredging Requirement at the Terminals

The access depth and required area for turning the vessel were reviewed based on the outcome of this study presented in Section 3.6 and 4.2 respectively. The review demonstrated no dredging at terminals is required for the proposed preliminary layouts.

Applecross Terminal

The layout of the proposed Applecross terminal marginally aligns with the estimated design depth contour of -2.35mCD (i.e., the orientation of the floating pontoon is parallel to the design depth contour). As the design depth accounts for an allowance for future siltation (i.e., overdredge) and an UKC allowance at low tide (Section 3.6), this depth is sufficient for the safe operations during the first years

following the construction. However, maintenance dredging may be required more frequently at the Applecross terminal compared to Matilda Bay, as the berth is marginally aligned with the design depth contour.

Figure 4.3 Applecross Terminal Preliminary Design (showing the design depth contour)

A bathymetric survey after the first year of operation is recommended for early detection of potential shallowing due to siltation and sedimentation. This survey will help determine the required frequency of monitoring. However, significant local shallowing is considered relatively unlikely, as the propeller action of the ferry is expected to reduce local sediment accumulation at the berthing areas. Alternatively, the berthing pontoon could be slightly shifted offshore to align with a deeper contour, reducing the likelihood of future maintenance dredging.

Matilda Bay Terminal

The proposed Matilda Bay Jetty gangway and floating pontoon are aligned (shore-normal orientation) which results in additional manoeuvring space at this terminal. The shallowest depth at floating pontoon (i.e., ferry berthing location) is approximately -3.8 m CD.

Figure 4.4 Matilda Bay Preliminary Design (showing the design depth contour)

Navigational marks may be required to indicate the area shallower than the design depth.

5 Summary and conclusion

BMT was commissioned to review the dredging requirement at the proposed new ferry terminals at Applecross and Matilada Bay. A review of the route between the stations was not part of this scope of work.

The information provided and the review outcome are summarised in this report. The following summary and conclusions should be read in conjunction with the assumptions and limitations documented in the report.

The concept depth for the proposed ferry and site-specific condition was estimated to the -2.35 mCD. A review of the recent high-resolution bathymetry data and the latest Preliminary Design layout demonstrates that no dredging is required for the proposed terminals.

Navigational marks may be required to indicate the area shallower than the design depth for both terminals.

The layout of the proposed Applecross terminal marginally aligns with the estimated design depth contour. The berthing pontoon could potentially be shifted slightly to align with a deeper contour (thereby reducing the likelihood of future maintenance dredging).

6 References

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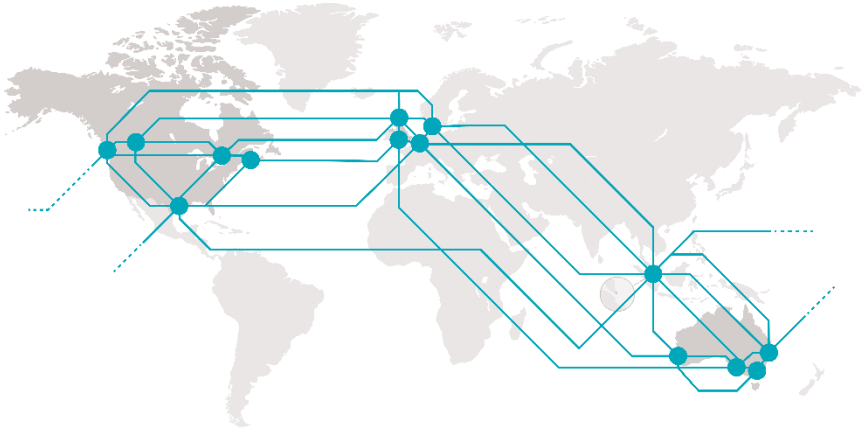

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