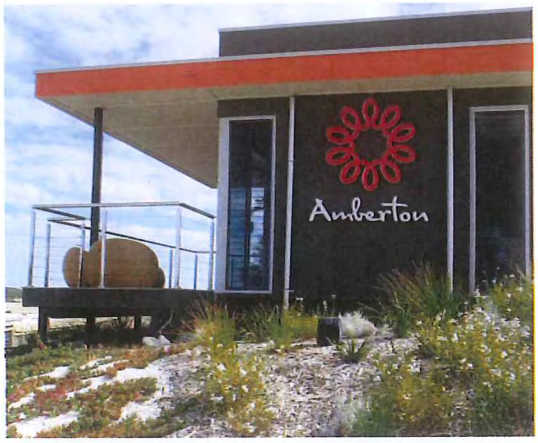

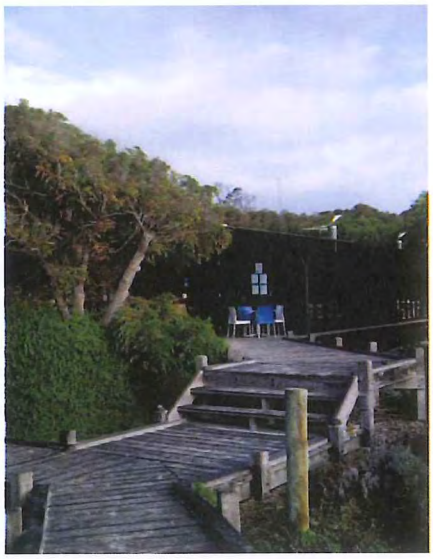

Plate 19 Examples of potential built form method and character to minimise construction impacts within foreshore reserve and enable ease of relocation (continued below).

Plate 19 Examples of potential built form method and character to minimise construction impacts within foreshore reserve and enable ease of relocation (continued from above).

7.7.5 Northern passive recreation area

7.7.5.1 Northern passive recreation area intent

A small passive recreation area is proposed for the northern section of the Amberton foreshore reserve. An open turf area is proposed to be located within a historically degraded part of the foreshore reserve and will provide a small kick-about area. This area may also incorporate flood storage (greater than 1:10 year event) and could include some minor facilities such as:

- Directional, safety and interpretative signage.
- Exposed aggregate, asphalt or poured concrete paving.
- Shelters/shade structures.
- Beach shower and foot tap, with drink fountain, or dog tap.
- WPC decking or boardwalks with viewing areas.
- Bicycle racks.
- Litter bins/dog bins/refuse collectors.
- Standard fencing to restrict access, with possible feature balustrade at viewing areas.
- Feature picket style fencing or artwork.
- Masonry retaining or freestanding walls.
- Rest point/seating opportunities.

The specific facilities located within the northern passive recreation area would be subject to detailed design and approval by the City of Wanneroo. This area will provide a smaller space for recreation surrounded by areas of native vegetation and proposed revegetation areas.

An example of a similar area within Burns Beach is provided in **Plate 20**.

Plate 20 Burns Beach Design efficiencies in coastal nodes providing seating opportunities/rest points and minimising impact on vegetated areas.

7.7.5.2 Northern passive recreation location

The northern passive recreation area has been located within a natural basin and hollow within the dunal system. The native coastal vegetation in this location is severely degraded and therefore it is located within a dune blow out requiring stabilisation and revegetation.

7.7.5.3 *Northern passive recreation area patronage*

It is the intention that the northern passive recreation area functions as a minor node for the local community. Facilities will be minimal and the focus of the area will be to provide a small passive recreation area within the dune hollow. The node is likely to be used by local residents who can walk from the adjacent Amberton development.

7.7.5.4 *Northern passive recreation area design*

The northern passive recreation area is adjacent to an area of POS within the Amberton development and therefore the area will be designed to be similar in appearance to this POS area, effectively representing an extension of the POS. Pathways and fencing are proposed to be used as a defining edge between areas of the Amberton foreshore reserve that are in good condition, in which pedestrian access will be prevented.

7.7.5.5 *Northern passive recreation area construction*

As outlined above, the northern passive recreation area will be designed and constructed to be similar to that of the adjacent POS area, incorporating consistent materials and feature elements. The materials used will be suitable for coastal conditions and installation works will be controlled by future construction drawings and specifications as part of the detailed design and approval process.

7.7.6 Pathway intersection and rest points

Small intersection and rest points are located within the Amberton foreshore reserve. These points may include the following:

- Directional, safety and interpretative signage.
- Exposed aggregate, asphalt or poured concrete paving.
- Standard fencing to restrict access.
- Masonry retaining or freestanding walls with seating.

An indicative concept for these intersection points is shown as **Plate 21**.

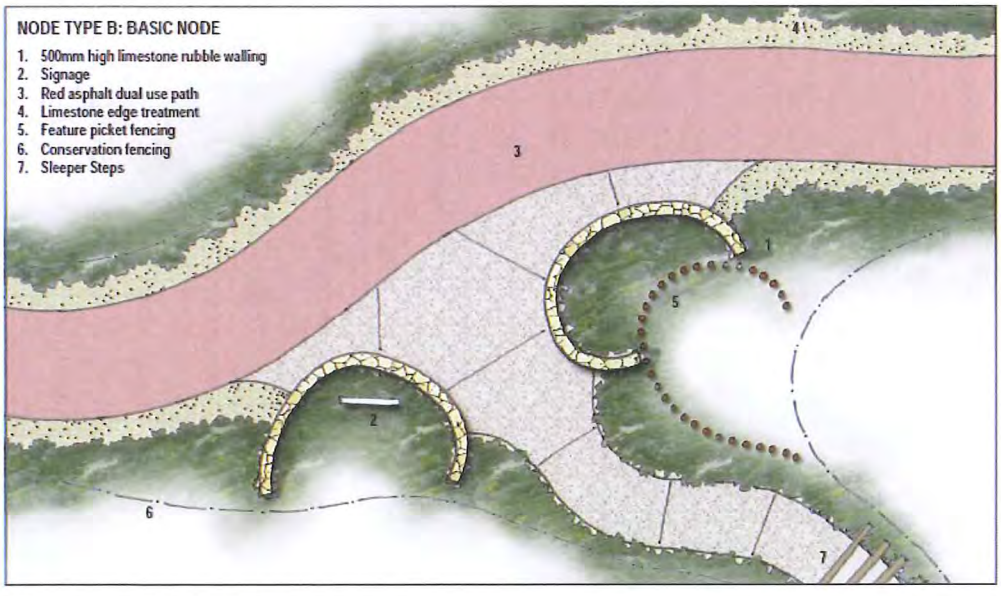

Plate 21 Intersection Point (plan view)

The Amberton foreshore master plan (see **Figure 10**) shows the proposed location for intersection points between areas of dual use path and pedestrian pathways to slow cyclist traffic and enable safe movement through these intersections.

The specific facilities of these intersection points within the Amberton foreshore reserve will be subject to a detailed landscape approval process to be negotiated with the City of Wanneroo.

7.7.7 Car park

Car parking bays have been included within the foreshore reserve in a currently degraded natural depression. A carpark has been provided given the significant width of the foreshore reserve (greater than 175 m) and is not required to meet the car parking requirements of the LSP or any broader car parking strategy.

Engineering design shall be focused on reducing impact to this area, with the car park being designed mainly for emergency vehicle access (with the car park connected to the emergency access), universal community access, maintenance vehicle access and minor café associated deliveries.

The carpark is proposed to be constructed of sealed asphalt and on-street parallel parking is also proposed for the length of the public road adjacent to the foreshore reserve.

7.7.8 Lookouts

7.7.8.1 Lookout intent

The foreshore is proposed to contain two lookouts to promote public viewing across the beach and surrounding foreshore reserve. The lookouts are a key facility for the Amberton foreshore reserve as they provide the following benefits:

- Provide important orientation and reference points when viewed from the path system and surrounds.
- Encourage and allow passive surveillance across the foreshore and beach.
- Provide regular periodic rest stops for pedestrian and cyclists.

Examples of coastal lookouts that could guide those proposed for the Amberton foreshore reserve are shown in **Plate 22**.


Plate 22 Injidup Beach Lookout (left) and Capricorn Village Lookout (right)

7.7.8.2 Lookout location

The lookouts are proposed to be located on dune peaks and ridges to maximise views. Ideally the lookouts will be located on areas that have been historically disturbed or degraded and are targeted already with a range of stabilisation and revegetation initiatives. This approach provides controlled stable access to high points where otherwise uncontrolled pedestrian access has historically occurred and may be most likely in the future. The Amberton foreshore master plan (see **Figure 10**) shows the currently proposed locations for these lookouts.

7.7.8.3 Lookout patronage

The lookouts are proposed be for general public use. As a result of their high point locations it is anticipated that stair access will be necessary in many instances to avoid extensive clearing and regrading for ramps. Lookouts are also proposed to occur at suitable areas where views may exist adjacent to proposed sealed paths. These lookouts will cater for disability access and cyclists.

7.7.8.4 Lookout design

The lookouts are proposed to be designed as a series of level platforms which are orientated to maximise key views. The lookouts will typically be inclusive of balustrades if required adjacent to significant fall heights. Lookouts may include shade structures and possible interpretive and directional signage. Subject to further design refinement the lookouts may be designed as a hierarchy in response to anticipated use patterns. For example:

- A more prominent type may occur in a high use zone on a dune peak and could include stair access, a level viewing platform, seating, shade, signage and full balustrades.
- A less prominent type may occur in a lower use zones adjacent paths and may simply include a level platform, seating and partial balustrade.

7.7.8.5 Lookout construction

The lookout elements are anticipated to be constructed of a range of materials suitable for coastal conditions. This may include rust free aluminium framing, HDPE plastic battens, hot dipped galvanised fixings and stirrups and galvanised reinforced concrete footings. Installation works will be controlled by future construction drawings and specification clauses as part of future detailed works approval applications with the intention of limiting clearing, limiting and control working access, outlining penalties and ensuring stabilisation to locally disturbed areas post installation.

7.7.9 Public art

Public art in the form of sculptures, decorative way finding and directional signage will be accommodated within the Amberton foreshore reserve. These items are important as they assist with way finding, provide areas of activity and can help educate the local community about heritage or environmental values.

All public art will require separate development approval which will detail the intent, maintenance regime and engineering requirements for any structures that need to be suited to this coastal environment.

7.7.10 Landmark and safety signage

Landmark and safety signage will be provided to the main pedestrian pathways and beach access points within the Amberton foreshore reserve and will include information on illegal access. All landmark and safety signage will comply with the City of Wanneroo's requirements and specifications. It should be noted that after 24 months of community use, signage should be reviewed to determine if additional signage is required to highlight to the community any evident coastal or other hazards. SLSWA have also provided recommendations on appropriate beach/swimming safety signage as part of the CARA.

7.8 Bushfire management

Planning for Bush Fire Protection (WAPC 2010) and the recently released draft *Planning for Bushfire Risk Management Guidelines* (WAPC 2014) is a guideline for various stages of the planning process to avoid inappropriately located or designed land uses, subdivision and development on land where a bushfire risk is identified so that an appropriate level of protection to life and property from bushfires is provided.

Fire management is expected to be managed as part of the subdivision approval process which will need to consider the hazards posed by vegetation within the foreshore to adjacent residential dwellings. Bushfire Management Plans will be required to be prepared as conditions associated with adjacent subdivision. A Fire Management Plan has been prepared by Strategen (2014) and demonstrates that a suitable, compliant and effective bushfire management outcome can be achieved for the site.

The provision of the public road separating the Amberton foreshore reserve and future residential dwelling adjacent to the foreshore reserve will provide a Building Protection Zone in these areas to reduce radiant heat and provide a line of defense. The DUP will also provide fire control access for small firefighting appliances within the foreshore reserve, although would not provide a formal fire service access route in accordance with the guidelines.

Separate technical assessments will be required to outline hazard ratings, delineate bushfire prone areas and Bushfire Attack Levels for dwellings within 100 m of classified vegetation (as defined in Australian Standards 36959 *Construction of building in bush-fire pone areas* (AS3959)). This will be completed for subdivision adjacent to the foreshore reserve in line with standard subdivision conditions.

7.9 Staging

The implementation of the Amberton FMP will be conducted in a staged manner to coincide with adjacent residential subdivision and development. An indicative staging plan has been provided as **Figure 12**, which has the implementation of the Amberton FMP proceeding from south to north. The subdivision process that actually creates the separate foreshore reserve will result in a subdivision condition that requires the foreshore reserve be ceded free of cost to the Crown (with a management order with the City of Wanneroo). These foreshore reserves will be created adjacent to the proposed subdivision area as shown in **Figure 12**.

The FMP will be implemented and the foreshore reserve maintained by Stockland for a period of five years (in accordance with SCPP) and sequentially handed over to Council for long term management and maintenance. This effectively means that Stockland will be implementing works in Crown land (with a management order with the City of Wanneroo) as the land is likely to have been ceded prior to foreshore works. However, should works be completed prior to subdivision, subdivision of the foreshore reserve will be undertaken prior to handover to enable the creation of a foreshore reserve which can be handed over to the City of Wanneroo for maintenance.

With regards to the staged handover of maintenance responsibilities, this will occur five years from practical completion of a particular stage. Given that only minor infrastructure and assets are proposed in the foreshore reserve, it is expected that all works within a stage will be completed at the same time. For example, if we assume that works associated with Stage 1 commence in January 2016 and are completed in April 2016 the process for handover will be as follows:

- The City of Wanneroo inspects and grants practical completion of works at Stage 1 in April 2016.
- Following this, the five year maintenance period begins for Stockland.
- In April 2021, following inspection of the foreshore reserve by the City of Wanneroo, the ongoing maintenance of Stage 1 is transferred to the City of Wanneroo.

While the implementation of the FMP will be on a staged basis, there are a number of work areas that may be completed in a particular area prior to adjacent residential development. These tasks include:

- Placement of brushing material or barriers (boulders) to reduce unauthorised access to the foreshore reserve.
- Provision of early beach access for residents. This has involved the creation of an access track and temporary car park (outside the Amberton foreshore reserve) and signage directing uses to the swimming beach in the southern portion of the Amberton foreshore reserve.
- Stabilisation works, including revegetation. Revegetation may be undertaken in strategic locations prior to development to ensure vegetation is well-established prior to residential development.

8 Summary of Compliance with SPP 2.6 State Coastal Planning Policy

The Amberton FMP has been prepared in accordance with the *State Planning Policy 2.6 State Coastal Planning Policy* (SCPP). The SCPP includes a number of policy measures which planning decisions and instruments, including foreshore management plans are required to comply with. These policy measures and how the Amberton FMP is consistent with them are discussed in further detail below.

8.1 Development and settlement

The SCPP measures for development and settlement generally applies to new coastal developments and recommends that these are strategically located and that use of the coast for recreation, conservation, tourism, commerce, industry, housing ocean access and other activities is sustainable and located in suitable areas.

While Amberton is a new development, there has been an extensive historic planning process (as discussed in **Section 2.2)** to inform the pattern of coastal development. Likewise, historic planning has informed the nature and scale of the Amberton foreshore master plan, which provides for a local beach with local facilities.

In accordance with the SCPP measures, the Amberton FMP and adjacent residential development has been planned to complement and enhance the natural environment including:

- Making use of coastal views through the use of lookouts and coastal café.
- Revegetation and dune stabilisation to improve environmental values within the Amberton foreshore reserve.
- Locating structures, facilities and pathways within historically degraded (cleared) areas within the Amberton foreshore reserve, with consideration of coastal hazards.

8.2 Water resources and management

The SCPP measures for water resources and management specify that coastal development should manage water resources in accordance with water sensitive urban design and integrated water cycle management. Specifically the Amberton FMP has responded to the SCPP measures through:

- Locating all stormwater treatment areas outside of the Amberton foreshore reserve.
- Having major events (greater than 1:10 year events) progress through overland flow paths into the Amberton foreshore reserve without requiring substantial modification of the natural dune system.
- Locating the sewer pump station and emergency overflow outside of the Amberton foreshore reserve.

8.3 Building height limits

There are no specific SCPP measures for building height limits that apply to the Amberton FMP given that an endorsed LSP exists and green title residential development is proposed.

8.4 Coastal hazard risk management and adaptation planning

A coastal hazard risk management and adaptation plan (CHRMAP) has been accommodated into the Amberton FMP and is dealt with in detail in **Section 10.**

8.5 Infill development

The site is not subject to infill development and therefore the infill development policy measures do not apply. Nevertheless, the Amberton FMP has responded to policy measures associated with the development which may be subject to coastal hazard over the planning timeframe, as discussed in **Section 10**.

8.6 Coastal protection works

No coastal protection works are proposed as part of the Amberton FMP.

8.7 Public interest

The local Amberton community has been informed of the development of the Amberton FMP through community consultation and meetings. In accordance with this SCPP measure, public access will be provided to the coast at regular intervals along the length.

Through subdivision and subsequent development of the Amberton Estate, the Amberton foreshore reserve will be sequentially ceded to the Crown (to be managed by the City of Wanneroo) as a public asset. The implementation of development will facilitate the creation of the foreshore reserve, facilitating legal public access and use of the foreshore and beach.

8.8 Coastal foreshore reserve

A coastal foreshore reserve has been historically determined based upon a coastal processes setback as determined by a technical assessment undertaken by M.P. Rogers in 2011, as discussed in **Section 3.8.** In accordance with this SCPP measure the coastal foreshore is proposed to be vested with the relevant local government for the purpose of coastal foreshore management, public access, recreation and conservation. The extent of the coastal foreshore reserve was formalised through the endorsement of the Eglinton LSP in February 2013.

In addition, the Amberton FMP coastal foreshore reserve provides for a clear demarcation between public and private land.

8.9 Coastal strategies and management plans

This FMP has been prepared to address this SCPP measure and will be reviewed and ultimately accepted by the City of Wanneroo and the WAPC. In accordance with this policy, Stockland will be responsible for the implementation of the Amberton FMP as well and the funding, maintenance, monitoring and management of foreshore works for a period of not less than five years.

8.11 Precautionary principle

In accordance with this policy measure, the Amberton foreshore management plan has aimed to avoid any significant environmental impacts and to reduce any other environmental impacts. The proposed development will not pose any significant threat to the environment and overall, through revegetation and stabilisation there will be significant improvements to the environmental and biodiversity values of the foreshore reserve. Development within the foreshore that is consistent with this FMP will not cause significant harm to the environment.

9 Implementation, Developer Maintenance and Handover

9.1 Implementation

An implementation schedule for the implementation of the foreshore management plan has been provided below (**Table 10**). It should be noted that development applications and/or landscape approval will be required for works within the Amberton foreshore reserve, which will provide a greater level of detail than provided within this FMP. Furthermore, it should be acknowledged that there may be some minor changes to the development elements incorporated into this FMP due to detailed engineering, drainage or subdivision design and approval process.

The preparation of development applications for foreshore works provides an approval process to consider these detailed designs and changes; however Council and WAPC will have regard to the concepts and general intent of this FMP when considering development applications and/or landscape approvals.

In terms of staging, it is acknowledged that staging and handover of areas will need to take into consideration the location of groundwater bores (for irrigation) and the distribution of use of groundwater from these. To facilitate multiple stages of handover there will need to be multiple bores.

9.2 Developer maintenance and practical completion

Developer maintenance refers to the period in which the developer, Stockland will maintain the foreshore reserve following practical completion of works (on a staged basis).

Practical completion relates to when landscaping construction and revegetation works have been completed in accordance with the Amberton FMP and in accordance with the detailed landscape plans. Prior to the City of Wanneroo undertaking inspection of the foreshore reserve works, the following information will be provided:

- As constructed landscape plans in PDF format, in DWG format and A3 hard copy.
- Bore installation details, controller manuals and software.
- As constructed electrical plans in PDF format, in DWG format and A3 hard copy of all.
- Electrical certification for lights, BBQ, bore cabinet etc.
- Copy of current bore licenses (license to take water).
- Certification for playground and playground audit (required upon installation prior to practical completion and on an annual basis thereafter).
- Building permits where required for structures.
- As-constructed irrigation plans in PDF format, in DWG format and A3 hard copy of all.

Following a final inspection by the City of Wanneroo additional detail will be provided on:

- Capital costs of all physical assets for inclusion in City of Wanneroo's asset register.
- 12-month maintenance schedule and estimate of annual maintenance costs.

The maintenance expectations for areas of public open space are clearly outlined in the City of Wanneroo *Local Planning Policy 4.3 Public Open Space* (2010). The requirements for maintenance of foreshore reserve are expected to be similar; however foreshore reserves are expected to be maintained by the developer for five years in accordance with SCPP.

The City of Wanneroo *Local Planning Policy 4.3 Public Open Space* (2010) notes the following are required for maintenance of public open space:

- *the City being satisfied that the maturity of vegetation, density of planting, species selection and standard of infrastructure are consistent with that specified in the landscaping plan approved by the City, as being acceptable for handover to the City;*
- *for at least 12 consecutive months prior to handover, the developer maintaining the POS to the same standard as it would otherwise be maintained by the City post-handover;*
- *the developer providing the City with annual metered bore water usage data for any irrigated public open space during the term of their maintenance period, to demonstrate compliance with the water licence allocation for that area; and*
- *the developer providing the City with as-constructed drawings and asset management data for the public open space and any facilities/infrastructure contained therein.*

During the developer maintenance period, infill planting, weed control and fencing repair will be undertaken over revegetation areas based upon monitoring undertaken by the revegetation contractor. The five year maintenance period for the foreshore reserve will allow significant establishment of native species, plus ongoing weed control.

9.3 Handover

Following the five year maintenance period, as outlined in **Section 7.9** above, areas of the foreshore will be handed over for ongoing management and maintenance by the City of Wanneroo. As a part of the formal handover process and to assist with the on-going maintenance, Stockland will provide the following:

- All bore licences applications to be lodged and transferred to the City of Wanneroo prior to handover, with appropriate electrical certification being provided on installation completion. Stockland to complete a *4t – Transfer a Bore Licence* and submit a cheque to City of Wanneroo to cover the costs of bore licence transfer. Stockland to provide City of Wanneroo with a copy of existing bore licence/s.
- Electricity transfer process (if applicable), with Stockland to pay the final electricity account and forward invoice copy to the City of Wanneroo's who will arrange for account details to be transferred to City of Wanneroo account name.
- Playground audits (required annually) and rectifications for the maintenance period are to be handed to City of Wanneroo (five years of playground maintenance will incur five playground audits).
- Details of the areas maintained.
- Revised 12-month maintenance schedule and estimate of annual maintenance costs.
- Maintenance specifications.
- OSPEC (survey).

The long term management and maintenance of the foreshore reserve is discussed further in **Section 11.**

Table 10 Amberton FMP Implementation schedule for developer

ACTION	LOCATION (AS SHOWN ON FIGURE 10)	TIMING/ TIMEFRAME	DESCRIPTION OF WORKS:		
			PRE-CONSTRUCTION IMPLEMENTATION	CONSTRUCTION IMPLEMENTATION	POST-CONSTRUCTION IMPLEMENTATION AND MONITORING
Construction management					
Temporary fencing of conservation and rehabilitation areas to prevent unauthorised access.		To be installed pre construction and removed post construction on a staged basis.	Install fencing around areas of native vegetation proposed to be retained. Where necessary this should be wind-break fencing standard to prevent sand drift.	Regularly inspect fencing and provide maintenance where required.	Remove fencing around site and dispose of appropriately Replace fencing around conservation areas with adequate long-term fencing.
Rehabilitation/ecological restoration					
Control and reduce the presence of weeds within conservation areas within the foreshore.	As shown on the Foreshore Management Plan (**Figure 10**). Foreshore management zones 2 and 3.	To be undertaken concurrent with revegetation works on a staged basis.	Weed control requirements will be assessed by a revegetation contactor and targeted in areas proposed for revegetation.	Weed control works will be undertaken seasonally in spring and autumn.	Ongoing weed control and infill revegetation should be undertaken during the maintenance period.
Stabilise degraded areas of foreshore (blow outs) to reduce ongoing erosion.	As shown on the Foreshore Management Plan (**Figure 10**).	To be undertaken concurrent with foreshore works on a staged basis.	Review degraded areas and determine appropriate stabilisation techniques.	Implement stabilisation techniques using soft engineering techniques (mulch, brushing, sand trap fencing and matting). Undertake re-contouring and earthworks if required.	Monitor stabilisation techniques and re-adjust if required until handover.
Undertake revegetation with native coastal species.	As shown on the Foreshore Management Plan (**Figure 10**).	To be undertaken as part of foreshore works on a staged basis.	Review revegetation requirements (direct seeding or tubestock planting) and determine seedling orders.	Undertake soil preparation and planting/seeing.	Monitor revegetation works and undertake maintenance works as required until handover.
Landscape treatments					
Undertake installation and construction of soft landscape treatments including tree, shrub, ground cover and turf planting.	Shown indicatively in the foreshore management plan in publicly accessible areas.	To be undertaken as part of foreshore works on a staged basis.	Undertake design of landscape treatments.	Implement soft landscape treatments.	Monitor landscape treatments and provide maintenance as required until handover.
Foreshore access					
Install dual use paths and boardwalks.	As shown on the Foreshore Management Plan (**Figure 10**).	To be undertaken as part of foreshore works on a staged basis.	Undertake design of pathways and networks.	Implement construction of dual use paths and boardwalks.	Monitor pathways and boardwalks and provide maintenance as required until handover.
Restrict and reduce uncontrolled access.	As shown on the Foreshore Management Plan (**Figure 10**).	To be undertaken prior to foreshore works as required.	Install barriers to uncontrolled access.	Review barriers throughout construction and repair/upgrade as required.	Continue to monitor uncontrolled access throughout maintenance period.
Install car park and emergency beach access.	As shown on the Foreshore Management Plan (**Figure 10**).	To be undertaken as part of foreshore works on a staged basis.	Undertake detailed design of car park and emergency beach access.	Construct car park and emergency beach access.	Monitor car park and emergency beach access.
Install permanent fencing to restrict access and protect native vegetation.	As shown on the Foreshore Management Plan (**Figure 10**).	To be undertaken as part of foreshore works on a staged basis.	Undertake detailed design of fencing to City of Wanneroo standards.	Construct fencing.	Monitor effectiveness of fencing and make repairs as necessary.

Amenities and structures					
Install amenities and structures for users of the Amberton foreshore reserve including: • Signage, • Shelters/shade structures • Beach showers and foot tap • Drink taps • Bicycle racks • Bins; • Feature fencing or artwork • Feature walling • Seating and rest points	As indicated in the Foreshore Management Plan (**Figure 10**).	To be undertaken as part of foreshore works on a staged basis.	Undertake detailed design of amenities and structures and submit for approval.	Implement structures and facilities	13 week consolidation period for all soft works. 12 month consolidation period for all hard works. 5 year developer maintenance period from date of practical completion
Control the spread of weeds within the area of native vegetation to be retained in conservation/passive public open space.	As shown on attachment **Figure 10**.	Pre, during and post construction, with continued ongoing maintenance.	Areas of vegetation to be retained in conservation/passive public open space should be assessed for weed abundance, and where possible treated and rehabilitated with local native species.	Ongoing monitoring and maintenance of conservation /passive public open space areas should be undertaken to prevent the spread of weeds, particularly during phases when construction will occur close to conservation areas.	Monitoring of rehabilitated areas should be undertaken in accordance with the Rehabilitation Plan Undertake ongoing weed management of the conservation/passive public open space areas.

10 Coastal Hazard Risk Management and Adaptation Plan

State Planning Policy 2.6: State Coastal Planning Policy (2013) specifies that a Coastal Hazard Risk Management and Adaptation Planning (CHRMAP) should be undertaken to support proposed development in coastal areas.

In accordance with SCPP, the CHRMAP process should include:

- Context for the CHRMAP.
- Identification of risks and vulnerability.
- Analysis and evaluation of risks.
- Risk management and adaptation options.
- Monitoring and review process.
- Communication and consultation process.

The CHRMAP process should adopt risk management framework to identify, evaluate and manage appropriate responses to coastal hazards, including inundation, storm surge and sea level rise. The sections below outline the CHRMAP that has been undertaken to support the Amberton FMP and specifically the provision of new assets or infrastructure within the Amberton foreshore reserve, within the nominated coastal processes setback.

The City of Wanneroo are planning to undertake a CHRMAP over the entire coastline within their local government area in the near future and as such, this CHRMAP has been developed so as to provide suitable input into this broader, regional scale hazard risk management and adaptation planning process.

10.1 Context

The approach adopted for the Amberton CHRMAP has been to assess the proposed assets in the foreshore reserve, in the context of a dynamic coastal environment around defined coastal process considerations. The Amberton CHRMAP considers the assets and infrastructure which are proposed to be located within the Amberton foreshore reserve and provides the City of Wanneroo with a framework to respond to the influence of coastal processes (including erosion and storm surge inundation) over a 100 year planning timeframe.

Local governments with existing coastal foreshore reserves and existing assets adopt a simplified coastal hazard adaptation process, whether this process is formalised or not, which involves responding and adapting to changes in the coastal zone, particularly those which occur following significant winter storms.

Existing CHRMAPs within Western Australia and Australia have generally been undertaken for existing coastal assets and infrastructure where the management imperative relates to the vulnerability and exposure of private assets (coastal homes) and infrastructure that may be affected by coastal processes. In this context, the CHRMAP process also deals with community expectations around existing assets and infrastructure and the persistence of these structures and facilities over time.

The proposed implementation of the Amberton FMP provides a different context where proposed new coastal assets can be located, developed or constructed in a way to account for future coastal processes and therefore respond to likely hazards.

Section 7 in Schedule 1 of the SCPP states that it "*is recognised that in circumstances…development may need to occur within an area identified to be potentially impacted by physical coastal processes within the planning timeframe".* Specifically the SCPP identifies that public recreation facilities with finite lifespan (less than 30 years) are appropriate to be located in areas of foreshore which may be affected by physical coastal processes in the long term (i.e. the planning timeframe of 100 years). This is on the proviso that any assets can be removed or modified should they be threatened by coastal hazards.

In addition, the SCPP states that coastally dependent or easily relocatable development is also acceptable within an area likely to be affected by coastal processes.

Generally the overarching objectives within the Amberton FMP have been to:

- Provide access to the beach at suitable intervals.
- Provide emergency beach access at the designated swimming beach.
- Provide facilities and amenity in line with community's expectation for a local beach.
- Conserve, stabilise and enhance coastal dune habitat.

These objectives have been central when progressing the CHRMAP process for assets and infrastructure within the foreshore reserve at Amberton, particularly adaptation responses which can be adopted to meet these objectives in the longer term.

10.2 Coastal hazard risk identification and vulnerability assessment

10.2.1 Coastal hazards

The coastal hazards which are relevant for the Amberton foreshore reserve include inundation and erosion from various coastal processes including sea level rise, tides, storm surges, waves and wind. These hazards apply at differing time scales with differing severity. Shoreline movement analysis shows that shoreline movement at the site has been characterised by recession over the longer term (M.P. Rogers 2011) and minor localised erosion of the primary dune was observed a during detailed site inspection in 2012.

Currently a 10 to 20 m high primary dune provides some protection from coastal hazards particularly winter storm events and offshore reefs also reduce the influence of storm surge, wind and waves on the foreshore.

10.2.2 Exposure to coastal processes over time

As outlined in **Section 3.8**, a coastal processes setback was determined based upon the 2003 SCPP, which was then used to delineate the foreshore reserve for the Eglinton LSP.

Further to this, and in accordance with the 2013 SCPP, a technical assessment was undertaken to determine the coastal processes setback at three different timeframes; 30, 50 and 75 years. This assessment included the S1, S2 and S3 components as well as a 0.2 m / year allowance for uncertainty (M.P. Rogers and Associates 2013). This provides an assessment of the likely shoreline vulnerability at several timescales over the 100 year planning window and the coastal process setbacks (i.e. indication of vulnerability) for these timeframes are provided in **Figure 13**. This assessment also included a calculation of the S4 storm surge inundation allowance and recommended minimum development levels. Accordingly the recommended minimum development level was 3.4 m AHD.

By breaking down the coastal processes assessment into separate temporal sequences, the potential vulnerability of different assets can be evaluated over time. These impacts can then be considered in conjunction with the value and lifespan of the asset to ascertain whether an asset's position within the foreshore reserve is appropriate. Furthermore through monitoring and measurement (see **Section 10.6**) the actual impact over time can be evaluated and compared to the predicted scenarios.

There is a degree of uncertainty when estimating the future vulnerability based upon the frequency of storms and future climate change scenarios. For context an "almost certain" scenario, which provides an indication of the likely minimum shoreline recession over time, has been determined. This "almost certain" scenario is based upon historical shoreline movement plus an estimate of potential shoreline recession due to sea level rise based upon a site specific application of the Bruun rule (using the Amberton foreshore beach slope profile). This "almost certain" coastal vulnerability assessment has been determined for the Amberton foreshore reserve for the 30 year period (see **Figure 13**). This has been included to provide a range to the 30 year coastal vulnerability assessment and demonstrate the level of uncertainty associated with estimating coastal vulnerability and likely future shoreline recession.

10.2.3 Structures and exposure

This CHRMAP specifically considers the proposed assets and infrastructure within the foreshore reserve.

As a local beach, the assets and infrastructure subjected to future physical coastal processes will be limited to assets that are defined as coastally dependent or easily relocatable under the SCPP. Specifically the functions, assets and infrastructure that have been considered as part of this CHRMAP include:

- Car park within the Amberton foreshore reserve
- Southern node, specifically a relocatable café facility
- DUP, pedestrian paths and boardwalks
- Emergency vehicle beach access
- Flood storage areas
- Foreshore reserve structures (such as seating, playgrounds, drinking fountains, bins, shelters, bicycle racks)
- Beach showers
- Lookouts.

The location of these assets within the Amberton foreshore reserve, with the 30, 50 and 75 year coastal processes/vulnerability extent is provided as **Figure 13**. Exposure of these assets to future vulnerability from coastal processes has been limited by locating the majority of these assets behind the fore dune, which will provide some protection from storm surge (and sea level rise), at least in the short term. The DUP system and pedestrian paths are also generally located by the secondary dune providing additional protection for this infrastructure over time. In addition, a series of offshore reefs west of the site also provide protection from storm surge and wave action. Furthermore the majority of development (other than beach access) has been allocated above the 3.4 m AHD storm surge inundation level and therefore is unlikely to be affected by storm surge for the duration of the planning period.

The coastal café facility is located seaward of the 30 year coastal vulnerability extent, but will be specifically equipped to be easily relocated and/or removed and the construction, servicing, siting,

tenure and leasing arrangements will be cognizant of this (as outlined in **Section 7.7.4**). The café will be subject to a specific Development Approval and conditions to be agreed with the City of Wanneroo to accommodate these considerations.

10.2.4 Sensitivity and adaptive capacity

The assets and infrastructure proposed for the Amberton foreshore reserve are generally low to medium cost assets which will be ultimately owned and maintained by the local government. While the assets may be sensitive to coastal hazards, they have a high adaptive capacity as they are easily removed or relocated and have relatively short lifespans from an asset management point of view. The location of these assets, their materials and construction will be cognizant of the coastal environment to minimise ongoing maintenance requirements.

10.3 Coastal hazard risk analysis and evaluation

The analysis of coastal hazard risk needs to consider the likelihood and consequence of the coastal hazard risks for the Amberton foreshore reserve. The likelihood represents the chance of erosion and or storm surge inundation affecting the future assets and infrastructure, while the consequence represents the impact that erosion or storm surge inundation will have on the social, economic and environmental benefits of a particular asset or feature. An example consequence table is provided in **Table 11**.

Table 11 Example consequence scale for coastal hazards (adapted from Ministry for the Environment and Wollongong Coastal Zone Management Plan).

RATING	SOCIAL	ECONOMIC	ENVIRONMENT
Catastrophic	Loss of life and serious injury. Large long-term or permanent loss of services, employment wellbeing, finances or culture (e.g. > 75% of community affected), international loss, no suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances >$5 million	Permanent loss of flora and fauna (no chance of recovery) with national impact.
Major	Serious injury. Medium term disruption to services, employment wellbeing, finances or culture (e.g. < 50% of community affected), national loss, very limited suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances > $2 - $5 million	Long-term loss of flora and fauna (limited chance of recovery) with regional impact.
Moderate	Minor injury. Major short term of minor long-term disruption to services, employment wellbeing, finances or culture (e.g. < 25% of community affected), regional loss, limited suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances > $100,000 - $2 million	Medium-term loss of flora and fauna (recovery likely) with regional impact.
Minor	Small to medium disruption to services, employment wellbeing, finances or culture (e.g. < 10% of community affected), local loss, many suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances > $10,000 - $100,000	Short-term loss of flora and fauna (strong recovery) with local impact.
Insignificant	Minimal short term inconveniences to services, employment, wellbeing, finances or culture (e.g. < 5% of community affected), neighbourhood loss, many alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances < $10,000	Negligible to no loss of flora and fauna (strong recovery) with local impact.

The likelihood and consequence can then be used to evaluate risk in accordance with a risk management matrix as shown below in **Table 12**.

Table 12 Risk matrix (adapted from Coffs Harbour Coastal Zone Management Study)

LIKELIHOOD	CONSEQUENCE				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Low	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Low	Medium	High	Extreme
Rare	Low	Low	Low	Medium	High

A specific risk evaluation for the CHRMAP has not been completed because:

- In accordance with SCPP, the coastal assets and infrastructure proposed are "coastally dependent", "easily relocatable" or "public recreation facilities with a finite life span". There is recognition within the SCPP that these assets could be impacted by coastal processes and the consequences of coastal hazard impacts on this infrastructure is minor.
- These assets are mostly low cost assets (less than $50,000 replacement value[1]) and therefore the consequence of erosion and storm surge inundation on these assets is generally "minor" or "insignificant" in accordance with **Table 11**.
- These assets generally have a design life of 30 years or less which allows the assets to be relocated or removed prior to coastal hazard impacts.
- There is no essential infrastructure or assets proposed within the Amberton foreshore reserve (e.g. transport infrastructure, water or sewerage infrastructure, residential development or other essential infrastructure (hospitals and schools)).
- Impacts on the community are considered to be relatively minor given the assets and infrastructure are associated with a local beach and "Minor" in accordance with **Table 11.** Amenity is provided within nearby public open space associated with the development and will be provided in future regional beaches to the north (Shorehaven coastal node) and south (Eglinton marina node).
- Adaptation measures are provided as part of this CHRMAP and can be accommodated into the planning, monitoring and maintenance of the foreshore reserve (i.e. retrofitting is not required). This provides clear expectations around the lifespan and temporary nature of assets and infrastructure which can also be included into any community consultation process.

It is therefore considered that overall the risk evaluation for the proposed coastal assets and infrastructure would generally be medium to low and as such the risk is acceptable.

Furthermore as part of developing a CHRMAP for the City of Wanneroo, officers within the City have developed a draft "asset value matrix" which assigns asset value based upon estimated monetary

[1] The proposed café within the Amberton foreshore reserve is expected to cost in excess of $50,000 replacement value. This structure will be subject to a separate approvals process and will be specifically designed to be relocated. Further information on the café design, construction and tenure arrangements is found in Section 7.7.4.

value, where low assets are <$50,000, medium value assets are $50,000 - $300,000 and high value assets are greater than $300,000.

Further to this, the value and lifespan of coastal assets has been used to develop a "minimum" setback value for a number of specific coastal assets within a local beach as shown in **Table 13** below.

Table 13 City of Wanneroo local beach assets and minimum setbacks.

ASSET	ASSET VALUE ($)	STRUCTURAL LIFESPAN (YEARS)	MINIMUM SETBACK (YEARS)
Public Ablutions	Medium	50	50
Car parking (20 bays)	Medium	Resurfacing required every 25-50 years. Indefinite lifespan if resurfaced.	50 (allows for resurfacing in 25)
Small park	Medium	Indefinite	75
Small playground	Medium	20	40
Lookout shelter	Medium	40	40
Picnic table	Low	20	20
Drinking fountain	Low	20	20
Seat	Low	20	20

The majority of coastal assets within the Amberton FMP are compliant with these setbacks (as discussed in **Section 10.4**) and therefore it is considered that the risk to the assets is acceptable.

10.4 Coastal hazard risk adaptation

In accordance with the *State Coastal Planning Policy Guidelines* (WAPC 2013), a CHRMAP typically involves an adaptation hierarchy, which includes four main categories. These four adaptation categories and relevant considerations for the foreshore reserve are detailed in **Table 14** below.

Table 14 CHRMAP adaptation hierarchy and measures relevant for the foreshore reserve (adapted from WAPC 2013).

ADAPTATION HEIRARCHY	MEASURES RELEVANT FOR THE FORESHORE RESERVE
Avoid	• Avoiding development within primary and fore dunes and low lying coastal areas.
Planned or managed retreat	• Removal of infrastructure as they become at risk by coastal hazards. • Prohibiting high value developments and infrastructure in at risk areas in favour of low cost activities (such as recreation, etc). • Retaining public coastal land in public ownership.
Accommodate	• Locating development on least hazardous portion of the site. • Reducing the footprint of the proposed building, and shifting the footprint away from the hazard. • Be designed to be durable and effective for the estimated time period and/or have reasonably well known maintenance and operating costs for the design period. • Indicate the anticipated response at the end of the estimated extended period when risks again approach intolerable levels. • The design of temporary or relocatable structures, or structures that could be readily repaired or reinstated following the impacts of the likely coastal hazards.
Protect	• Dune management. • Emergency management • Construction methods or materials that reduce the consequences of inundation and/or reduce the costs of relocation.

The CHRMAP process for the Amberton FMP has been based on a list of assets, the risk management and adaption options, monitoring and triggers. Given a coastal hazard risk evaluation has not been completed, an alternative (or worst case) adaptation mechanism is also provided. A summary of the CHRMAP for the foreshore reserve is provided as **Table 15** and the potential impacts on coastal assets and infrastructure over three separate timescales (30, 50 and 75 years) is provided on **Figure 13**. Assessment at three separate timescales, allows progressive assessment of the assets, which is appropriate to their cost and lifespan, rather than requiring all assets to be located beyond the coastal processes setback, at which point their value as a "coastal" asset is reduced.

The design and layout of the Amberton FMP has been primarily based on an approach whereby all assets and infrastructure have been located outside of the 30 year coastal processes setback (except beach access, beach showers and the proposed café). Therefore the Amberton FMP has primarily used the adaptation measure of "avoid" to setback assets and infrastructure to ensure that this infrastructure is present for at least 30 years in accordance with the SCPP. This also provides a 30 year window to consider the level and extent of shoreline recession and modify adaptation measures as required.

Following this 30 year timeframe, the majority of these assets would then adopt the "planned/managed retreat" adaptation mechanism, due to the fact that they are low-value coastal assets located in an area subject to coastal processes, where retreat is the most sensible option. These assets also have a limited asset life span (generally less than 30 years) which allows planned/managed retreat to occur naturally over time, where assets are simply not replaced at the end of their life span in conjunction with shoreline recession. This progressive assessment is appropriate for coastal assets, as their value is inextricably linked to their proximity to the beach. Facilities will also be provided in other areas of POS within the Amberton Estate.

The "accommodate" option would also be adopted as an adaptation mechanism through the detailed design and construction of assets and the materials used. Similarly, ongoing maintenance and inspection of coastal assets will allow accommodation of coastal processes, where by temporary and minor impacts (sand drift, inundation) can be managed.

Furthermore the extensive revegetation and stabilisation works provided within the foreshore reserve (particularly within the primary dune) will also "protect" coastal assets and infrastructure at least in the short to medium term. Likewise the presence of Tamala limestone below the Safety Bay sand may also serve to reduce the extent of coastal shoreline recession and provide some protection to coastal assets and infrastructure. This is not specifically referred to in the CHRMAP summary (see **Table 14**), however would be applicable to all assets and infrastructure located within the foreshore reserve, and may mean that the costal processes setbacks are conservative given the shoreline is inherently more stable than adopted in the costal processes setback scenarios.

None of the proposed assets within the Amberton foreshore reserve are proposed to be protected through beach nourishment or replenishment or through the construction of seawalls or groynes, however revegetation and stabilisation of the fore dune as part of the implementation of the Amberton FMP will provide some protection to coastal assets and may reduce the severity of coastal hazards, at least in the short to medium term as outlined above.

Some assets, such as the café node and/or car parking can be relocated (also a "planned/managed retreat" adaptation option) to provide these facilities over the longer term. These facilities are discussed in more detail in the sections below.

The approach for triggers and monitoring has been to incorporate coastal hazard monitoring into the current maintenance program of assets and infrastructure. Coastal shoreline recession and storm surge inundation are gradual processes which can be routinely monitored over time. Initially, winter storms may lead to increased sand drift or dune movement, followed by gradual de-stabilisation of the fore dune. Following this, strong south westerly winds (particularly in summer) may result in large sand drift events following the removal of vegetation from the fore dune, which may then lead to increased sand accumulation in areas behind the fore dune.

Inspection of coastal assets and the shoreline following severe winter storms will provide an indication of the progressive impacts and threats from coastal hazards and severity of these hazards on areas of the foreshore. In this way, the triggers provided in **Table 15** do not mean that adaptation responses have to be undertaken immediately but rather they provide feedback that more regular and focused inspection, maintenance and monitoring may be required. In particular, the monitoring and triggers for the 50 and 75 year scenarios are expected to be revised over time based upon coastal hazard impacts observed (particularly during the first 30 years) and the broader regional CHRMAP process being undertaken by the City of Wanneroo.

The interface between the foreshore reserve and the development (such as any regrading within the foreshore reserve) is not considered to be coastal infrastructure as it is only required to integrate the levels from the public road appropriately back to the foreshore landform and is not essential to the operation of the development (i.e. the structural integrity of the road). The development boundary road, parallel carparking and areas of POS immediately adjacent to the foreshore reserve are required to be integrated into the existing coastal landform within the foreshore reserve. A mixture of soft and hard engineering techniques are proposed to manage this interface, and these will be specific to the coastal landform and landform stability within the foreshore reserve. In this way, it is the coastal

landform and stability which will drive the interface treatments. Given this, the interface between the foreshore reserve and the development has not been included within this CHRMAP.

10.4.1 Proposed car park

The proposed car park in the foreshore reserve provides improved beach accessibility for people with disabilities, young children and the elderly. The proposed car park has been located behind the extent of 50 year coastal processes vulnerability and in accordance with the current SCPP can be described as a public recreation facility with a finite lifespan. Typically a car park requires resealing every 25 – 30 years and following discussions with the City of Wanneroo, it was considered that a minimum 50 year lifespan was appropriate for a coastal car park (as outlined in **Table 13**).

As such, after 50 years, the proposed car park is likely to be affected by physical coastal processes, although the frequency and speed at which these influence the structure of the car park is not currently clear or easily predictable. Should the fore dune erode, sand drift will first become visible in the car park, particularly after severe winter storm events. Initially, general maintenance and repair will allow the car park to continue to be used, although being affected by coastal processes.

Should the coastline recede, the beach and swimming areas will be closer to the development and it is expected that the requirement for car parking will decrease as the distance to the beach becomes more easily walkable. Furthermore the staging of development will mean that over time, there are more beach users within walking and cycling distance to the foreshore.

In order to accommodate the car parking spaces provided by the coastal car park outside of the foreshore reserve, one adaptation measure is to provide a portion of road reserve (located adjacent to the southern POS area within the Amberton development) for car parking at the appropriate time (**Figure 13**). The requirement for additional car parking is expected to be determined by the City of Wanneroo and may be influenced by the location (and presence) of the coastal café (see **Section 10.4.2**).

As the beach interface moves closer to the car park, the car park will continue to provide an option for emergency access to the beach (following potential erosion of the proposed emergency access which extends from the end of the car park road), assuming that this area is still suitable for swimming (and therefore requires emergency beach access).

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Table 15 CHRMAP summary

ASSETS	PLANNING TIMEFRAME 30 YEARS				PLANNING TIMEFRAME 50 YEARS				PLANNING TIMEFRAME 75 YEARS			
	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)
Car park within foreshore reserve	**Avoid.** Asset has been located outside of the 50 year coastal processes setback. This is in accordance with the CoW requirements (**Table 13**). **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required. Removal of sand through street sweeping or mechanical removal.	Car park to be inspected following severe winter storms as part of general car park maintenance.	Sand drift into car park. Erosion/inundation visible at western portion of car park	Restrict access to car park at affected locations.	**Avoid.** Asset has been located outside of the 50 year coastal processes setback. This is in accordance with the CoW requirements (**Table 13**). **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required. Removal of sand through street sweeping or mechanical removal	Car park to be inspected following severe winter storms as part of general car park maintenance.	Sand drift into car park. Erosion/inundation visible at western portion of car park	Restrict access to car park at affected locations.	**Planned/Managed retreat.** Asset has been designed to allow retreat through materials and siting. **Accommodate.** Ongoing maintenance will enable repair of asset as required. Removal of sand through street sweeping or mechanical removal.	Car park to be inspected following severe winter storms as part of general car park maintenance and retreat signage/access updated accordingly	Sand drift into car park. Erosion/inundation visible in car park. Public reporting.	Close off entire car park.
Café	**Planned/Managed retreat.** Asset to be designed to allow for removal and located near 20 year coastal processes setback. Lightweight frame to enable easy dismantling (and reuse) of structure. **Accommodate.** Asset designed for coastal conditions	Café owner to observe coastal changes and report to council. Review location of shoreline periodically and determine if lease extension can be granted.	Sand drift. Visible erosion of fore dune in front of café.	Relocate café landward within designated lot. Remove café.	**Planned/Managed retreat.** Asset to be designed to allow for removal. Lightweight frame to enable easy dismantling (and reuse) of structure. **Accommodate.** Asset designed for coastal conditions	Café owner to observe changes and report to council.	Sand drift. Visible erosion of fore dune in front of café	Relocate café landward within designated lot. Remove café.	**Café** likely to be relocated by this timeframe.			
Boardwalks	**Planned/Managed retreat.** Boardwalks designed & constructed to have components removed if dunes are eroded. Lightweight materials can be used to enable easy removal. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required.	Monitoring undertaken as part of standard boardwalk maintenance. Boardwalks to be inspected following severe winter storms as part of general maintenance.	Sand drift, fore dune movement, erosion beneath boardwalks due to water encroachment, access not available due to level changes	Removal of boardwalks with the replacement of pathways at grade (possibly not providing universal access).	**Planned/Managed retreat.** Boardwalks designed & constructed to have components removed if dunes are eroded. Lightweight materials can be used to enable easy removal. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required.	Monitoring undertaken as part of standard boardwalk maintenance. Boardwalks to be inspected following severe winter storms as part of general maintenance.	Sand drift, fore dune movement, erosion beneath boardwalks due to water encroachment, access not available due to level changes	Removal of boardwalks with the replacement of pathways at grade (possibly not providing universal access).	**Planned/Managed retreat.** Boardwalks designed & constructed to have components removed if dunes are eroded. Lightweight materials can be used to enable easy removal. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required	Monitoring undertaken as part of standard boardwalk maintenance. Boardwalks to be inspected following severe winter storms as part of general maintenance.	Sand drift, fore dune movement, erosion beneath boardwalks due to water encroachment, access not available due to level changes	Removal of boardwalks with the replacement of pathways at grade (possibly not providing universal access).

ASSET	PLANNING TIMEFRAME 30 YEARS				PLANNING TIMEFRAME 50 YEARS				PLANNING TIMEFRAME 75 YEARS			
	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)
Coastal paths	**Planned/Managed retreat.** Coastal paths constructed of long lasting materials (concrete and asphalt). **Accommodate** Multiple pathways provide north south connection through foreshore. Ongoing maintenance will enable repair/realignment of asset as required.	Monitoring undertaken as part of standard pathway maintenance. Pathways to be inspected following severe winter storms as part of general maintenance.	Sand drift, dune movement, inundated pathways	Relocation of pathways outside of the influence zone. Pathway outside of foreshore reserve (associated with foreshore road) can provide north south connection.	**Planned/Managed retreat.** The asset can be designed to be removed or not replaced in stages over time. **Accommodate.** Lifespan of coastal paths is less than 50 years, so upgrades will allow for staged removal and realignment. Ongoing maintenance will enable repair of asset as required.	Monitoring undertaken as part of standard pathway maintenance. Pathways to be inspected following severe winter storms as part of general maintenance..	Sand drift, foredune movement, inundated pathways	Relocation of pathways outside of the influence zone. Pathway outside of foreshore reserve (associated with foreshore road) can provide north south connection.	**Planned/Managed retreat.** The asset can be designed to be removed or not replaced in stages over time. **Accommodate.** Lifespan of coastal paths is less than 50 years, so upgrades will allow for staged removal and realignment.	Monitoring undertaken as part of standard pathway maintenance. Pathways to be inspected following severe winter storms as part of general maintenance.	Sand drift, foredune movement, inundated pathways	Relocation of pathways outside of the influence zone. Pathway outside of foreshore reserve can provide north south connection.
Emergency access	**Planned/Managed retreat.** Emergency access has been allowed to retreat over time while still providing access. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required.	Monitoring undertaken as part of standard maintenance. Access points inspected following severe winter storms as part of general maintenance.	Sand drift, dune movement, inundation.	Provide alternative emergency access. If required. Close off emergency access if unsafe.	**Planned/Managed retreat.** Future emergency access maybe provided by car park and coastal paths at southern coastal node. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required.	Monitoring undertaken as part of standard maintenance. Access points inspected following severe winter storms as part of general maintenance.	Sand drift, dune movement, inundation.	Evaluate requirement for emergency access. Close off emergency access if unsafe	**Planned/Managed retreat.** Future emergency access maybe provided by car park and coastal paths at southern coastal node. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required.	Monitoring undertaken as part of standard maintenance. Access points inspected following severe winter storms as part of general maintenance.	Sand drift, dune movement, inundation.	Evaluate requirement for emergency access. Close off emergency access if unsafe
Flood storage areas	**Avoid.** All treatment areas have been located outside of the foreshore only flows greater than 1:100 will enter into the Amberton foreshore reserve. Asset has been located outside of the 30 year coastal processes setback.	Flood storage areas to be inspected in accordance with City of Wanneroo standard maintenance.	Sand drift around flood storage area. Scouring of flood storage areas.	Repairs to flood storage areas as required.	**Avoid.** All treatment areas have been located outside of the foreshore, only flows greater than 1:100 will enter into the Amberton foreshore reserve. Asset has been located outside of the 50 year coastal processes setback.	Flood storage areas to be inspected in accordance with City of Wanneroo standard maintenance	Sand drift around flood storage area, inundation of flood storage areas, Scouring of flood storage areas.	Flood storage areas to be repaired/ stabilised as required.	**Planned/Managed retreat.** Only flow greater then a 1:100 has been contained within Amberton foreshore reserve. Large events to discharge via overland flow into dunes and eventually into ocean as per natural drainage system.	Flood storage areas to be inspected in accordance with City of Wanneroo standard maintenance.	Sand drift around flood storage area, inundation of flood storage areas, Scouring of flood storage areas.	Flood storage areas to be repaired/ stabilised as required.

ASSET	PLANNING TIMEFRAME 30 YEARS				PLANNING TIMEFRAME 50 YEARS				PLANNING TIMEFRAME 75 YEARS			
	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)	RISK MANAGEMENT AND ADAPTATION OPTIONS	MONITORING	TRIGGERS	ALTERNATIVE RESPONSE (WORST CASE)
Public open space structures	**Avoid.** All public open space structures are located outside of the 30 year coastal processes setback. The City of Wanneroo recommends a minimum setback of 20 years for these structures(Table 14)	Monitored as part of standard City of Wanneroo maintenance.	Assets in poor physical state with rust, corrosion, damage etc.	Full removal of assets.	**Accommodate.** Public open space assets installed will most likely have a maximum lifespan of 30 years in this location. **Planned/Managed retreat.** Assets can be removed and not replaced or relocated as appropriate.	Monitored as part of standard City of Wanneroo maintenance.	Assets in poor physical state with rust, corrosion, damage etc.	Full removal of assets.	**Accommodate.** Public open space assets installed will most likely have a maximum lifespan of 30 years. **Planned/Managed retreat.** Assets can be removed and not replaced or relocated as appropriate.	Monitored as part of standard City of Wanneroo maintenance.	Assets in poor physical state with rust, corrosion, damage etc.	Full removal of assets
Lookouts	**Planned/Managed retreat.** Asset will be removed and not replaced over time. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required. The City of Wanneroo recommends a minimum setback of 40 years for lookouts, however proposed lookout structures are to be a flat platform extension of proposed boardwalks and are not considered to be "medium" value assets as assumed by the City of Wanneroo.	Monitoring undertaken as part of standard maintenance.	Sand drift, dune movement, inundation.	Full removal of assets.	**Planned/Managed retreat.** Asset will be removed and not replaced over time. **Accommodate.** Asset designed for coastal conditions. Ongoing maintenance will enable repair of asset as required.	Monitoring undertaken as part of standard maintenance.	Sand drift, dune movement, inundation.	Full removal of assets.	**Planned/Managed retreat.** Asset will be removed and not replaced over time. **Accommodate.** Asset designed to be durable for the time period.	Monitoring undertaken as part of standard maintenance.	Sand drift, dune movement, inundation.	Full removal of assets.
Beach showers	**Planned/Managed retreat.** Beach showers installed will most likely have a maximum lifespan of 20 years in this location. Assets can be relocated as appropriate. While the City of Wanneroo requires a 50 year coastal processes setback for public ablutions, this is not considered to include separate beach showers but rather a public toilet	Monitored as part of standard City of Wanneroo maintenance.	Beach showers in poor physical state with rust, corrosion, damage etc.	Early relocation of assets.	**Planned/Managed retreat.** Beach showers installed will most likely have a maximum lifespan of 20 years. Assets are small and can be relocated as appropriate.	Monitored as part of standard City of Wanneroo maintenance.	Beach showers in poor physical state with rust, corrosion, damage etc.	Early relocation of assets.	**Planned/Managed retreat.** Beach showers installed will most likely have a maximum lifespan of 20 years. Assets are small and can be relocated as appropriate.	Monitored as part of standard City of Wanneroo maintenance.	Beach showers in poor physical state with rust, corrosion, damage etc.	Early relocation of assets.

	block (which is not proposed).											

10.4.2 Proposed café node

The café will provide a community node for Amberton and is co-located with the swimming beach, coastal carpark and emergency beach access.

The café facility is located on the leeward side of the primary dune and as such can be expected to be vulnerable to coastal processes within the 30 year planning timeframe. It is expected that the initial lease for this facility will be 10 years with a potential 10 year extension.

The café will be constructed of lightweight material that is practical and cost-effective to relocate (see **Plate 19**). The café will be specifically designed for relocation and subject to a separate Development Approval by the City of Wanneroo.

Furthermore, a separate elongated title will be created for this structure, which extends landward to proposed POS. This will enable the movement of this structure over time.

Any initial lease arrangements for the café (in the initial proposed location) should be established for a maximum of 20 years on a staged lease arrangement, however this can be reviewed and if shoreline movement or coastal erosion is not progressing consistent with predictions, there is an opportunity to renew and/or extend lease arrangements.

Further information on the café design, location, construction and tenure/lease arrangement is provided in **Section 7.7.4.**

10.5 Funding arrangements

Stockland will be responsible for the initial installation of structures, infrastructure and revegetation within the foreshore reserve. In accordance with the SCPP, areas of the foreshore will be managed by Stockland for a period of no less than 5 years. Further information on the implementation of the FMP is provided in **Section 9**.

The installation of commercial facilities (café) into the foreshore provides an opportunity for the City of Wanneroo to receive a profit from these facilities over time. The remaining facilities have been designed or located such that there are no excessive costs or resources outside of a normal monitoring and maintenance framework. Asset maintenance and replacement at the end of the asset life span will allow for planned/managed retreat as required. The long term monitoring and maintenance of the Amberton foreshore reserve is discussed further in **Section 11.**

10.6 Monitoring and review

The City of Wanneroo is currently proposing to undertake a CHRMAP that will cover the entire City of Wanneroo coastline. It is anticipated that this document will cover monitoring and review of the entire CHRMAP process on a regular basis. It will also be important to evaluate the change to coastal foreshore and compare this with predictions made in accordance with SCPP. Throughout the maintenance period, Stockland will make note of any observed changes to the shoreline, and monitor and record triggers in accordance with **Table 15**. This information will be provided to the City of Wanneroo at handover to provide information on the current impact of coastal hazards.

CHRMAP is a cyclical process, where ongoing monitoring and review allow the management and adaptation measures to be reviewed to ensure the management plan remains relevant. In this way adaptation measures can be altered over time and this will form part of the City of Wanneroo's long

term CHRMAP process, which will extend well beyond the relevant timeframe for the implementation of this FMP.

10.7 Communicate and consult

Stockland will continue to update the local community on the foreshore, the coastal processes assessment and asset maintenance. Stockland currently undertakes monthly meetings with residents and provide weekly construction/approval updates. In the future, the foreshore works, plus the CHRMAP process will form part of this regular communication process.

Beyond the implementation timeframe for this FMP, it is expected that the City of Wanneroo will include a comprehensive communication and consultation strategy with all residents within the City of Wanneroo as part of their CHRMAP process.

11 Long term monitoring and maintenance

The maintenance requirements for the Amberton foreshore reserve will generally be consistent with current City of Wanneroo landscape maintenance requirements for coastal areas. An indicative landscape maintenance schedule outlined in **Table 16** for the foreshore reserve provides a general indication of maintenance tasks to be undertaken by Stockland during the maintenance period. A review of this schedule will be undertaken prior to the areas of foreshore reserve being handed over to the City of Wanneroo. This table provides a schedule of expected maintenance, including frequency of the action and yearly number of visits.

Table 16 Ongoing maintenance schedule for the Amberton foreshore reserve.

FORESHORE RESERVE ELEMENT AND/OR TASK	ACTIONS	FREQUENCY	NUMBER OF TIMES PER YEAR
Hard landscape including DUP, beach access, fencing, gates, pedestrian paths and boardwalks	Inspection	Monthly	12
	Repair	As required	As required
Furniture	Inspection	Monthly	12
	High pressure hosing	Annually	1
	Sealing of timber	Annually	1
	Repair	As required	As required
Irrigated turf areas (within passive recreation areas)	Mowing	Fortnightly (September – April) Monthly (May – August)	21
	Fertiliser	Annually (September)	1
	Top dressing	As required	As required
Weed removal (within passive recreation areas)	By hand	Monthly	12
	Chemical treatment	Annually	1
Flood storage areas	Inspection	Annually	1
	Plant removal and trimming	Annually	1
Garden beds within passive recreation areas	Inspection	Monthly	12
	Fertiliser	Biannually (February and September)	2
	Mulch replenishment	Annual	1
	Pruning and trimming	Every 6 months	2
	Weeding	Monthly	12
	Plant replacement	As required	As required
Trees within passive recreation areas	Inspection	Annually	1
	Pruning	As required	As required

FORESHORE RESERVE ELEMENT AND/OR TASK	ACTIONS	FREQUENCY	NUMBER OF TIMES PER YEAR
	Fertiliser	Biannually (February and September)	2
	Mulch replenishment	Annually	1
Irrigation	Inspection	3 times per week (September – April) Weekly (May to August)	123
	Flushing	Monthly (May – August)	4
	Repair	As required	As required
Playground	Inspection	Fortnightly	26
Soft fall	Clean (by hand)	Fortnightly	26
	Clean (mechanical)	Annually	1
Rubbish removal		As required	Every visit
Graffiti removal		As required	Every visit
Lighting	Maintenance, including bulb replacement.	As required	As required
Revegetation	Infill planting	As required. Planting to be undertaken in spring.	As required
	Weed removal	As required.	As required.

This routine maintenance schedule also provides an opportunity to review the potential impacts of coastal processes, such as sand drift, inundation and erosion (as outlined in **Table 15**). This is particularly important during the winter storm season when large changes to the shoreline may occur.

This routine maintenance schedule provides an opportunity to observe changes to the coastline and implement the adaptation measures outlined in the CHRMAP, such as the relocation and/or removal of coastal assets and infrastructure in accordance with **Table 15.** Relocation and/or removal of coastal assets and infrastructure as identified in the CHRMAP will also occur in accordance with the expected life span of coastal assets. Therefore no additional monitoring or maintenance is required beyond the City of Wanneroo's usual maintenance schedule for areas of foreshore reserve and public open space.

The development of a regional CHRMAP by the City of Wanneroo also provides an opportunity to undertake regular monitoring and review of a) ongoing coastal processes such as shoreline recession and b) the efficacy of adaptation measures across the entire local government area. It is anticipated that the regional CHRMAP will be reviewed on regular basis to ensure that the management and adaptation measures established remain relevant. The Amberton FMP CHRMAP is intended to be incorporated into the wider CHRMAP produced by the City of Wanneroo.

12 Conclusions

The Amberton FMP provides a framework to guide the planning, development, revegetation and management of the Amberton foreshore reserve. As part of preparing the FMP, a review of the historic planning and environmental investigations was undertaken to determine the opportunities and constraints presented by the foreshore reserve. SLSWA undertook a CARA which provided recommendations on the most appropriate location for a swimming beach.

This FMP has considered these opportunities and constraints to develop a foreshore management plan that provides controlled access to the coast, with activation and passive recreation opportunities and strategic lookouts to incorporate coastal views. Amenity is focussed on the southern coastal node (café node) with the provision of car parking, passive recreation areas and a café with public toilet facilities. The general location and layout of these works are provided within the Amberton master plan (**Figure 10**).

Management of the foreshore and the proposed development of the Amberton foreshore reserve are discussed in **Section 7**, which provides information on:

- Construction management
- Interface management
- Rehabilitation/ecological restoration of historic disturbance
- Fauna management
- Water management and Water Sensitive Urban Design (WSUD)
- Access
- Beaches
- Foreshore reserve amenities and structures
- Bushfire management
- Staging.

In accordance with the SCPP, Stockland will fund, monitor and maintain the foreshore works for a period of five years, and it is expected that portions of the foreshore will be handed over to the City of Wanneroo for ongoing maintenance on a staged basis. This will be subject to ongoing discussion and agreement between Stockland and the City of Wanneroo as the subdivision of the adjacent areas progresses.

The FMP has considered a CHRMAP for coastal assets and infrastructure in the foreshore reserve to respond to coastal processes over time. In accordance with the SCPP, the majority of coastal assets are coastally dependant and easily relocatable and as such meet the requirements as a "variation" to the SCPP. Beyond this timeframe, the general approach has been to allow for planned or managed retreat of assets and infrastructure which will allow these structures to be removed at the end of life span, with options for relocation where relevant. In this way, no excessive costs or resources outside of a normal monitoring and maintenance framework are required to implement the proposed adaptation measures.

Following approval of the FMP, detailed development approval and/or landscape approval will be required from the City of Wanneroo and/or the Western Australian Planning Commission prior to implementation. This FMP provides the key framework to guide the preparation of such applications by Stockland and the assessment and approval of such applications by the City of Wanneroo.

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FIGURES

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Figure 1: Locality Plan

Figure 2: Metropolitan Region Scheme Zoning

Figure 3: Cadastral Information

Figure 4: Topographic Contours

Figure 5: Geology

Figure 6: Soils and Landforms

Figure 7: Vegetation Condition

Figure 8: Vegetation Communities

Figure 9: Foreshore Management Zones

Figure 10: Amberton Foreshore Master Plan

Figure 11: Areas of Vegetation to be Retained and Revegetated

Figure 12: Staging of Foreshore Implementation

Figure 13: CHRMAP Summary

Figure 1:	**Locality Plan**	**Plan Number: EP12-032(01)--F38**	
Project:	Amberton Foreshore Management Plan	Drawn: GRO	Date: 17/12/12
Client:	Stockland Pty Ltd	Approved: CKK	Date: 19/06/14
		Checked: JDH	Scale: 1:17,000@A4

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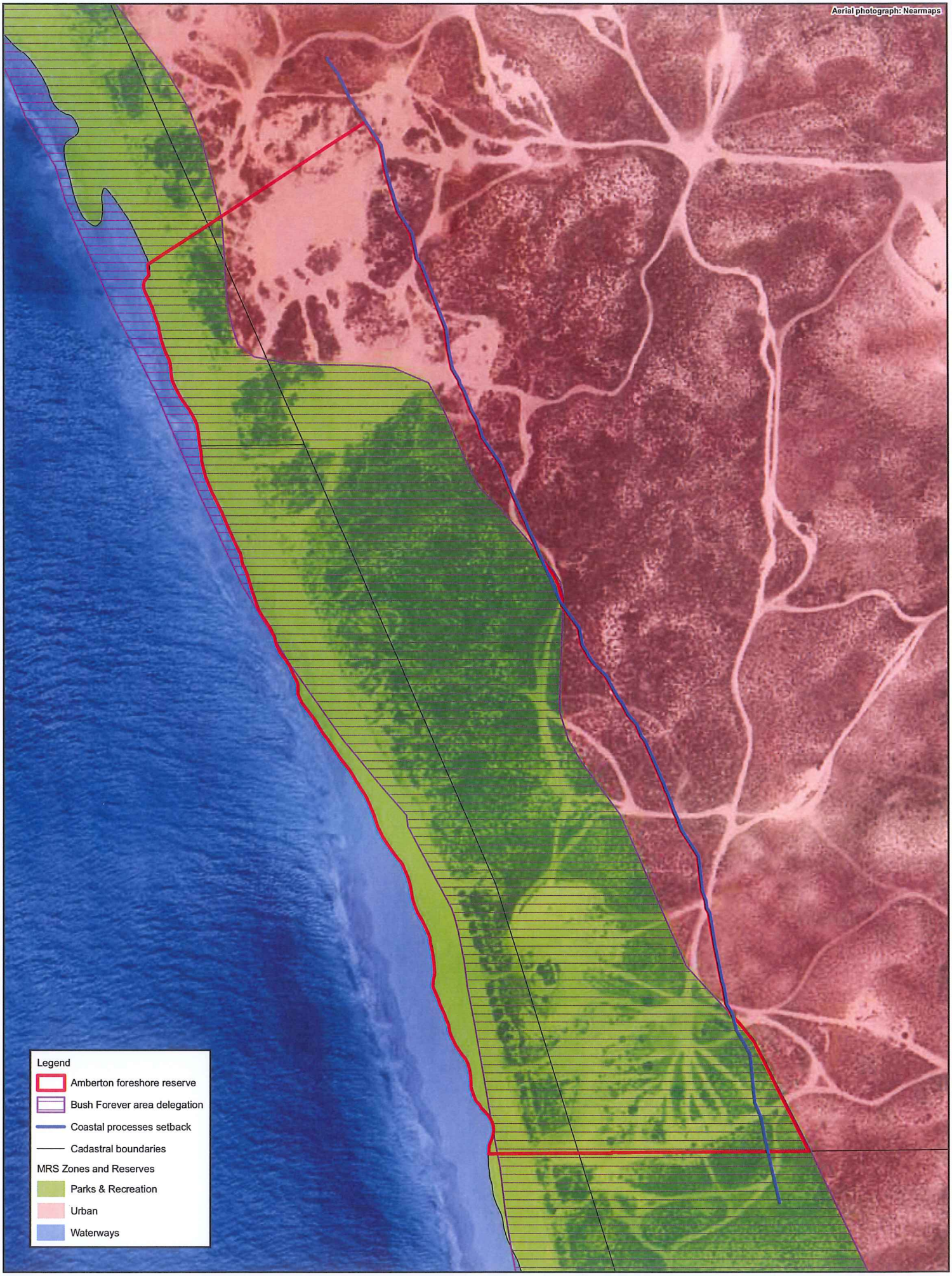

Figure 2: **Metropolitan Region Scheme Zoning**

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

Plan Number: EP12-032(01)--F11

Drawn:	GRO	Date:	10/08/12
Approved:	JDH	Date:	19/06/14
Checked:	CKK	Scale:	1:3,000@A4

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Sources: The following datasets were used in the production of this map: MRS Zones and Reserves - DOP (2011), Bush Forever Sites - DoP (2007), Coastal processes setback - M.P. Rogers (2011)

Figure 3:	**Cadastral Information**
Project:	Amberton Foreshore Management Plan
Client:	Stockland Pty Ltd

Plan Number: EP12-032(01)--F41			
Drawn:	GRO	Date:	29/04/13
Approved:	JDH	Date:	19/06/14
Checked:	CKK	Scale:	1:3,000@A4

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Figure 4:	**Site Topography**	**Plan Number: EP12-032(01)--F12**	
Project:	Amberton Foreshore Management Plan	Drawn: GRO	Date: 10/08/12
Client:	Stockland Pty Ltd	Approved: JDH	Date: 19/06/14
		Checked: CKK	Scale: 1:3,000@A4

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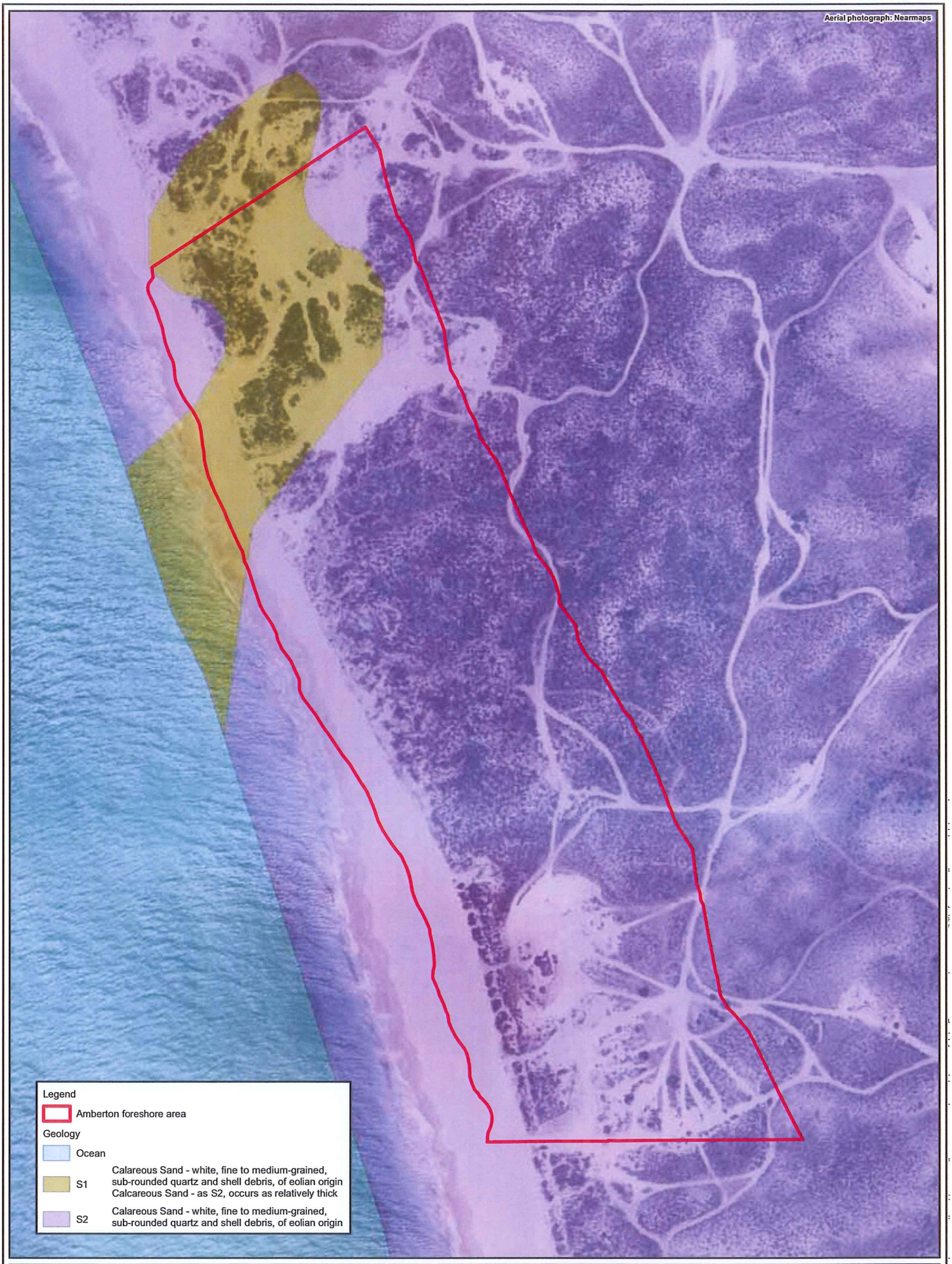

Figure 5:	**Geology**
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Client:	Stockland Pty Ltd

Plan Number: EP12-032(01)--F44			
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Approved:	JDH	Date:	19/06/14
Checked:	CKK	Scale:	1:3,000@A4

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Sources: The following datasets were used in the production of this map: Geology - Gozzard (1982)

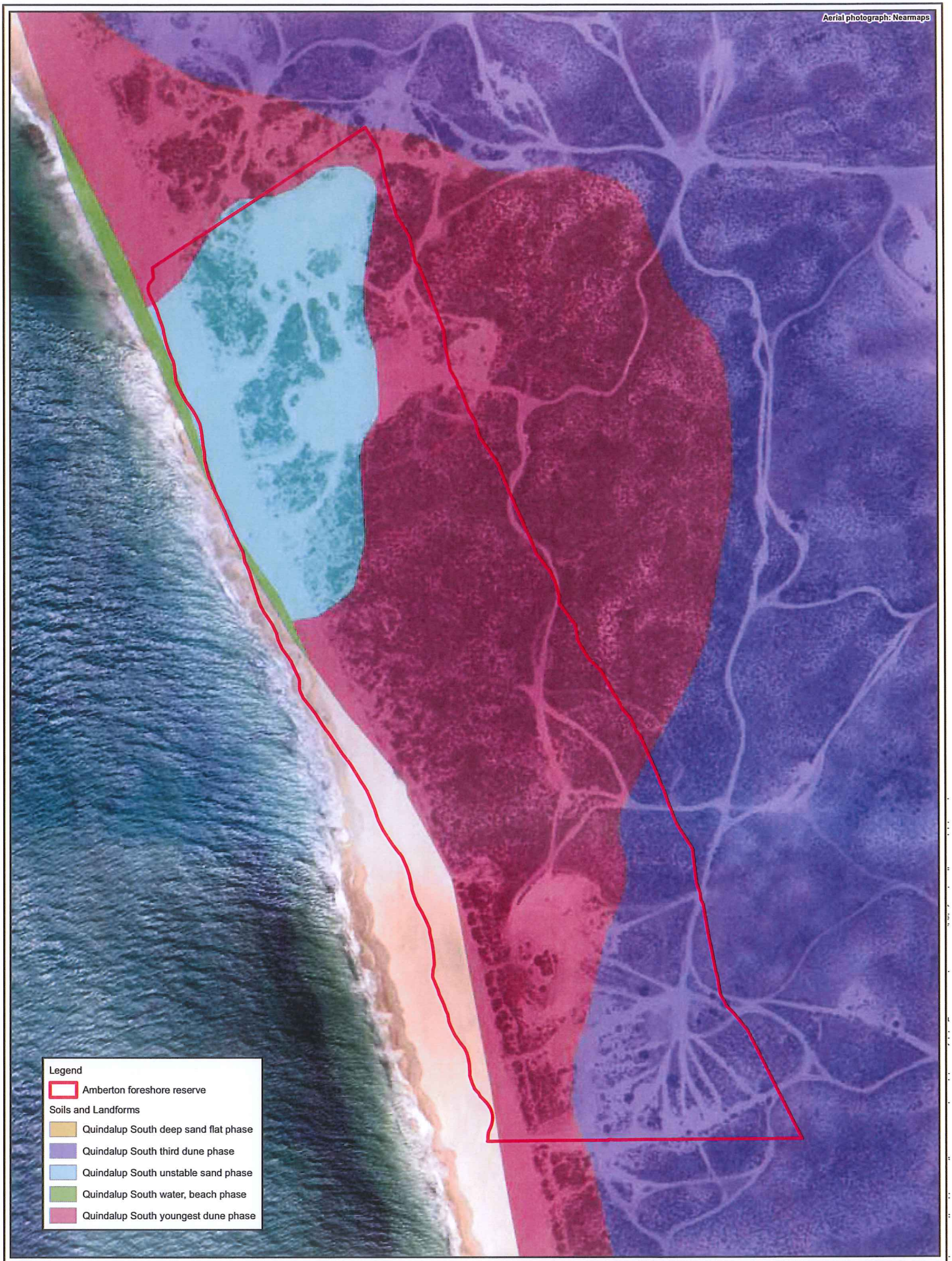

Figure 6: Soils and Landforms

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

Plan Number: EP12-032(01)--F45

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Approved:	JDH	Date:	19/06/14
Checked:	CKK	Scale:	1:3,000@A4

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Sources: The following datasets were used in the production of this map: Landforms and Soils - DoA (2007)

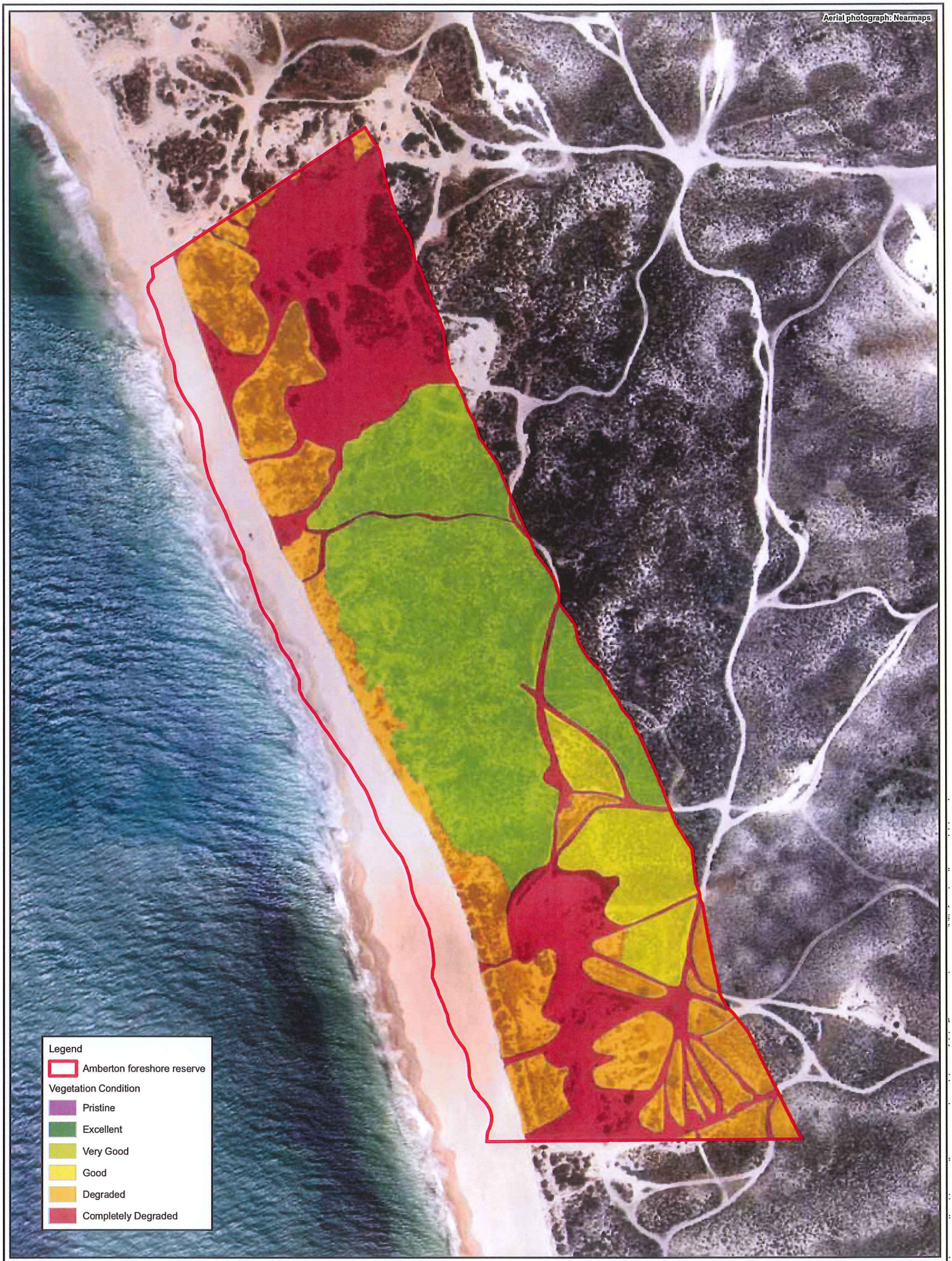

Figure 7: Vegetation Condition

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

Plan Number: EP12-032(01)--F46			
Drawn:	GRO	Date:	29/04/13
Approved:	JDH	Date:	19/06/14
Checked:	CKK	Scale:	1:3,000@A4

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Sources: The following datasets were used in the production of this map: Landforms and Soils - DoA (2007)

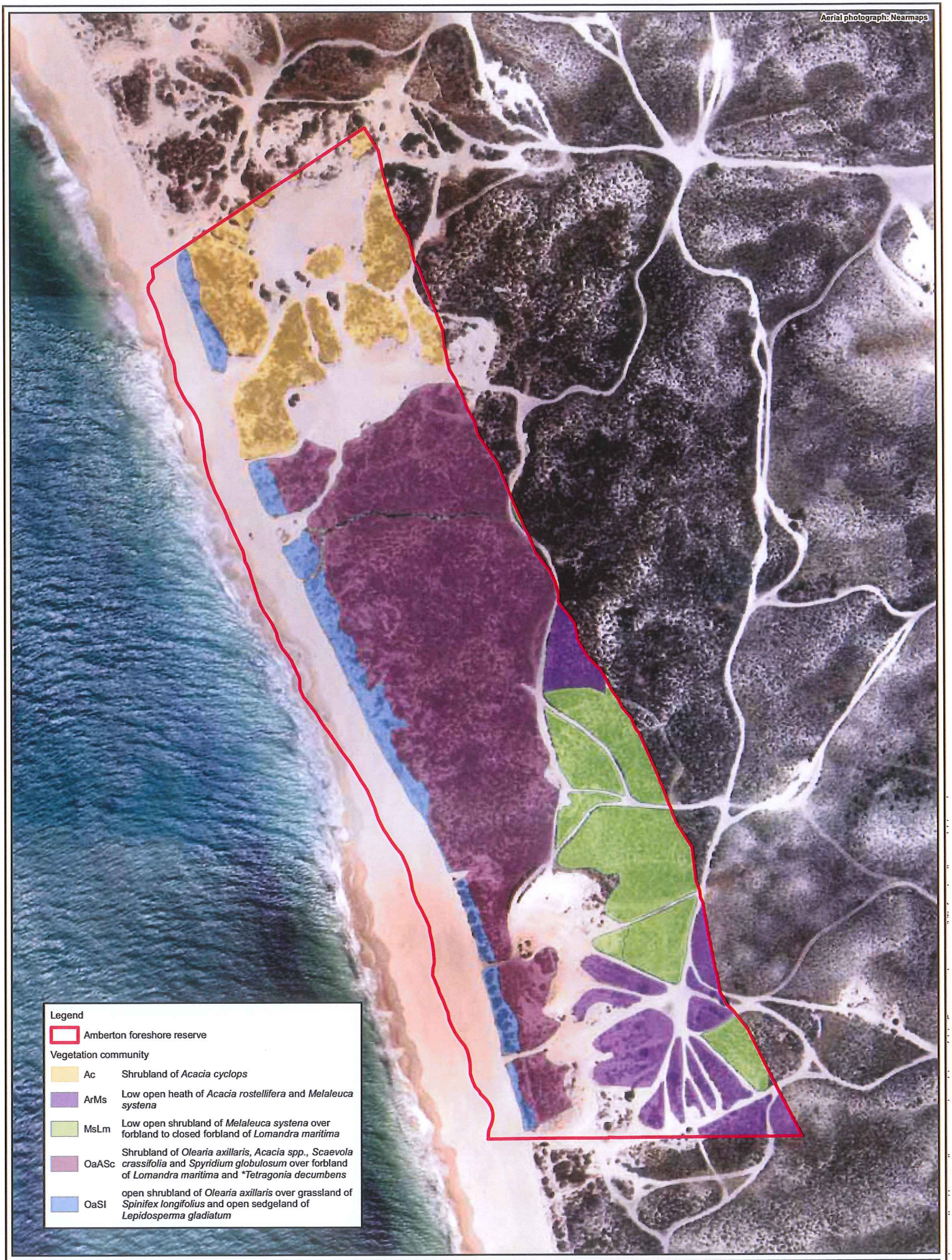

Figure 8: Vegetation Communities

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

Plan Number: EP12-032(01)--F47

Drawn:	GRO	Date:	29/04/13
Approved:	JDH	Date:	19/06/14
Checked:	CKK	Scale:	1:3,000@A4

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Sources: The following datasets were used in the production of this map: Vegetation communities - Emerge Associates (2012)

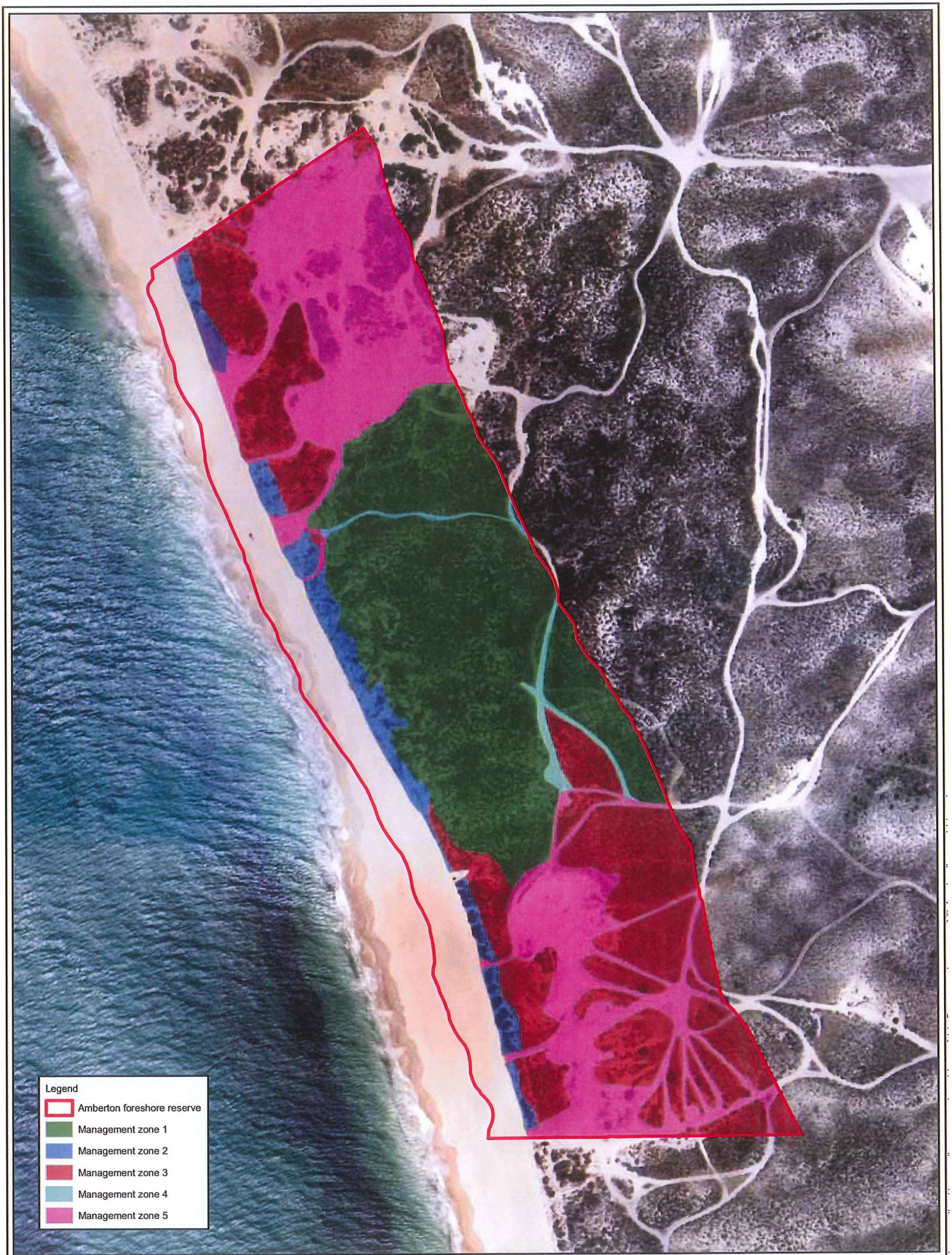

Figure 9: Foreshore Management Zones

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

Plan Number: EP12-032(01)--F48			
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Approved:	JDH	Date:	19/06/14
Checked:	CKK	Scale:	1:3,000@A4

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AMBERTON FORESHORE MASTER PLAN REV R

FIGURE 10 - PRELIMINARY LANDSCAPE CONCEPT

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Figure 11: Areas of Vegetation to be Retained and Revegetated

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

N

Plan Number: EP12-032(01)--F53			
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Approved:	JDH	Date:	01/05/15
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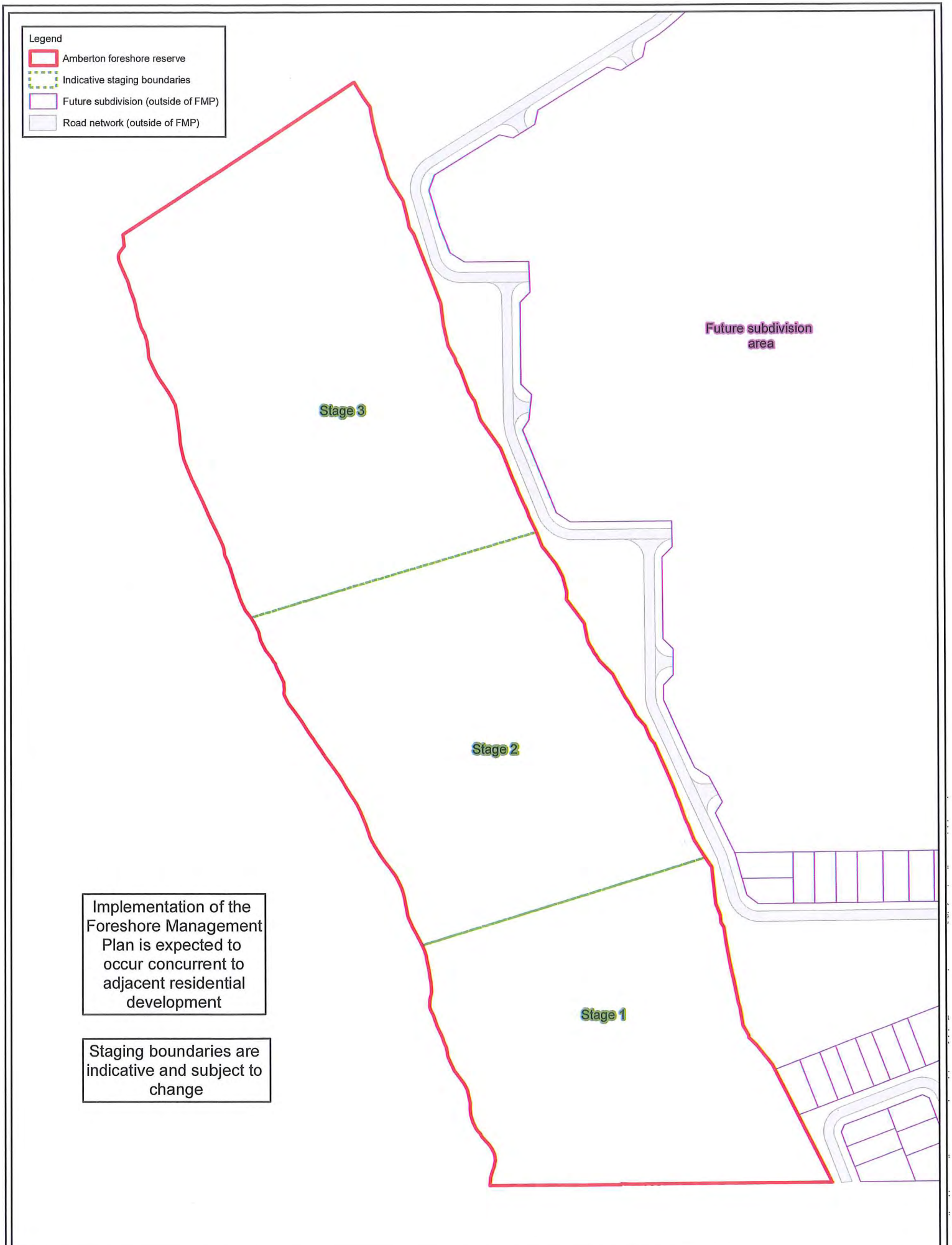

Figure 12: Staging of Foreshore Implementation

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

Plan Number: EP12-032(01)--F49b

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Approved:	JDH	Date:	28/07/15
Checked:	ADB	Scale:	1:2,750@A4

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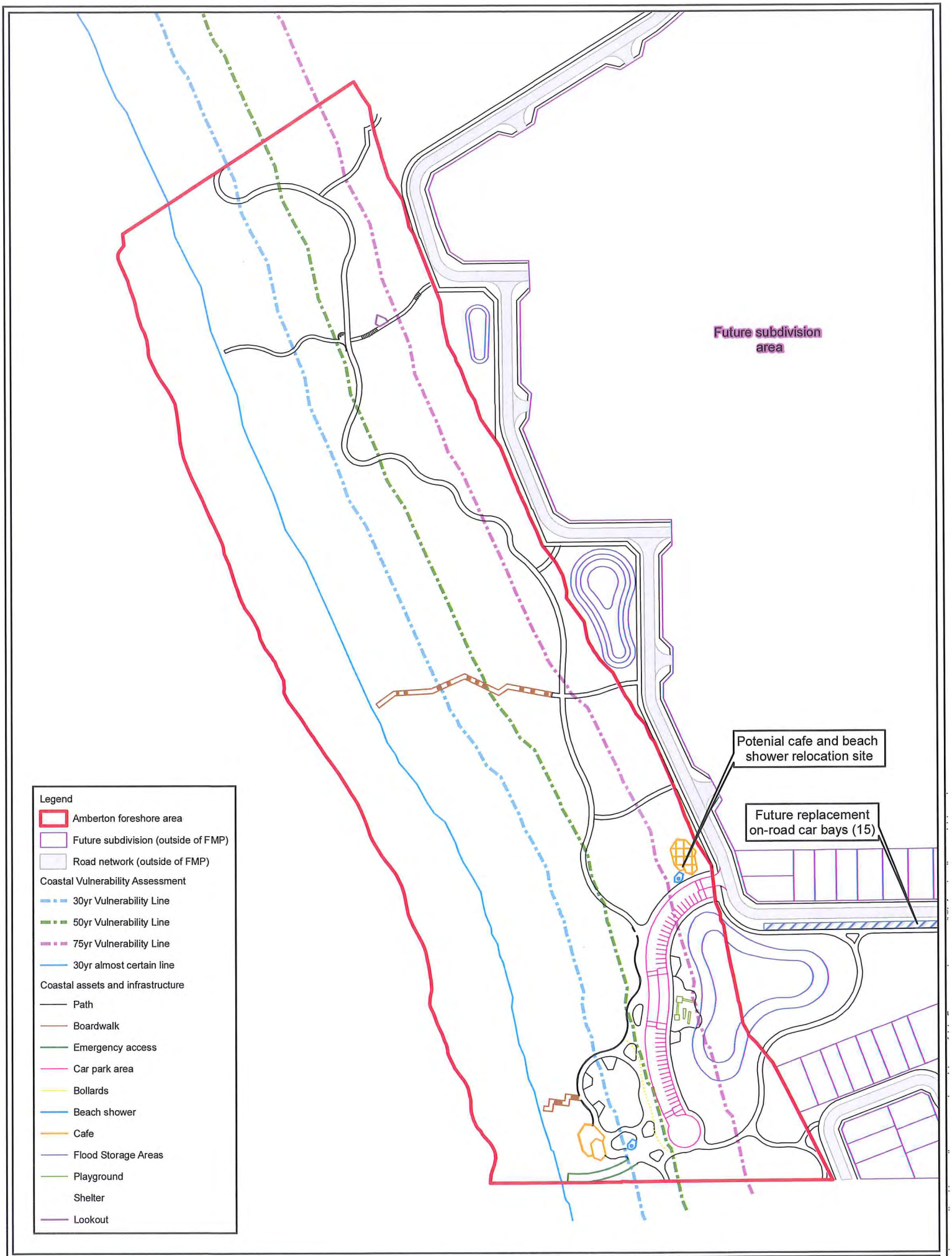

Figure 13: CHRMAP Summary

Project: Amberton Foreshore Management Plan

Client: Stockland Pty Ltd

Plan Number: EP12-032(01)--F51d			
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Approved:	JDH	Date:	28/07/15
Checked:	ADB	Scale:	1:2,750@A4

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APPENDIX A

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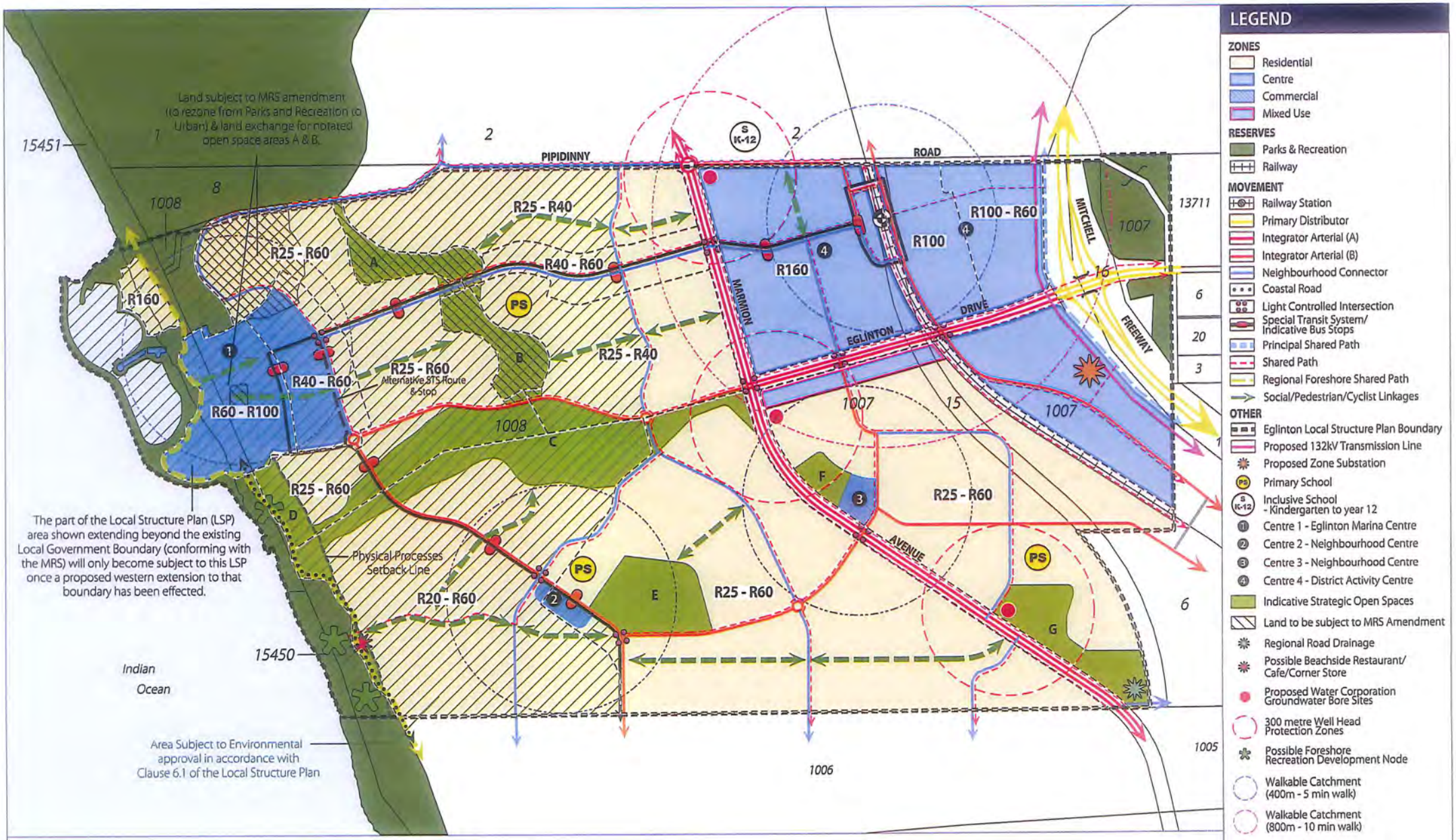
EGLINTON LOCAL STRUCTURE PLAN NO. 82



LEGEND

ZONES
- Residential
- Centre
- Commercial
- Mixed Use

RESERVES
- Parks & Recreation
- Railway

MOVEMENT
- Railway Station
- Primary Distributor
- Integrator Arterial (A)
- Integrator Arterial (B)
- Neighbourhood Connector
- Coastal Road
- Light Controlled Intersection
- Special Transit System/ Indicative Bus Stops
- Principal Shared Path
- Shared Path
- Regional Foreshore Shared Path
- Social/Pedestrian/Cyclist Linkages

OTHER
- Eglinton Local Structure Plan Boundary
- Proposed 132kV Transmission Line
- Proposed Zone Substation
- Primary School
- Inclusive School - Kindergarten to year 12
- Centre 1 - Eglinton Marina Centre
- Centre 2 - Neighbourhood Centre
- Centre 3 - Neighbourhood Centre
- Centre 4 - District Activity Centre
- Indicative Strategic Open Spaces
- Land to be subject to MRS Amendment
- Regional Road Drainage
- Possible Beachside Restaurant/ Cafe/Corner Store
- Proposed Water Corporation Groundwater Bore Sites
- 300 metre Well Head Protection Zones
- Possible Foreshore Recreation Development Node
- Walkable Catchment (400m - 5 min walk)
- Walkable Catchment (800m - 10 min walk)

NORTH

0 100 500m

Plan No: EGLEG-2-001 • Date: 10/05/2012 • Not to Scale@A3

Note: All areas and dimensions subject to detail survey.

NOTES

1) Areas identified as being of National Environmental Significance under the Environmental Protection and Biodiversity Conservation Act 1999 may be subject to assessment by the Federal Department of Sustainability, Environment, Water, Population and Communities, in accordance with this Act. The outcome of any such assessment may require either a modification to the LSP or minor variations from the LSP at the subdivision or development stage.

2) The taking of individual Graceful Sun Moths, as a result of the clearing of habitat such as Lomandra Hermaphrodita and Maritima, requires the permission of the Minister for Environment, or their delegate, pursuant to the Wildlife Conservation Act 1950.

3) An easement of up to 32 metres may be required for the proposed 132kV overhead transmission line. This may have implications on adjacent land uses. Final - width of the easement and the location of the substation will need to be confirmed as part of the future structure planning of Centre Zones.

4) Location of the proposed Water Corporation Groundwater Bore Sites and associated 300 metre Well Head Protection Zones is indicative only, to be confirmed at subdivision stage.

APPENDIX B

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EXISTING ENVIRONMENT

Existing Environment

Location and topography

Climate

The climate of the site is described as a Mediterranean climate, with hot, dry summers and moderately wet, mild winters.

The majority of rainfall within the region occurs between May and September each year, and on average is between 400 to 850 millimetres per year. However, in the last 40 years there has been a marked decrease in rainfall (approximately 11 per cent decrease), with a noticeable shift to a drier climate across the south-west of Western Australia (Water Corporation 2009). 2010 was one of the lowest years of rainfall on record, with only 503.8 millimetres recorded in Perth, compared to the long-term average of 852.6 millimetres per annum.

The closest weather station to the site which records rainfall is at Two Rocks, found approximately 11.5km kilometres north-west of the site. The annual rainfall at Two Rocks for the year 2011 was 654.2 millimetres, which is similar to the annual median of 684.8 millimetres (Bureau of Meteorology 2012).

The climate data from the closest station (Gingin) indicates that the annual maximum temperature is 26.3^{0}C which is a summary of data collected since 1996. In winter the area is affected by storm surges characterized by north westerly winds, and impacted by sea breeze during the summer months. These coastal processes cause changes to the foreshore reserve

The predominant winds come from the south-west and are a very important feature of coastal environments as they are a major determinant of landwards sand migration, influencing landforms and landscape. During summer, winds blow from the east to south east in the morning (4am to midday) and from the south-west in the afternoon (1pm to 6pm, the local sea breeze). Winter is characterized by north-westerly storm winds that back around to the west and south-west, interspersed with calmer periods.

Flora and Vegetation

Regional Context

The site lies within the Swan Coastal Plain (Drummond Botanical Subdistrict) Phytogeographical Subregion as described by Beard (1990). This region is characterised by banksia low woodlands on leached sands and marri (*Corymbia calophylla*) on less leached soils and Melaleuca swamps.

Vegetation complex mapping for the Swan Coastal Plain undertaken by Heddle et al. (1980) indicates that the Quindalup complex is predominant within the Amberton foreshore area. The Quindalup dune system consists of unconsolidated calcareous sand which form the parabolic dunes situated along the coast.

The foreshore reserve is located within the Bush Forever site indicated by the Metropolitan Regional Scheme (MRS).

Flora and Vegetation Survey

The foreshore vegetation consists generally of heaths and woodlands. Parts of the foreshore has been degraded and cleared, with the most significant contributor being uncontrolled dune access. The off road tracks have caused dunal blowouts in areas which were initially considered for conservation.

In order to determine the vegetation communities located within the Eglinton foreshore reserve, a flora and vegetation survey was conducted by E. Bennett to support the MRS amendment and reported by ATA Environmental (2005). Emerge Associates undertook a detailed inspection of the Amberton foreshore area in 2012 in order to update the vegetation communities and vegetation condition.

Significant Flora

Species of flora acquire DRF or PF conservation status where populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation (DEC) recognises these threats and subsequently applies regulations towards population protection and species conservation. The DEC enforces regulations under the Wildlife Conservation Act 1950 (WC Act) to conserve DRF species and protect significant populations. PF are described as potentially rare or threatened species and are classified in order of threat. DRF and PF category definitions are listed below in **Table 1**.

Table 1 Definition of Rare and Priority Species (Atkins, 2008)

Conservation Code	Category
R	**Declared Rare Flora – Extant Taxa.** Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
X	**Declared Rare Flora – Presumed Extinct Taxa** Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
P1	**Priority One – Poorly Known Taxa** Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as"rare flora", but are in urgent need of further survey.
P2	**Priority Two – Poorly Known Taxa** Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as "rare flora", but urgently need further survey.
P3	**Priority Three – Poorly Known Taxa** Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as "rare flora" but need further survey.
P4	**Priority Four – Rare Taxa** Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

No Declared Rare Flora Species was located within the site (RPS, 2008). There is evidence of Priority 4 (*Conostylis pauciflora* subsp. *Pauciflora*) being recorded in the site or within close proximity which was identified by E. Bennett as reported in ATA Environmental (2005).

Threatened Ecological Communities (TEC)

In Western Australia, Threatened Ecological Communities (TECs) are assessed by the Western Australian Threatened Ecological Communities Scientific Advisory Committee and endorsed by the Minister for the Environment. While they are not afforded direct statutory protection at a state level (unlike DRF under the Western Australia *Wildlife Conservation Act 1950* (WAWC Act)) their significance is acknowledged through other state environmental approval processes such as Environmental Impact Assessment pursuant to Part IV and Part V of the Environmental Protection Act 1986 (EP Act).

Some TECs are also afforded statutory protection at a Federal level pursuant to the Environment Protection and Conservation 1999 Act (EPBC Act). The EPBC Act provides for the protection of TECs, which are listed under section 181 of the Act, and are defined as "Critically Endangered", "Endangered" or "Vulnerable" under Section 1820. There were no TEC's located on the Eglinton foreshore site.

Weed Surveys

There are a number of weed species associated with various areas of the Amberton foreshore. The most common weed species associated with the Amberton foreshore are listed in **Table 2** below.

Table 2: Common Weed Species

Scientific Name	Common Name
Avena barbata	Slender Wild Oat
Cakile maritima	Sea Rocket
Carpobrotus edulis	Hottentot Fig
Euphorbia paralias	Sea Spruge
Euphorbia terracina	Geraldton Carnation Weed
Hypochaeris glabra	Smooth Catsear
Pelargonium capitatum	Rose Pelargonium
Sonchus oleraceus	Sowthistle
Tetragonia decumbens	Sea Spinach
Trachyandra divaricata	Dune Onion Weed

Terrestrial Fauna

Fauna Surveys

A vertebrate fauna survey was conducted for the Alkimos - Eglinton area by Alan Tingay & Associates in October 1996.The survey indicated the differences in diversity of species across the major habitat types including the Old Quindalup heaths located within the Amberton foreshore area. The old Quindalup heaths are seen as having a great amount of fauna diversity across the site.

Graceful Sun Moth Survey

The graceful sun moth is listed as "Endangered" under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Priority 4 by the DEC. The GSM was listed under the EPBC Act in 2009 and was recently removed from the Western Australia *Wildlife Conservation Act 1950*.

A graceful sun moth survey was conducted by Coffey Environmental (2010) in order to determine the presence and density of the graceful sun moth within the Eglinton Estate. The survey was conducted in accordance with newly released DEC methodology for the procedure, and took place over four days in March 2010. Weather conditions were favourable for surveys as temperature remained below 24°c, cloud cover was present and wind speeds didn't exceed 12km/h.

In total 93 graceful sun moth were recorded within the Eglinton LSP during March surveys. The foreshore is located within Lot 1008, which is abundant in the favoured graceful sun moth food species *Lomandra maritima*. However, no graceful sun moth were observed along any transects located within the Amberton foreshore area. This is likely due to the higher velocity winds experienced in the primary dunes.

Hydrology

Surface Water

There are no known surface water features within the Amberton foreshore area.

Infiltration testing

Infiltration testing was carried out within the Amberton foreshore area on 13th June 2013. Two areas of the Amberton foreshore area were tested for infiltration one in the north of the foreshore and one in the south. The field work comprised of in situ infiltration testing using a Wooding Infiltrometer and a dual ring infiltrometer. The Wooding infiltrometer was used twice at each test location, with a third measurement taken from the dual ring infiltrometer. The use of these two methods allows for greater certainty in the resulting infiltration rates.

The shallow soil profile at the each location consisted of pale yellow, medium grained sand. The top 10-15 cm of the soil profile was loose, presumably as a result of dry and windy conditions and disturbance from vehicle access. This layer was removed to allow the Wooding infiltrometer to be firmly seated, but was left in place for the dual ring infiltrometer. The loose material at the surface did not appear to influence the infiltration rate.

The results of the infiltration testing are summarised in **Table 3**.

Table 3: Summary of infiltration results

LOCATION	LOCATION (GDA)		ESTIMATED INFILTRATION RATE (M/DAY)	
	EASTING	NORTHING	WOODING INFILTROMETER	DUAL RING INFILTROMETER
Foreshore 01	372049	6503769	37.5	37.4
Foreshore 02	372281	6503270	22.2	19.3

The results from both methods of measurement are closely correlated, which provides confidence that the saturated infiltration rate has been accurately determined at each location. The estimated infiltration rates are within the ranges of those typically associated with medium grained coastal sands.

It is the intention that the infiltration testing provides site specific information for the City of Wanneroo to consider infiltration rates within drainage areas. The City of Wanneroo typically allows a design rate that is 20% of the measured infiltration rates. This would result in the stormwater infrastructure being sized according to infiltration rates of between 3.8 m/day and 7.5 m/day

APPENDIX C

emerge ASSOCIATES
Integrated Science & Design

COASTAL AQUATIC RISK ASSESSMENT REPORT

Surf Lifesaving Western Australia 2014.