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PTA 250302 Swan River Ferry Expansion Project – Perth to Applecross
Coastal Engineering Support – Preliminary Coastal Process Impact Assessment

Dear Rebecca,

The Swan River Ferry Expansion Project, led by the Public Transport Authority (PTA) in collaboration with the Department of Transport, involves the expansion of Transperth ferry operations on the Swan River (Figure 1). The project is initially proposed to deliver five new electric ferry vessels, new ferry terminals at Applecross and Matilda Bay, and modifications to the existing terminal at Elizabeth Quay. Associated electrical infrastructure will also be installed to support overnight charging at the DTMI-managed Barrack Street Jetty (No. 1 or 2), and to enable rapid high-capacity charging at Matilda Bay and 'back-up' charging facilities at Applecross and Elizabeth Quay. The service is planned to operate at approximately 20-minute intervals, enabling a one-hour round trip between Applecross, Matilda Bay, and Elizabeth Quay.

Seashore Engineering has been engaged by the PTA to provide coastal engineering support to the project. This letter presents an initial evaluation of the potential impacts of the proposed terminal infrastructure on coastal processes, prepared to inform the Environmental Protection Authority (EPA) referral process. The evaluation is based on the identification of dominant active coastal processes at each site, and the potential interaction between these processes and the proposed infrastructure. This assessment primarily draws upon a review of existing studies and data, records of historical modifications, analysis of shoreline and bed changes in the context of metocean drivers.

The assessment focuses on the proposed new facilities at Matilda Bay and Applecross, which may introduce a range of potential influences on coastal processes. Key considerations include:

- Minor sheltering effects from berthed vessels and jetty structures, noting that the piled design proposed will limit this impact;
- Vessel related impacts, including potential increases in local wave activity generated by ferry wakes;
- Possible changes to alongshore sediment transport if shore-based elements such as jetty abutments or erosion protection structures extend into the active hydraulic zone, including as a result of future shoreline retreat.

The proposed terminal sites at Elizabeth Quay and Barrack Street are expected to have negligible additional impact on coastal processes in these areas due to:

- The presence of existing jetty structures already accommodating high levels of vessel traffic, including established ferry operations; and
- The extensively modified nature of the shoreline, which has been entirely constructed through dredging and reclamation and is bordered by continuous walling.

Detailed consideration of these sites has subsequently not been included in the assessment.

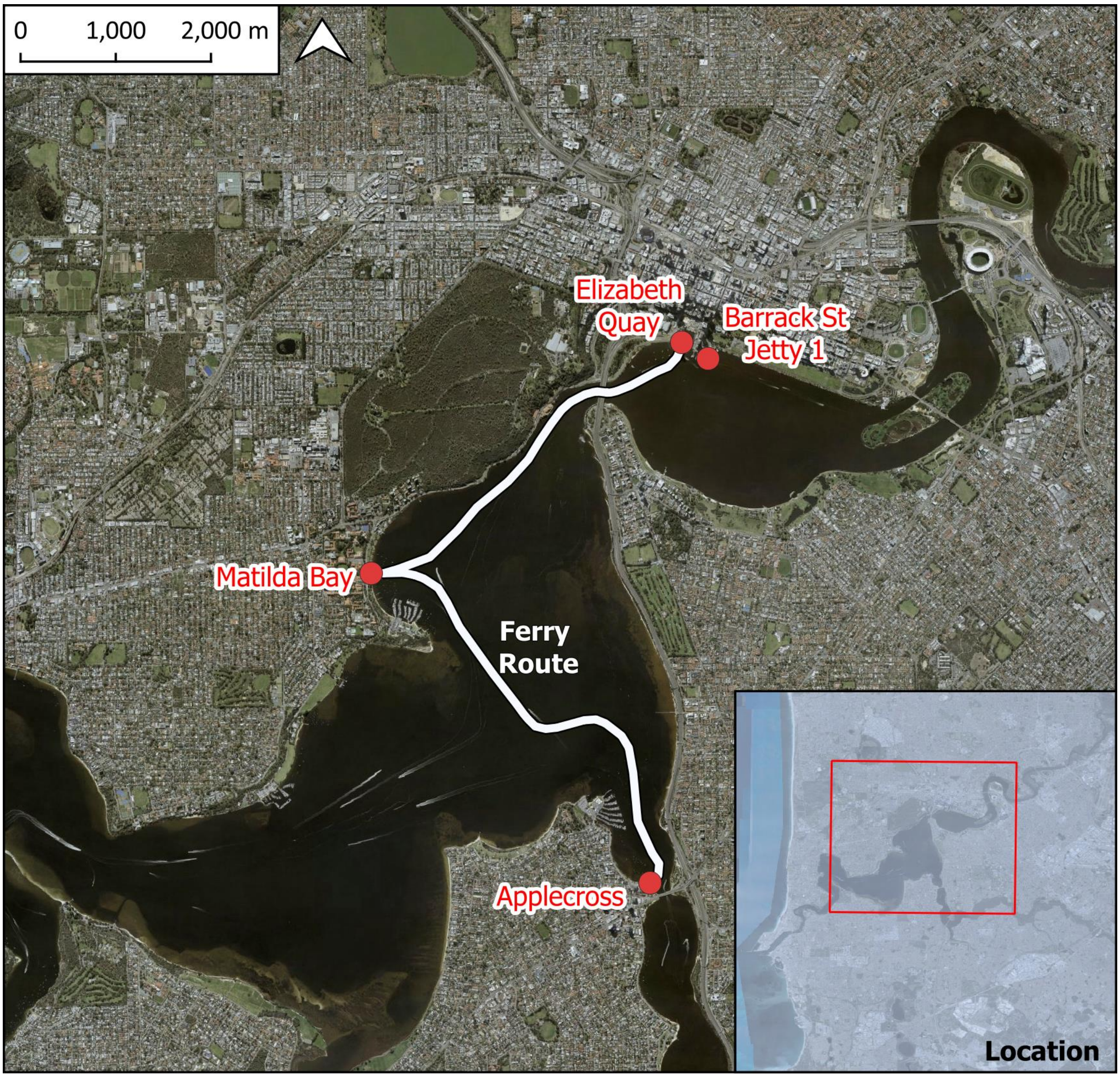

Figure 1: Site Figure

1. Background

1.1. PROPOSED MARINE FACILITIES

The marine facilities proposed at the terminal sites include new jetty structures at Applecross and Matilda Bay, a slight extension to the existing jetty at Elizabeth Quay, and the utilisation of jetties at Barrack Street which are to be replaced by the Department of Transport. The design configurations of the new jetty structures are illustrated in Figure 2, based on digital information provided by the PTA. It is noted that the marine facilities have been designed for a 50-year operational life, and that the final configuration may vary from the current designs.

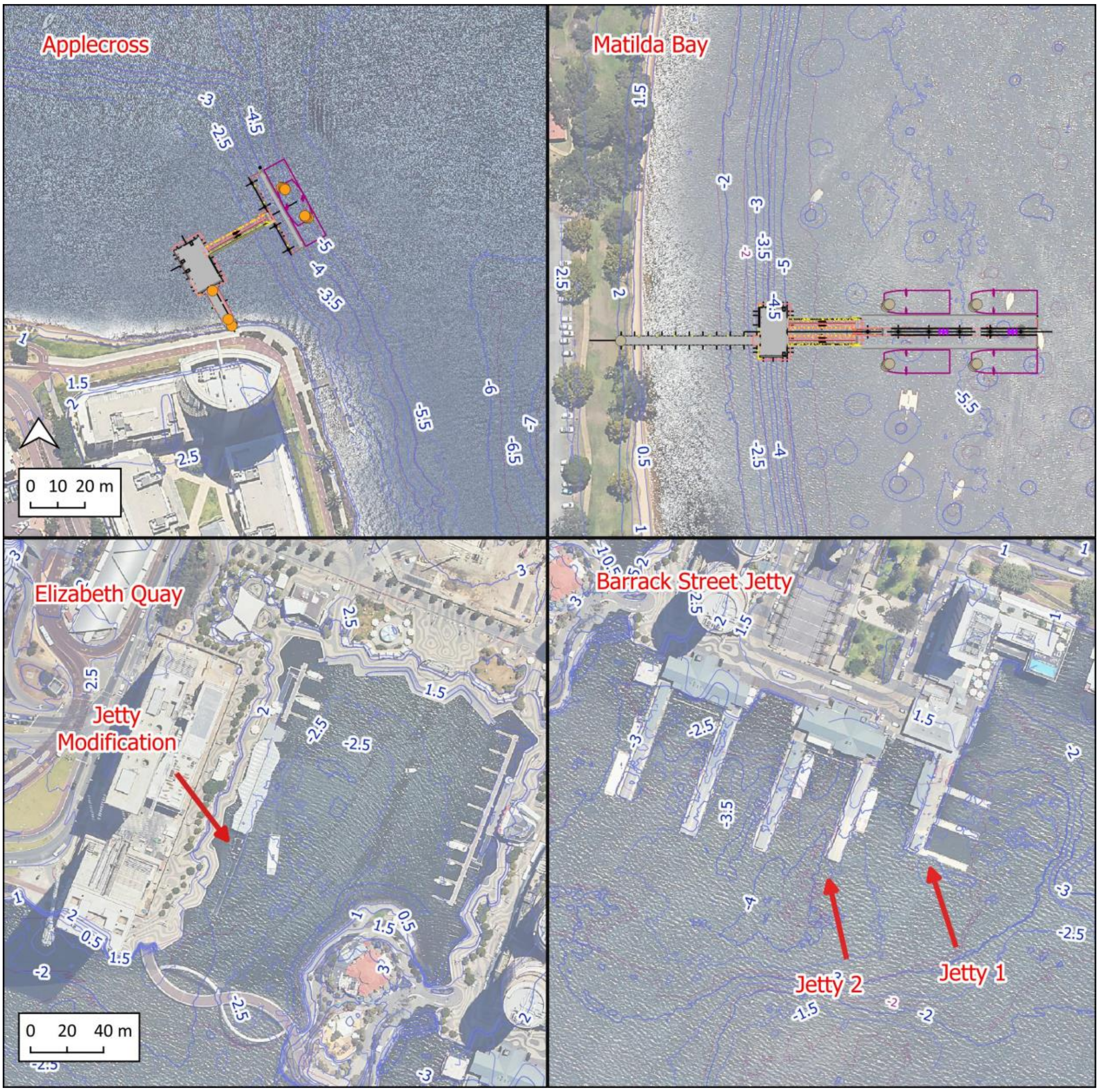

Figure 2: Proposed Extents of Marine Facilities

1.2. REGIONAL SETTING

The proposed terminal sites are located within the Melville Water and Perth Water basins, which form part of the modern estuarine system of the Swan and Canning Rivers. This estuary originally developed from a drowned river valley and is characterised by a long, narrow entrance channel that restricts the inflow of marine sediments. Melville Water comprises a wide estuarine basin with a deep, relict riverine channel, while Perth Water has been shaped by substantial terrestrial input, resulting in a comparatively shallow and flat basin morphology.

The sites are generally exposed to relatively small to moderate currents due to the microtidal setting, broad basin geometry, and the presence of deep relict channels within Melville Water. Subsequently wind waves and water level variations are often the dominant drivers of foreshore hydrodynamic stresses.

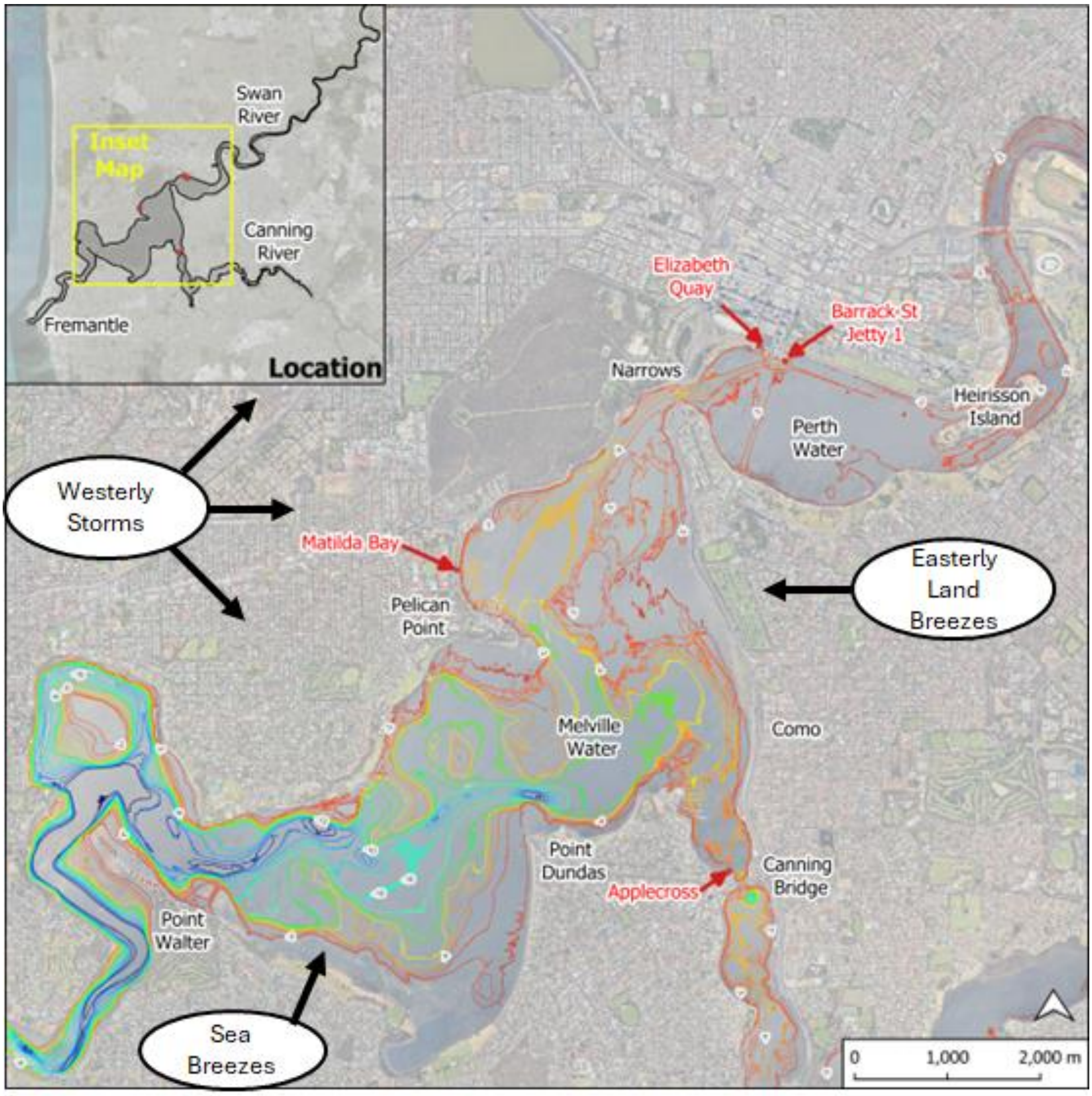

Figure 3: Swan River Estuary Structure and Dominant Winds

Wave conditions are governed by a combination of wind speed, wind direction, and the available fetch length (i.e. the distance over which wind can generate waves), and are further influenced by frictional damping in shallow waters. Perth's wind regime is dominated by southerly sea breezes, easterly land breezes, and westerly storm events, with wave patterns varying considerably across the estuarine basins. The greatest wind waves occurs in the eastern part of the Melville Water basin, where strongest westerly winds can act over long fetches.

Historical flood observations and hydrodynamic modelling, most recently by BMT (2019), confirm that flood levels decay substantially once flows enter Perth Water basin. As such, peak water levels in this area are typically associated with coastal inundation events. However, during extreme flood events, elevated flows can persist through Perth Water at speeds above those typically generated by tidal or wind-driven forcing.

1.3. HISTORIC MODIFICATION OVERVIEW

Large-scale civil works have substantially modified the Swan–Canning Estuary system. Key historical changes include:

- Removal of the rock bar at Fremantle beginning in 1897, which significantly increased tidal propagation; and
- Construction of dams on the Helena River (Mundaring Weir construction in 1902 and Pipehead Dam in 1957) and Canning Rivers (Canning Dam 1940) which reduced catchment flows and sediment supply from upstream sources (Le Page, 1986).

Additional significant modifications have occurred through historical dredging, reclamation, and other engineering works. Many of these interventions have had a substantial influence on sediment dynamics in their vicinity, with the largest observed changes to bed and shorelines within the Swan and Canning River system occurring directly as a result of these works (Seashore Engineering, 2024). In some cases, the response is still persisting 50–70 years after the initial works, typically involving an early phase of rapid adjustment followed by a more gradual, long-term change.

A detailed summary of known dredging and reclamation works was compiled by Riggert (1978) (Figure 4). These activities were undertaken for a variety of purposes, including navigation, flood control, extraction of materials (such as shell for cement), infill of floodplains for mosquito control, reclamation for roads and bridge abutments, landfill for recreation and capping of waste disposal sites (Riggert, 1978; Le Page, 1988). A significant shift away from large-scale dredging occurred in the mid-1980s, coinciding with the dissolution of the Public Works Department in 1985; the sale or scrapping of State-owned dredge vessels such as the *Stirling* (c. 1975) and *Leschenault* (c. 1984); and the introduction of environmental legislation that limited dredging to essential navigation purposes. More recently, however, dredging has continued in selected areas to maintain navigability around jetties and yacht clubs for recreational access.

Further detail on the modifications influencing Matilda Bay and Applecross is provided in Section 2.2 and 3.2, respectively.

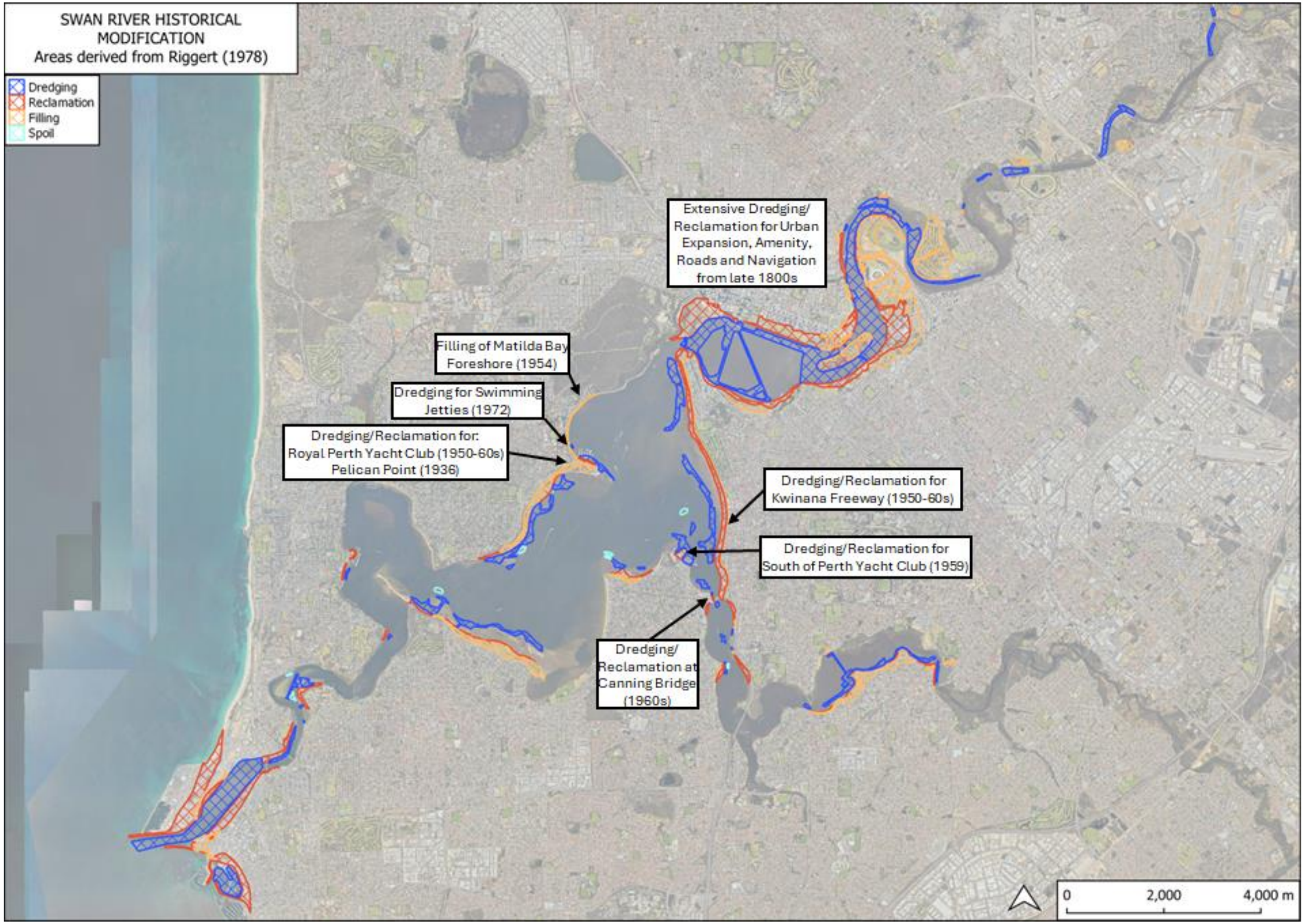

Figure 4: Swan River Historical Modification to 1977: Areas Derived from PWD Drawings P41264-04-01 to P42164-06-01 (Riggert 1978)

2. Matilda Bay

2.1. SITE DESCRIPTION

The proposed terminal site is located near the centre of Matilda Bay, within the Melville Water basin. The bay is bounded to the south by Pelican Point, where the Royal Perth Yacht Club is situated, and extends over 1 km to the north.

Matilda Bay is a low-energy setting, with its east-facing orientation providing natural shelter from prevailing south to south westerly seabreezes and strong southwest to northerly winds during storm passage. Additionally, its position within a broad basin and away from a deep relict river channel suggests that river and tidal flows are minimal, with currents near the shore primarily wind driven.

The greatest exposure occurs during easterly winds, which can act across fetch distances of approximately 2.0 to 3.5km. While these conditions can occur throughout the year, they are typically most frequent and strongest between January and February. The bay has a gradual arc, with the north end more exposed to southeasterlies and the south end to northeasterlies.

Matilda Bay is bounded by a shallow, gently sloping subtidal terrace that typically extends about 30m from the shore. Beyond this, the seabed drops sharply from depths near –1.0 m AHD to around -4.5 m AHD. The terrace plays a key role in foreshore dynamics, acting as an active sediment transfer zone and attenuating wave energy.

The beach structure consists of a relatively narrow strip, with the bank typically rising above 2.0 m AHD and comprising grassed areas interspersed with mature trees. The steepness of the bank varies due to topographic differences (including due to historic fill), and patterns of erosion and accretion around the bay.

Where erosion has encroached upon the bank, scarp development and tree root exposure have occurred, which has prompted installation of limestone block walls along parts of the foreshore (Figure 5). The proposed terminal site is located along a gentler sloping section of the foreshore without trees, resulting in lower potential for scarp development and slightly greater capacity to retain beach amenity and recreational value compared to other parts.

Figure 5: Photographs Illustrating Foreshore Condition Adjacent to Matilda Bay Site

2.2. MODIFICATIONS

The Matilda Bay and Pelican Point areas have been substantially modified from their original form, with key changes potentially influencing sediment dynamics across the bay illustrated in an aerial imagery sequence from 1953 (Figure 6). The original extent and composition of foreshore vegetation are not well documented; however, historical Admiralty Charts from 1896 suggest that vegetation was largely absent at that time.

The most substantial modifications to the Matilda Bay foreshore include:

- Major reclamation and dredging works between 1936 and 1938 around Pelican Point. These works aimed to reclaim swamp areas and create a smoother foreshore. The key motivations included reducing mosquito breeding, controlling algae, limiting sewage accumulation, improving public health, and enabling future development—specifically the planned Perth to Fremantle Road (later abandoned in 1938).
- Reclamation was undertaken across the wider Matilda Bay foreshore to raise bank levels, with mapped extents and dates in Riggert (1978) indicating that fill was placed on the bank directly landward of the beach in 1954.
- Smaller-scale dredging works were also undertaken for the northern expansion of the Royal Perth Yacht Club and construction of the original Matilda Bay boat ramp (1965), as well as the Matilda Bay swimming jetties (1972). Although no records have been identified, dredging near the UWA boat shed likely occurred prior to 1953, removing part of the terrace to create a deeper pocket adjacent to the shed to support navigable access.

More recently, sections of limestone block walling have been installed along parts of the bay in response to erosion-related scarping and exposure of tree roots.

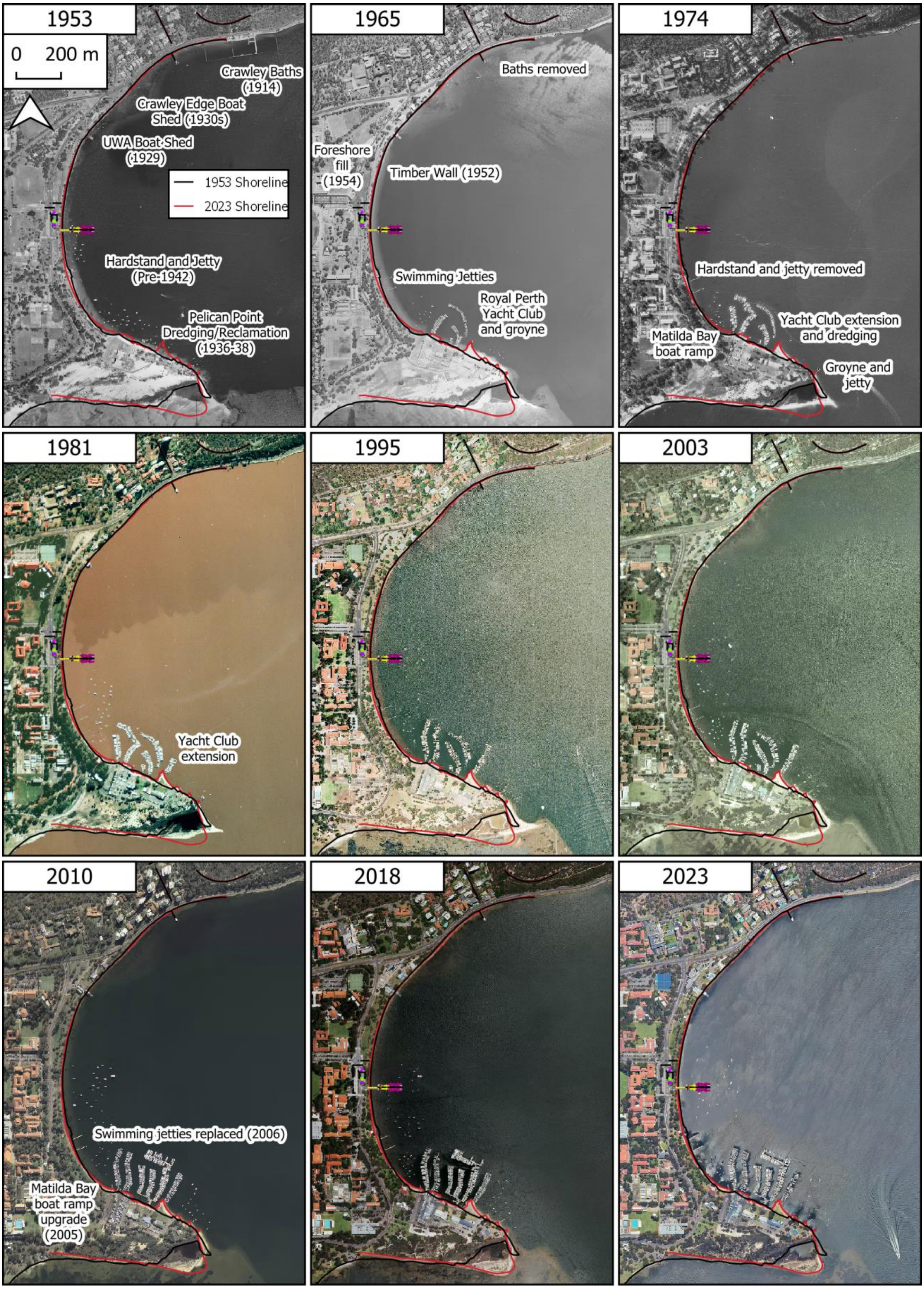

Figure 6: Matilda Bay: Historical Aerial Imagery (1953-2023)
Derived early (1953) and latest (2023) shorelines are shown, along with key modifications

2.3. OBSERVED DYNAMICS

Shoreline change has been assessed through analysis of shoreline movement identified from aerial imagery across selected time periods for Matilda Bay (Appendix A). This assessment demonstrates patterns of erosion, and accretion, which have occurred in response to natural processes and human interventions.

Overall, the Matilda Bay shoreline has shown a general tendency toward erosion, particularly on either side of the proposed terminal site. This erosion has become more pronounced since 2003, likely influenced by elevated mean sea levels during this period. This erosion has impacted amenity and use of foreshore sections due to exposure of building rubble used as fill, formation of scarps, and exposure of tree roots encroachment into mature trees (Figure 1). In response, limestone block walling has been installed along parts of the bay.

A portion of the eroded material from either side of the terminal site has been transported southward under north–northeasterly wind conditions and has likely contributed to:

- Accumulation north of the Matilda Bay boat ramp, where sediment has been captured. The ramp's capacity to trap sediment increased following its riverward extension in the 2005 upgrade.
- Infill of dredged areas, including those at the Matilda Bay boat ramp, the Royal Perth Yacht Club navigation areas, and a dredged pocket near the swimming jetties.

The combined sheltering effects of the yacht club and the sediment capture zones created by the ramp and dredged areas have restricted the redistribution of sediment back to the north, as could have occurred prior to these modifications.

Eroded material has also likely been transported northward, contributing to slow infill of the dredged area adjacent to the UWA boat shed and a zone of accumulation along the shore further north. A transition from accretion to erosion after 2003 is consistent with a reduced period of northward sediment transport.

Bathymetric survey data dating back to the 1960s indicates that the terrace margin and offshore areas across much of the bay has undergone minimal change in position or elevation, apart from the slow infill of dredged areas. This behaviour suggests sediment transport from the shoreline to offshore or along the terrace is minimal.

2.4. KEY FINDINGS

- The easterly aspect and embayed setting create a sheltered, low-energy environment, with coastal forcing primarily driven by easterly wind events.
- The shoreline adjacent to the proposed terminal has experienced net erosion since 1953, with sediment redistributed both northward and southward. Erosion typically ranges from 5 to 10 m, increasing to nearly 20 m in areas where sediment was previously captured at a now-removed hardstand and jetty located approximately 200 m south of the site.
- Historical dredging has altered sediment pathways, with slow infill observed in dredged areas near the Royal Perth Yacht Club, UWA boat shed, swimming jetties, and Matilda Bay boat ramp. The boat ramp also functions as a sediment trap on its southern side.
- Historical bank raising (dated to 1954) has increased the bank's susceptibility to scarping during erosion events. Limestone block walls have been installed in response across several sections, particularly south of the terminal site.
- The subtidal terrace, generally around 30 m wide, acts to attenuate wave energy and supports active sediment transfer zone. Survey data indicate minimal sediment transport along its margin, except in areas influenced by dredging.
- The bay is expected to experience enhanced erosion under future sea level rise, due to increased wave impact on the banks and a reduced role of the terrace in dissipating wave energy. This susceptibility is supported by observed erosion responses under elevated mean sea levels since the early 2000s.

3. Applecross

3.1. SITE DESCIPTION

The proposed terminal site is located north of Canning Bridge, at the junction of the Swan and Canning Rivers. Its position near the channel constriction at the bridge means the adjacent section of river can experience relatively high flows during tidal exchanges between the Swan and Canning estuary basins. However, these flows have been significantly reduced by upstream damming and the installation of the Kent Street Weir, which prevents tidal incursion into the upper reaches of the Canning River. As a result, flow-driven dynamics at the site are now likely to be substantially reduced.

The foreshore from which the terminal extends from has a northerly aspect and is exposed to:

- Small wind waves generated across short fetches of 500–650 m toward the Kwinana Freeway on the Como side of the river; and
- Larger waves arriving from a narrow directional band (±10° of 350°N) across a longer fetch of up to 5 km over Melville Water. These conditions occur much more infrequently, typically during storm events with strong NNW to NNE winds under pre-frontal weather systems.

The shoreline and bathymetry in this area is relatively complex, influenced by its position near the entrance to the Canning River and past modifications from bridge construction, reclamation and dredging. The shoreline adjacent to the site forms part of a continuous 300 m section of walling that extends from the south side of Canning Bridge to approximately 35 m west of the terminal. This walling was installed to stabilise the bank and has provided protection to the prior road reserve, shared path, bridge abutment, and nearby high-rise development associated with the Raffles Waterfront. The stretch of foreshore to the west and extending northward toward the South of Perth Yacht Club has variable remaining buffers to the adjacent to the shared path and comprises of small pockets of beach between vegetation areas, drains, and sections of revetment.

The proposed terminal extends across a broad, flat, shallow terrace up to 100 m wide, with typical elevations ranging between -0.7 m and -0.5 m AHD. It incorporates an L-shape to the berthing area which is positioned along the north–south running terrace margin adjacent to the river channel. This terrace plays a role in local foreshore dynamics, particularly by attenuating wave energy.

The foreshore is relatively low-lying, with the adjacent shared path and lowest road levels on Canning Beach Road currently set at approximately +1.1 m AHD. At this elevation, the path is already susceptible to overtopping during elevated water level and northerly wave events, with inundation frequency to increase under projected sea level rise scenarios over the 50-year design life. Design of the jetty’s landward connection will subsequently need to accommodate future conditions and allow for integration with both present and future path levels if raised.

Figure 7: Photographs Illustrating Foreshore Condition Adjacent to Applecross Site

3.2. MODIFICATIONS

The original foreshore was identified as having well-established vegetation, based on historical Admiralty Charts from 1896. Since then, it has undergone considerable modification, with key changes potentially influencing sediment dynamics across the bay illustrated in the aerial imagery sequence from 1953 (Figure 6).

The most significant modifications to the Applecross foreshore include:

- Construction of Canning Bridge, originally built in the 1800s, replaced in 1939, and expanded on the south side in 1958. These changes locally altered the flow dynamics in the area.
- Extensive dredging and reclamation in the 1950-1960s, including to support the Kwinana Freeway on the eastern bank and development of the South of Perth Yacht Club to the north. Works immediately adjacent to the site included dredging a section of the terrace for the Canning Bridge landing for navigation in 1968 and reclamation along the east-facing shore north of Canning Bridge.
- Various efforts to stabilise parts of the foreshore, beginning with the construction of a mortared rock wall in the 1970s extending north of Canning Bridge across the terminal site, followed by replacement and extension of the northern part with rock revetment with Raffles Waterfront development in 2008.

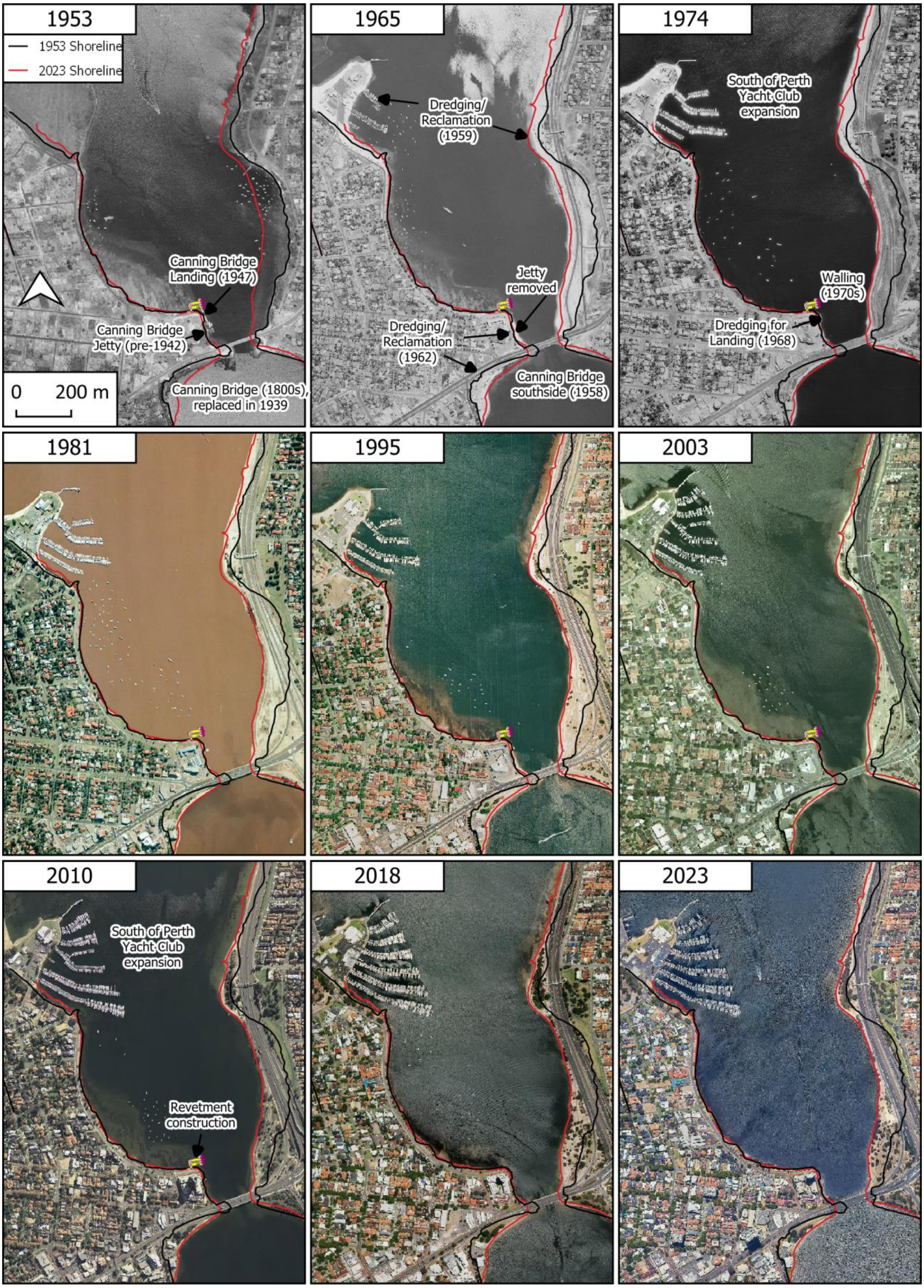

Figure 8: Applecross: Historical Aerial Imagery (1953-2023)
Derived early (1953) and latest (2023) shorelines are shown, along with key modifications

3.3. OBSERVED DYNAMICS

Shoreline change has been assessed through analysis of shoreline movement identified from aerial imagery across selected time periods extending south of Canning Bridge to South of Perth Yacht Club (Appendix A). This assessment demonstrates patterns of erosion, and accretion, which have occurred in response to natural processes and human interventions.

Overall, the Applecross shoreline has exhibited a general tendency toward erosion since reclamation in the 1960s, reflecting the gradual loss of reclaimed material to offshore areas. This erosion has accelerated over the past 20 years, possibly influenced by elevated mean sea levels.

Shoreline changes near Canning Bridge have been strongly influenced by alongshore redistribution of sediments from reclaimed areas. Erosion of the east-facing reclaimed shoreline fronting the Raffles Hotel, north of Canning Bridge, began in the 1960s and led to the construction of mortared rock walling in the 1970s. Erosion continued until around 2003, by which time the beach in front of the wall had been lost. Most of the eroded material was likely transported into the adjacent channel, contributing to a reduction in overall channel area evident in bathymetry surveys, with the greatest narrowing observed near Canning Bridge and progressively less toward the north. A smaller portion moving northward, contributing to small sediment transport across the terminal site and toward the shoreline to the west.

Since 2003, increased erosion has occurred along the north-facing shoreline fronting the Raffles Hotel, which includes the proposed terminal site. This change is likely associated with the loss of the small sediment supply. In response, shoreline protection was upgraded in 2008 through the installation of a rock revetment that extended 15 metres eastward beyond the original mortared wall. Erosion stress has since persisted, with focused erosion occurring at the revetment’s end where the scarped bank is encroaching toward the shared path.

3.4. KEY FINDINGS

- The terminal site is located at the junction of the Swan and Canning Rivers, near a natural channel constriction at Canning Bridge. While this area can experience relatively high flows in the river channel during tidal exchanges between the two estuary basins, flow-driven dynamics are now substantially reduced due to upstream damming and the Kent Street Weir.
- The northerly facing foreshore is exposed to small waves generated across short fetches (500–650 m) from Como, and infrequent but larger storm waves across extended ~5 km fetch from the NNW.
- The area is highly modified, with historical changes including bridge construction, reclamation, dredging, and installation of walling and revetments.
- Progressive erosion of the east- and north-facing shoreline fronting the Raffles Hotel (including terminal site) has occurred since the 1960s reclamation, driven by redistribution of this material. This erosion led to the installation of a mortared wall in the 1970s and subsequent revetment upgrade on the north-facing shoreline in 2008 for bank protection.
- The adjacent channel shows a reduced cross-sectional area, indicating that much of the eroded material from the reclaimed shoreline has been deposited within the channel. This infill is most pronounced near Canning Bridge and diminishes toward the north.
- Ongoing erosion stress persists, with transfer to the end of the 2008 revetment where localised scarping is encroaching toward the shared path. This erosion is linked to sediment supply depletion, following the loss of beach material from the east-facing shoreline.
- The foreshore is low-lying, with path and road levels around +1.1 m AHD, making these areas susceptible to overtopping during elevated water levels and northerly storm events.

4. Potential Impacts to Coastal Processes

Understanding of existing morphology, foreshore and bed dynamics, and active sediment transport pathways, and their interaction with the new terminal structures and vessels at Applecross and Matilda Bay, have been used to interpret potential impacts to coastal process from the project.

The small extension of the jetty at Elizabeth Quay and continued use of the existing facility at Barrack Street Jetty (No. 1 or 2) are considered to have negligible additional influence on coastal processes, and therefore have been excluded from this assessment framework. This is due to:

- The presence of existing jetty structures already subject to high vessel use, including established ferry operations; and
- These areas have been extensively modified, with shorelines entirely constructed through extensive dredging and reclamation, and bordered with continuous walling.

4.1. INTERUPTION OF SEDIMENT TRANSPORT

Fixed structures extending into the river may impede the alongshore sediment transport, usually resulting in sediment capture on an ‘updrift’ side and corresponding erosion ‘downdrift’.

For Matilda Bay, the present design includes a 10 m-wide jetty abutment, positioned just landward of the existing grassed bank. At this location, bank elevations are above +1.0 m AHD, outside the active sediment transport zone, and the abutment is therefore not expected to interrupt sediment transport in the short term. However, the distance the abutment protrudes into the river will increase if the ongoing erosion trend in the bay continues, and this will be amplified recession caused by sea level rise.

Once protrusion begins, the initial impact is expected to be localised bank erosion and scarp formation adjacent to the abutment (typically within 5–10 m), driven by increased beach dynamics and flanking effects on either side. This process is expected to occur with approximately 1–5m of beach recession. Mitigation of these scarps will generally require stabilisation structures with adequate tie-ins to the surrounding bank (e.g. revetments or retaining walls), with bank regrading to reduce scarp height possibly used as an initial intervention.

If the abutment protrudes further riverward over time, sediment can be locally retained on either side due to potential for alternating northward and southward transport. However, the greater frequency of southeasterly winds and longer fetch driving northward transport, suggests accumulation is likely to be more pronounced on the southern side. This pattern is evident in the historical shoreline positions shown in 1942 and 1953 imagery, adjacent to a hardstand and jetty that was once located approximately 200m south of the site (see Figure 6).

Sediment captured at the abutment will be supplied primarily from a nearfield response, leading to a tendency for enhanced erosion just beyond the capture zones. As most of the foreshore to the south is already protected by walling, the impact on the bank in this area is likely to be limited. However, potential loss of beach width may affect recreational use, and risks to the integrity of the existing walling (e.g. undermining) may also need to be considered. The reduced presence of walling to the north of the site heightens the implications of enhanced bank erosion, with greater potential for scarp formation and impacts on trees.

Future mitigation of these potential impacts in the long-term should be considered within the context of foreshore management implemented before such impacts become significant. Parts of the bay already require management due to erosion and scarping that affect beach amenity, expose rubble fill, reduce recreational value, and cause stress to established trees. Any mitigation would need to be developed in consultation with the Department of Biodiversity, Conservation and Attractions (DBCA), which manages the foreshore strip, and align with a broader management strategy for Matilda Bay[1].

For Applecross, the jetty abutment is integrated into the footprint of an existing rock revetment, with a universal access ramp extending approximately 2–3 m beyond the revetment across a 20m section. While this extension has potential to interrupt sediment transport along the base of the revetment, shoreline change assessment suggests that present-day transport in this area is minimal. This is primarily due to the presence of the revetment, and because the small volume of westward sediment movement that followed the 1960s reclamation had largely ceased by 2003, after loss of the beach along the east-facing shoreline to the south.

4.2. SHELTERING EFFECTS

As the terminals consist primarily of piled structures, any sheltering effects will be minimal and largely associated with berthed vessels and floating jetties. These may result in a slight reduction in wave and surface current energy in the lee of the structures.

4.2.1. Currents

As bed dynamics are driven by bed currents, modifications to surface currents may have limited potential to influence bed or sediment transport. However, localised scour is plausible adjacent to piles set in shallow depths or near the terrace margin at Applecross, where stronger bed currents may occur close to the Canning Bridge channel construction.

4.2.2. Waves

For Matilda Bay, the single shore-perpendicular jetty design minimises lee-side sheltering under all wave conditions. Additionally, exposure to wave energy from a broad range of easterly directions reduces the potential for significant sediment buildup and adjacent erosion that typically occurs where sheltering is consistent under a more unidirectional wind-wave regime. There may be a slight tendency for sediment accumulation in the lee of the structures due to marginal reductions in wave-driven sediment transport away from the terminal.

[1] The previous management plan for Matilda Bay Reserve was developed in 1992, intended to cover the period from 1992 to 2002. It recommended:

a. "Implement measures to deal with erosion by modifying the beach area and plant appropriate vegetation that is consistent with landscape values"
b. "Construct suitable bank protection if other measures fail to relieve erosion."

The **Applecross** site is expected to experience negligible impacts from wave sheltering. Under northerly wave conditions, any wave reduction will affect only a short section of foreshore north of Canning Bridge, which is already protected by walling, has a low sediment supply, and has no functional beach. Sheltering from northeasterly wind waves may cause a minor decrease in wave energy across a small section of the revetment directly in the lee of the structures; however, this effect is limited by the lack of available sediment for transport to the area.

4.3. VESSEL WAKE

Wake generation depends on water depth, vessel speed, and hull geometry, and the wake energy dissipates as it moves away from the vessels path. Because boat wakes are typically steeper than wind-generated waves, they tend to exert greater erosive power. However, this is partly balanced by against wind waves occurring continuously in high numbers, while wakes are generated as short sets during vessel passage.

Potential for wake generation from a 24 m catamaran passenger ferry with a draft of 0.884 m under operating conditions has been evaluated by INCAT (2025). The study identified a maximum wave height of approximately 0.55m at a distance of 60 m from the ferry's path when traveling at 15 knots. This wave height reduces to about 0.2 m at 400 m from the path. At the Department of Transport's 8-knot speed limit within Matilda Bay and for the approach to Applecross, maximum wake heights reduce to approximately 0.12m near the ferry and about 0.42 m at 400 m from the path.

Comparison to wind wave calculations indicates that vessel wake generated by ferries operating at permitted speeds is not expected to exceed typical wind wave conditions at Matilda Bay. A simple wind wave hindcast, using methods outlined in the Coastal Engineering Manual (USACE, 2006) and wind data recorded at the Melville Water Bureau of Meteorology station, suggests that:

At Matilda Bay:

- A 1-year ARI southeasterly wind event, with a wind speed of 42 km/h acting across a 3.7 km fetch to the Como foreshore, would generate a wave height of approximately 0.35 m; and
- Wave heights of 0.2 m are estimated to be exceeded, across all wind directions, for a cumulative duration of around 15 days per year on average.

At Applecross:

- A 1-year ARI northerly wind event, with a wind speed of 45 km/h acting across a 5.0 km fetch, would generate a wave height of approximately 0.45m; and
- Wave heights of 0.2m are estimated to be exceeded, across all wind directions, for a cumulative duration of around 1 days per year on average.

Although wake energy may add to overall wave energy at both Matilda Bay and Applecross sites, its influence on sediment dynamics is expected to be relatively small. This is because each vessel passage typically generates only two main waves, which decay with distance from the track and have low energy at speeds below 12 knots. The cumulative wake energy reaching the shore (i.e. each vessel passage) at likely speed and path is therefore expected to be far less than that of wind waves, which typically exceed 1,000 waves per hour. However, management of these impacts should still be addressed through ferry operational procedures, including approach angle, passage and speeds.

4.4. VESSEL SCOUR

Vessel manoeuvring during berthing and departure can contribute to localised deepening beneath, as well as the resuspension of sediments into the water column. The extent of these effects depends primarily on water depth, bed composition, and the energy produced by vessel thrusters. Sediment sampling at both Matilda Bay and Applecross by BMT in 2025 has indicated high silt and clay content, which is particularly susceptible to disturbance.

At Matilda Bay, the shallowest depths within the proposed berth areas are generally around -4.5 m AHD (-3.8 m CD), with the most inshore berths positioned approximately 30 m offshore from the shallow terrace margin, which rises to above -1.0 m AHD. These depths may support dispersion of vessel thruster energy, limiting the potential for extent and magnitude of bed disturbance.

For Applecross, the berthing area is set against the terrace margin, which could result in some localised slumping of the terrace into the channel. It is noted that this section of the terrace has already been modified by dredging and reclamation works undertaken in 1968.

Further evaluation of vessel-induced scour could be warranted, with management of these impacts is typically addressed through operational procedures.

5. Management

Management opportunities to mitigate potential impacts on coastal processes at the terminal sites at Matilda Bay (Table 1) and Applecross (Table 2) are outlined below, along with likelihood and consequence ratings to indicate the relative scale of each issue.

Identifying appropriate management actions requires an ongoing monitoring program, which should typically include:

- **Annual site inspections and reporting** following construction to assess foreshore change, with the potential to reduce frequency after three years. At Matilda Bay, annual inspections should resume if the jetty abutment begins to protrude onto the beach.
- **Hydrographic surveys** of the main navigation areas every five years, to confirm the scale of any bed-level impacts.

Table 1: Matilda Bay – Summary of Potential Impacts and Management Considerations

Location	Description of Impact	Likelihood	Consequence	Management Considerations
Berth Areas	Vessel scour and sediment resuspension	Mod	Low	Consider further evaluation and mitigation through operational procedures.
Jetty Abutment	Interruption of sediment transport (**short-term**)	Low	Negligible	Design jetty abutment to be positioned landward of present bank position.
	Interruption of sediment transport (**medium-term**)	High	Low	Plan for either local bank stabilisation or landward relocation if abutment begins to protrude to beach
	Interruption of sediment transport (**longer-term**)	High	Mod	If the abutment walling protrudes to lower beach (i.e. beach level at toe <0.5m AHD), consider mitigation within bay in consultation with DBCA and within the broader foreshore management context.
Lee Side of Marine Facilities	Wave and current Sheltering	Low	Low	Not required.
Shoreline Near Terminal	Vessel wakes influence	Mod	Low	Mitigate through operational procedures

- Interruption of sediment transport, vessel wake influence, and sheltering effects all have the potential to affect sediment transport patterns; however, for the purposes of this assessment they are considered separately.
- The relative consequence of impacts to shore may be greater if soil testing identifies contaminants adjacent to the shore.

Table 2: Applecross – Summary of Potential Impacts and Management Considerations

Location	Description of Impact	Likelihood	Consequence	Management Considerations
Berth Areas	Vessel scour and sediment resuspension	Mod	Low	Consider further evaluation and mitigation through operational procedures.
Jetty Abutment	Interruption of sediment transport	Low	Low	Monitor erosion west of the site and advise the City of Melville[1] of any emerging risks to their assets resulting from erosion
Lee Side of Marine Facilities	Wave and current Sheltering	Low	Low	Not required.
Shoreline Near Terminal	Vessel wakes influence	Mod	Low	Mitigate through operational procedures.

[1]City of Melville manages the foreshore adjacent to the Applecross terminal site.

6. Conclusions

Overall, the proposed new ferry terminals at Applecross and Matilda Bay are expected to have relatively minor impacts on coastal processes, based on their interaction with existing morphology, foreshore and bed dynamics, and active sediment transport pathways. This is primarily due to:

- The shore-based elements (i.e. jetty abutments) being positioned landward of the existing shoreline at Matilda Bay and within an existing revetment footprint at Applecross, limiting potential interruption of sediment transport;
- Facilities consisting of piled structures, with sheltering effects largely associated with berthed vessels and floating jetties, causing only slight reductions in wave and surface current energy on the lee side; and
- Existing speed limits and vessel approaches ensure boat wakes generate waves smaller than the ambient wind wave climate, with impacts at Applecross primarily confined to the already walled foreshore areas;

Management opportunities have been identified to minimise any potential impacts. This includes potential future responses to a continued erosion at Matilda Bay (including with sea level rise) which may cause the jetty abutment to protrude further riverward, leading to increasing interruption of sediment transport.

Small extensions of the jetty at Elizabeth Quay and continued use of the existing facility at Barrack Street Jetty (No. 1 or 2) are considered to have negligible influence on coastal processes, due to:

- Existing jetty structures already experiencing high vessel use, including established ferry operations; and
- Extensive prior modification of these areas, with shorelines entirely constructed through dredging and reclamation, and bordered by continuous walling.

Sincerely,

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Appendix A Shoreline Change Assessment

Shoreline change has been assessed through analysis of shoreline movement identified from aerial imagery across selected time periods for Matilda Bay and Applecross foreshores. This assessment demonstrates the erosion, and accretion patterns, which have occurred in response to natural processes and human interventions.

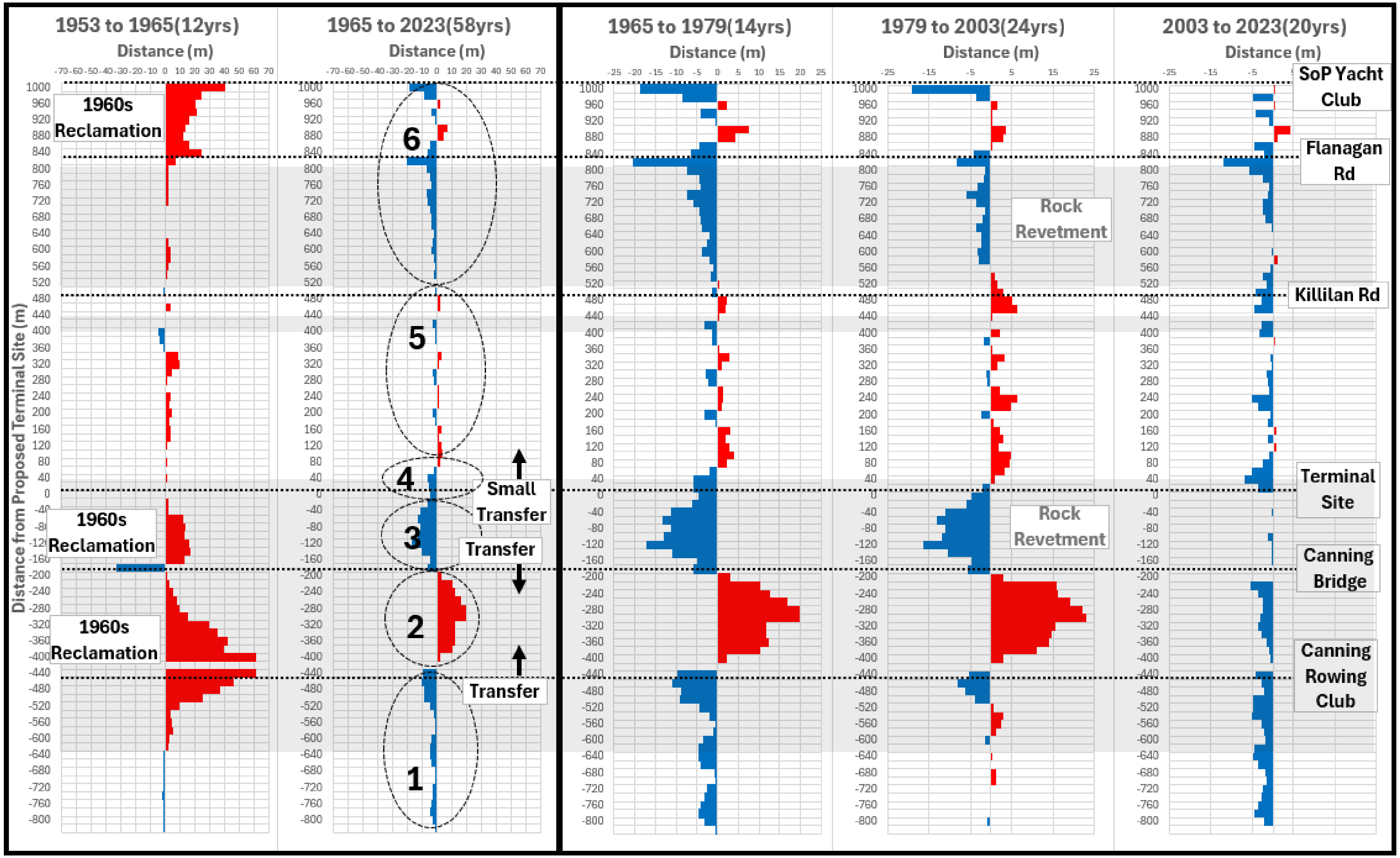
APPENDIX A.1 APPLECROSS

Overall, the Applecross shoreline has exhibited a general tendency toward erosion since the 1960s reclamation, reflecting the gradual loss of reclaimed material to offshore areas. This erosion has enhanced over the past 20 years, likely influenced by elevated mean sea levels. Shoreline changes near the Canning Bridge have been heavily influenced by the alongshore redistribution of reclamation.

Key changes observed across the Applecross shoreline between 1953 and 2023 include:

Zone 1	**Erosion** of the shoreline south of the Canning Rowing Club following 1960s reclamation works, with a high rate of loss observed during the first 14 years to 1979. This eroded material was predominantly transported northward, contributing to accretion in Zone 2.
Zone 2	**Progressive accretion** on the southern side of Canning Bridge between 1965 and 2003, advancing this shoreline beyond the original reclaimed extent of the 1960s. This accretion is associated with the capture and storage of material adjacent to the bridge abutment, sourced primarily from the northward transport of reclaimed material from Zone 1 (south of the Canning Rowing Club). Since 2003, a switch to erosion has occurred, indicating that supply has been exhausted, with material loss potentially occurring offshore, including in response to a period of elevated mean sea level.
Zone 3	**Erosion** of the reclaimed east-facing shoreline fronting the Raffles Hotel, north of Canning Bridge, commenced in the 1960s and led to the installation of a mortared rock walling along this section (evident in 1970s aerial imagery). Erosion continued until around 2003, at which point the beach in front of the wall had been completely lost, although further erosion may have persisted as bed lowering riverward of the wall. Most of the eroded material was likely transported to the bridge and into the river channel, with a smaller proportion moving northward to Zone 4.
Zone 4	**Increased erosion** since 2003 of the north-facing shoreline fronting the Raffles Hotel (includes proposed terminal site) which is associated with depletion of a small sediment supply from Zone 3. In response, shoreline protection was upgraded in 2008 through installation of a rock revetment, including a 15m eastward extension beyond the previous limit of the mortared rock wall. Erosion stress has persisted since 2008, with focused erosion occurring at the revetment's end where the scarped bank is encroaching toward the shared path.

Zone 5	**Overall stability** of the shoreline extending northward to Killian Road between 1953 and 2003, likely supported by a relatively wide terrace and sections of stabilising vegetation. Changes during this period were primarily due to local sediment redistribution following the loss of sections of vegetation. Since 2003, this section has experienced **increased erosion stress**, although revegetation efforts during this time have now established wider vegetation buffers to help control erosion. The erosion is likely driven by a combination of: • Disturbance from stormwater systems releasing focused flows. • Reduced sediment supply from Zone 3 and across Zone 4; • Increased potential for sediment mobility following earlier vegetation loss; • Influence of higher mean sea levels, which increases the height of wave impact on the shore and enables greater wave energy to propagate across the shallow terrace.
Zone 6	**Tendency for erosion** along the north- and east-facing foreshores on either side of Flanagan Road. This is influenced by the relative absence of a terrace margin in this stretch, with offshore depths rapidly dropping below –4 m AHD, including to dredged areas within the South of Perth Yacht Club. These conditions have promoted offshore sediment transfer, with rock revetment subsequently built where limited buffer remains near the shared path south of Flanagan Road. Local alongshore sediment transport patterns are evident, including a small accumulation of material in the lee of the South of Perth Yacht Club, sourced from sediment transported northward from south of Flanagan Road and deposited in the sheltered area behind the yacht club.



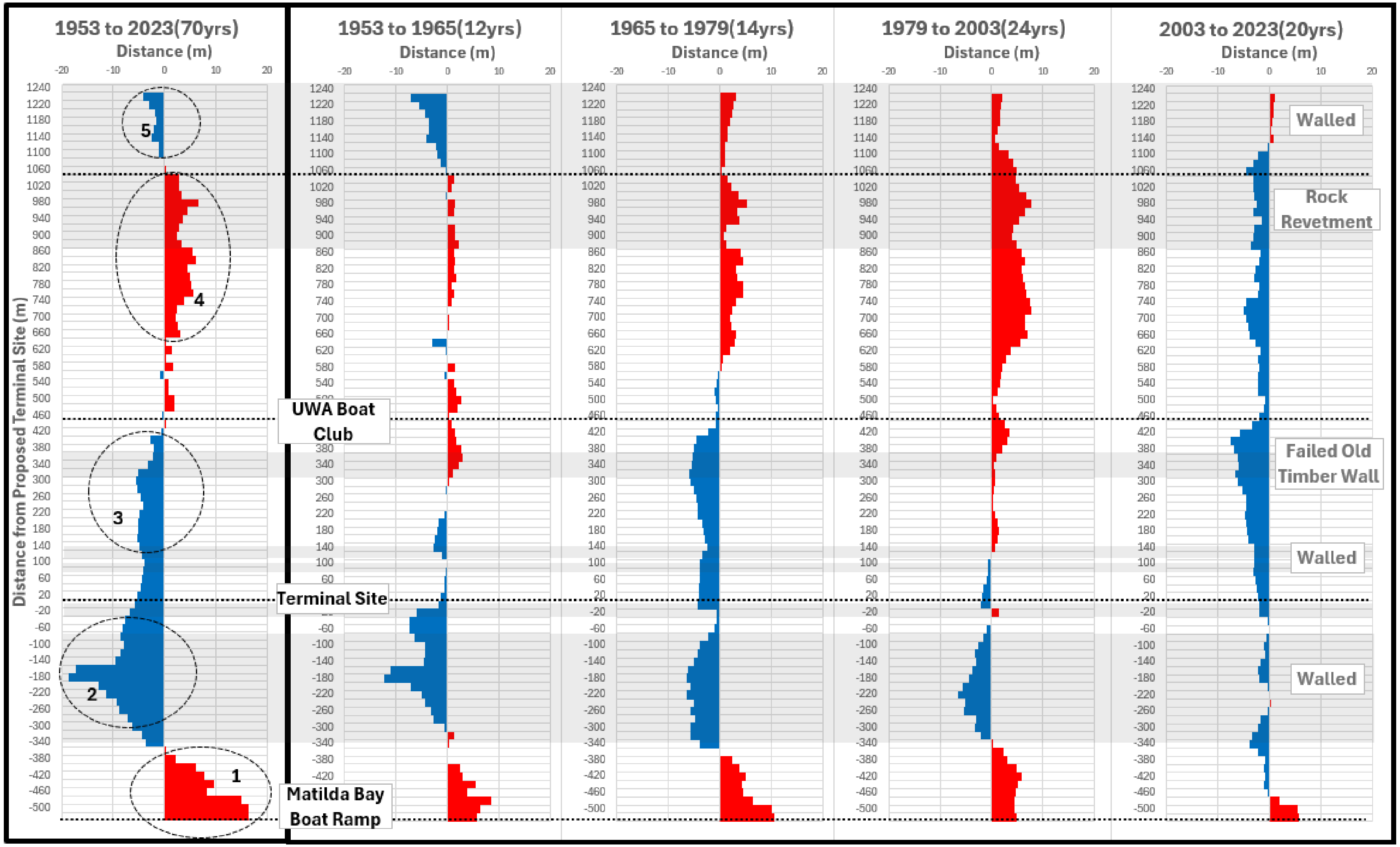
Applecross – Measured Shoreline Change for Selected Periods Between 1953 and 2023

APPENDIX A.2 MATILDA BAY

Overall, the Matilda Bay shoreline exhibits a general tendency toward erosion, particularly on either side of the proposed terminal site. This pattern suggests a net loss of sediment to offshore areas, with the increased erosion observed since 2003 likely influenced by elevated mean sea levels during this period.

Key changes observed across the Matilda Bay shoreline between 1953 and 2023 include:

Zone 1	**Progressive accumulation** on the northeast side of the Matilda Bay boat ramp due to the capture of sediments transferred from the north (up to 15m). This process has been enhanced by the sheltering effect of the Yacht Club, which limits the potential for sediment to move back northward.
Zone 2	**Erosion** to the south of the proposed terminal site (typically ranging 5-10m), resulting from a combination of southward sediment transport toward the Matilda Bay boat ramp (Zone 1), release of sediment previously stored following removal of the jetty facility between 1965 and 1974, and infilling of dredged areas for swimming jetties in 1972. The majority of this shoreline section is now protected by limestone block walling, installed in response to ongoing erosion.
Zone 3	**Erosion** north of the proposed terminal site (typically 5m), extending to the UWA Boat Shed, which includes a section of failed timber walling installed in 1957. Continued shoreline retreat onto the adjacent steep banks has led to the formation of scarps across this section. Most of this erosion occurred during two periods—1965–1979 and 2003–2023—highlighting the zone's sensitivity to variable conditions and shifts in prevailing sediment transport direction.
Zone 4	**Accretion** north of the UWA Boat Club primarily between 1965 and 2003 (ranging 3-7m), likely due to sediment input from Zones 3 and 5. A transition to erosion after 2003 reflects the depletion of supply from Zone 5 and a lack of recent northward transport from Zone 4. This shift has prompted revetment extensions at the northern end of the site to protect Mounts Bay Road and the adjacent shared path.
Zone 5	**Erosion** occurred following the initial release of sediments that had accumulated on the south side of Crawley Baths, following their removal between 1953 and 1965. Walling was subsequently installed by 1974 across this section.



Matilda Bay – Measured Shoreline Change for Selected Periods Between 1953 and 2023