

Appendix D.18. Grace Darling Park, Lancelin

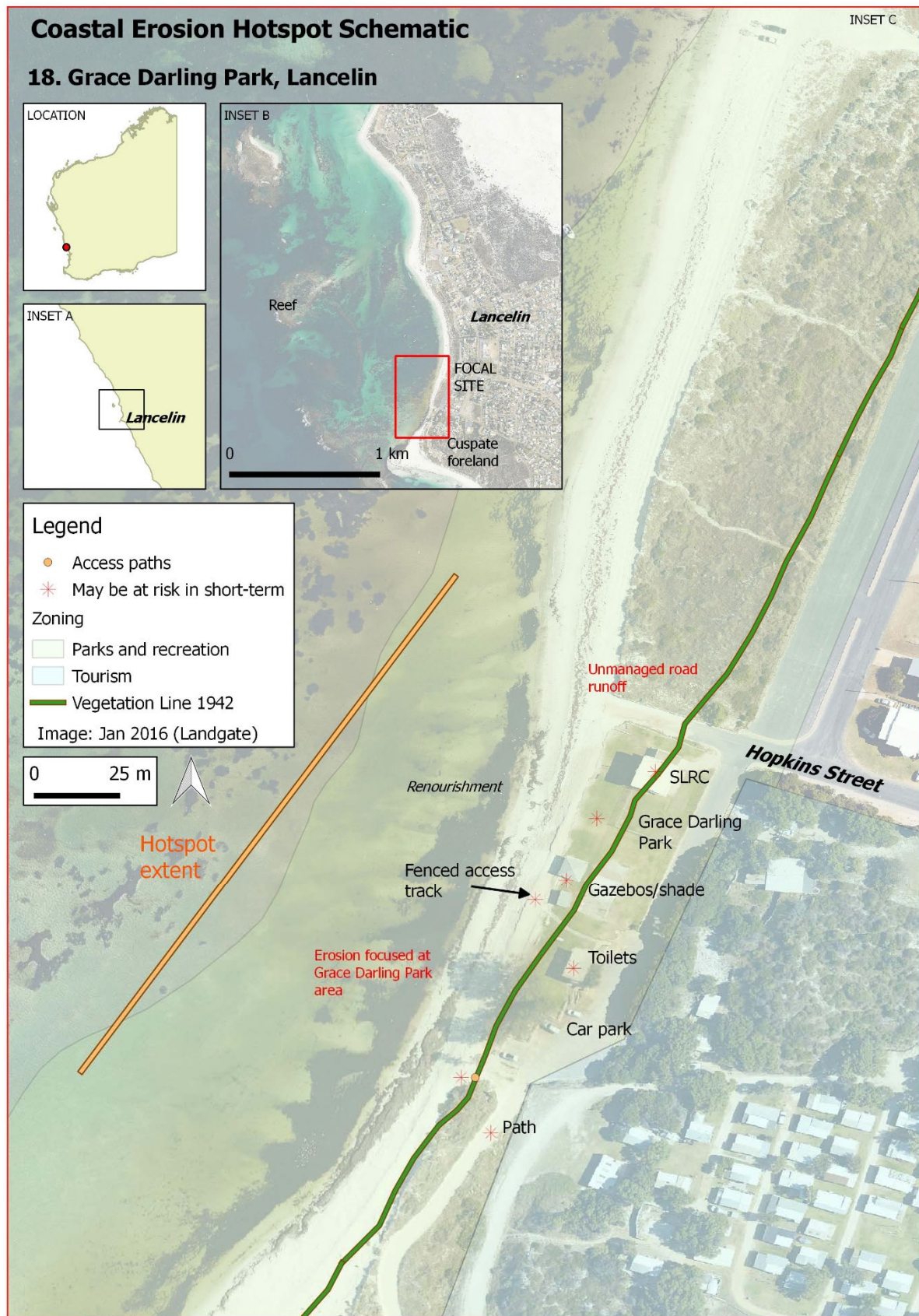


Figure D-18: Grace Darling Park, Lancelin schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-18: Grace Darling Park, Lancelin summary information

Hotspot No.	18
Hotspot Name	Grace Darling Park, Lancelin
Local Coastal Manager	Shire of Gingin
Hotspot issue	<p>Grace Darling Park is located on a sandy cusped foreland in the lee of Edward Island and reef systems with variability of the foreshore position of up to 75m in 70 years. The variability in foreshore position is due to variation in weather and wave regimes and sediment availability. Facilities were added to the park during a period of accretion, at a maximum in 1994. The park has experienced rapid erosion from winter storms since 2012, with <10m buffer remaining following renourishment works. Recent works have included removal of beach shelters and renourishment campaigns, with all of the renourished sand eroded in the May 2016 storm. The Lancelin coast fluctuates in response to variation in weather and wave regimes.</p> <p>Ten publicly owned assets may be at risk of erosion damage in the area (see attached figure), with seven assets at risk of damage in the short-term, including beach access points, Grace Darling Park, gazebos, toilet block, Lancelin Sea Search and Rescue building, path and fenced beach access points. In the longer term, the car park, Hopkins Street and associated services are high-value assets at risk.</p>
Extent of erosion problem and hotspot characteristics	<p>From 180m S of Hopkins Street to 20m N of Hopkins Street</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: In Progress - Final stages of CHRMAP recently awarded to Cardno</p> <p>Hazard Assessment: MRA (2016 - Immediate risk of erosion identified (existing buffer <S1)</p> <p>Management & Adaptation Options: The Shire of Gingin is currently undertaking sand nourishment as an interim protection measure.</p> <p>Additional Comments: Nil</p> <p>Reports:</p> <p>MRA (2016) Coastal Erosion Hazard Assessment, Ledge Point, Lancelin and Cervantes. Prepared by MP Rogers & Associates for the Shire of Gingin and Shire of Dandaragan. Report R721, Rev. 2, Apr-2016.</p> <p>Damara (2012) The Coast of the Shires of Gingin and Dandaragan, Western Australia: Geology, Geomorphology and Vulnerability. Prepared by Damara WA Pty Ltd and Geological Survey of Western Australia for the Department of Planning and Department of Transport.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly sedimentology (Notre Dame student)
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	7 public assets susceptible to erosion hazard. Path, park with toilet block and gazebos, SLRC (marine rescue), fenced beach paths, beach paths
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	9 public assets susceptible to erosion hazard. Path, car park, park with toilet block and gazebos, SLRC (marine rescue), sports court, fenced access paths, access paths.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	11 public assets susceptible to erosion hazard. Hopkins Street, path, car park, park with toilet block and gazebos, SLRC (marine rescue), sports court, fenced access paths, access paths. Services: Water and telecommunications.
Existing management	<p>Avoid (N),</p> <p>Retreat (Y - Low value infrastructure has been progressively removed),</p> <p>Accommodate (N),</p> <p>Protect (Y - Active sand renourishment)</p>

Management options for Imminent timeframe (0–5 years)	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Increase sand renourishment volumes) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Acute erosion hazard for existing facilities >2 months/year (i.e. ineffective nourishment) Monitoring: Photographic monitoring Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Avoid (N), Retreat (Y - Remove or relocate existing facilities), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M (cost may be higher dependent on land availability) Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: N/A Monitoring: Beach width Alternate option: Protect is optional. However, the natural instability of this shore is such that protection will not work, regardless of its method, unless a massive seawall (which will halt the current beach usage) is built. Occasional minor repair, but ultimate retreat, is the only sensible option.
Management and adaptation options for Projected timeframe (25+ years).	Avoid (N), Retreat (Y -Remove or relocate existing facilities), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	Additional infrastructure; stabilisation works.

Appendix D.19. Ledge Point

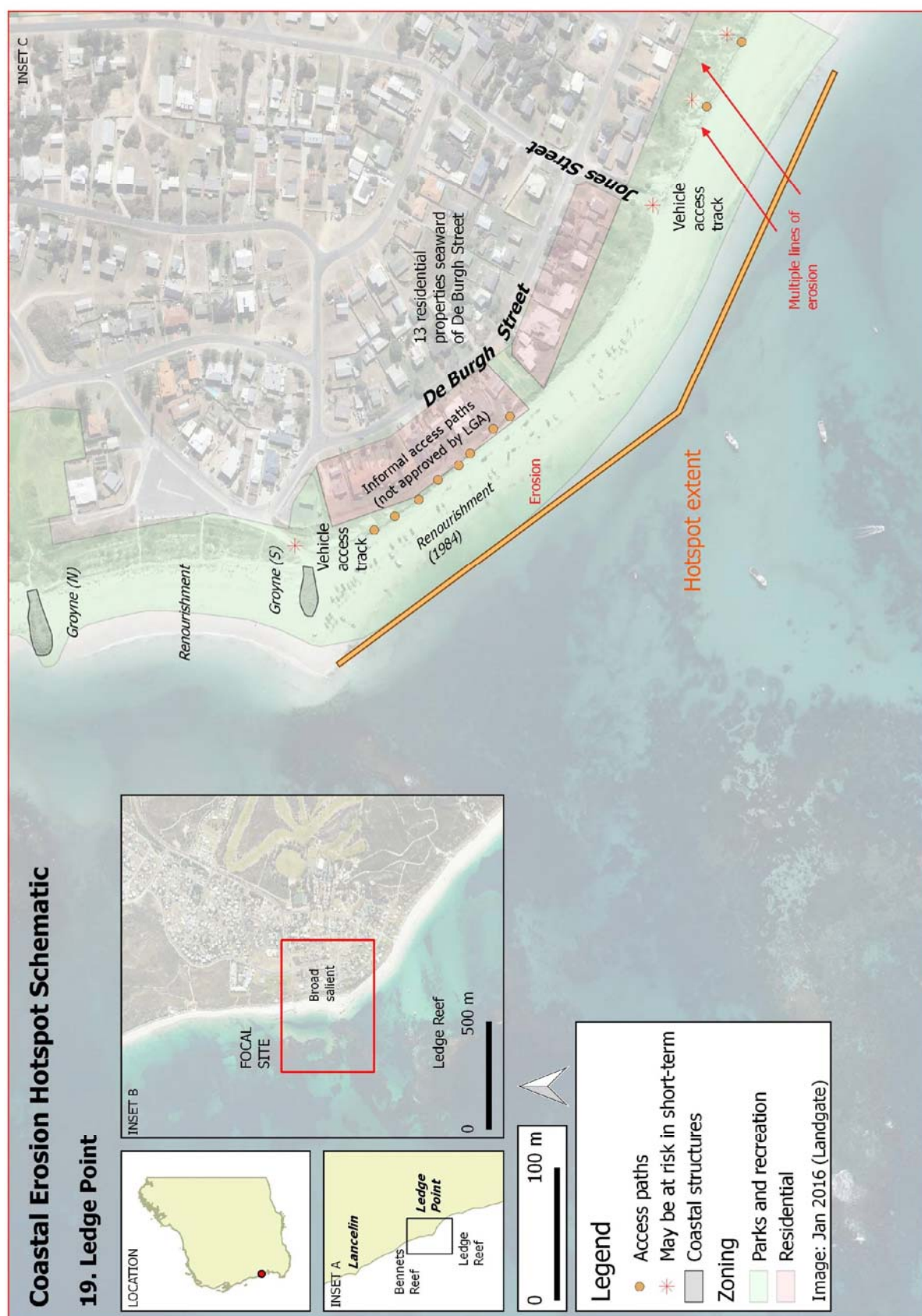


Figure D-19: Ledge Point schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-19: Ledge Point summary information

Hotspot No.	19
Hotspot Name	Ledge Point
Local Coastal Manager	Shire of Gingin
Hotspot issue	<p>The Ledge Point hotspot is on the southern side of the Ledge Reef salient, extending from the southern groyne to the eastern end of De Burgh Street. The coast is susceptible to storm erosion, variability in sediment supply and landform migration in the lee of the reef. The town was established in 1955 for crayfishing following a history of camping and shacks. As part of the town establishment the dunes along De Burgh Street were modified and flattened to allow for residential development. The adjacent beach has required management, with anecdotes of a timber seawall to protect properties, along with installation of groynes in the 1970s and 1980s with associated renourishment. Storm erosion is expected during periods of low sediment supply with partial recovery with development of low foredunes. Wholescale retreat may occur due to reduced sediment supply, with scarping of the embankments of private properties and increased embaymentisation between reef and groyne features.</p> <p>Four publicly owned assets may be at risk of erosion damage in the area (see attached figure), two of which may be at risk in the short-term. These include the Jones Street vehicle access track (a sand ramp with bank stabilisation) and ten sand access tracks (counted as one combined asset). In the medium- to longer-term, a 10-20m section of Jones Street is also at risk and the De Burgh Street vehicle access ramp. Six private properties may be at risk in the short-term, increasing to 13 in the long term. Many of the properties have private access to the beach which is considered uncontrolled access. Recreational activities on the shore and in inshore waters include walking, swimming, fishing, driving on beach and boat launching. The main non-governmental stakeholders that are likely to have an active interest in how this foreshore is managed include Ledge Point Community Association and Ledge Point Coastcare Group.</p>
Extent of erosion problem and hotspot characteristics	<p>The south-facing side of the salient extending east of the southern groyne to the eastern end of De Burgh Street.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: In Progress - Final stages of CHRMAP recently awarded to Cardno. Draft report due July 2017. CMPAP funded.</p> <p>Hazard Assessment: MRA (2016) - Immediate risk of erosion identified (existing buffer <\$1)</p> <p>Management & Adaptation Options: Nil</p> <p>Additional Comments: Adaptive capacity of existing groynes not considered in MRA (2016)</p> <p>Reports:</p> <p>MRA (2016) Coastal Erosion Hazard Assessment, Ledge Point, Lancelin and Cervantes. Prepared by MP Rogers & Associates for the Shire of Gingin and Shire of Dandaragan. Report R721, Rev. 2, Apr-2016.</p> <p>Damara (2012) The Coast of the Shires of Gingin and Dandaragan, Western Australia: Geology, Geomorphology and Vulnerability. Prepared by Damara WA Pty Ltd and Geological Survey of Western Australia for the Department of Planning and Department of Transport.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Renourishment source, littoral transport (requirement to maintain southern groyne) and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>2 public assets susceptible to erosion hazard. Jones St vehicle access track (sand ramp with bank stabilisation), 10 informal access tracks.</p> <p>Private properties: 6 properties on De Burgh Street (note 4 already have some retreat into land)</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>4 public assets susceptible to erosion hazard. 10m of Jones Street, Jones St vehicle access track (sand ramp with bank stabilisation), De Burgh vehicle access track, 10 informal access tracks.</p> <p>Private Properties: 8 properties on De Burgh Street.</p>

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	4 public assets susceptible to erosion hazard. 20m of Jones Street, Jones St vehicle access track (sand ramp with bank stabilisation), De Burgh vehicle access track, 10 informal access tracks. Private Properties: 13 properties on De Burgh Street
Existing management	Avoid (Y - some private properties on De Burgh Street have sufficient buffer to storm erosion), Retreat (N), Accommodate (N), Protect (Y - some historic renourishment undertaken (1984), groyne at the point) Note: The existing strategy does not provide protection to the private properties.
Management options for Imminent timeframe (0–5 years)	Avoid (Y - Some private properties (approx. 6 south west of number 23) on De Burgh Street have sufficient buffer to storm erosion), Retreat (N), Accommodate (Y - dune fencing. Access control from individual properties. Drainage management.), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Avoid - None Accommodate - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Buffer width <5m. Monitoring: Buffer width measurement Alternate option: Protect - bioengineer dune.
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Under moderate erosion, existing properties will be threatened by storm erosion. Avoid (N), Retreat (Y -Eight private properties along De Burgh Street), Accommodate (Y - measures to encourage dune growth in recovery phase. Sand management focused on entrances (particularly where there is vehicle access)), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - H Accommodate - L Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Houses under immediate threat. Monitoring: Photographic monitoring Alternate option: Protect (not recommended) if boating facility is installed. Also, it could be considered to construct a boat launching harbour in front of dune-top blocks, using Jones St as the road access.
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Under sustained erosion, existing property boundaries will be in the ocean. Avoid (N), Retreat (Y - 13 private properties. Loss of Jones Street vehicle access, improve De Burgh Street vehicle access), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	Protection. However, if boating facility is constructed to the south, protection is an alternate (and still not recommended) option to retreat.

Appendix D.20. Seabird Foreshore, Gingin

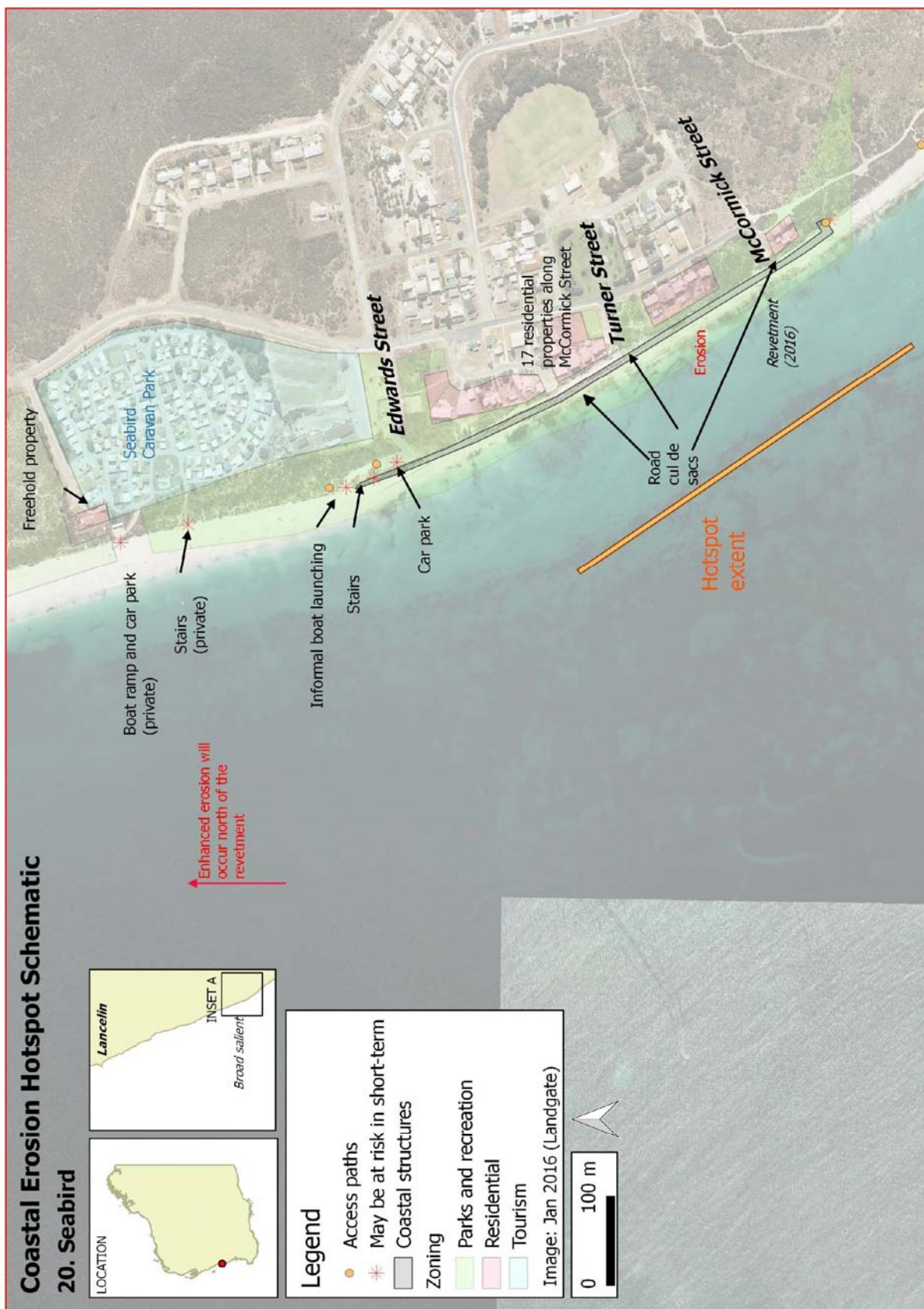


Figure D-20: Seabird Foreshore, Gingin schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-20: Seabird Foreshore, Gingin summary information

Hotspot No.	20
Hotspot Name	Seabird Foreshore, Gingin
Local Coastal Manager	Shire of Gingin
Hotspot issue	<p>Seabird is located on an unstable salient with infrastructure located too close to the coast, including private properties. Seabird is one of the coastal townsites based on squatters shacks built on the top of the foredunes by lobster fishermen in the 1950's and 1960's. Freehold title was created towards the end of those decades. The Coastal Townsites Committee of the then Town Planning Department recommended, in the early 1970's, that Seabird should not be further developed, and should be limited to licensed fishermen only, because of its vulnerability to erosion and wave action. A fuelling jetty was known to have been destroyed in earlier years by storms and erosion. Turner Street was built on the seaward face of the foredune, to provide vehicle access to the beach for the fishermen.</p> <p>Erosion is due to instability of the salient from changing meteorologic and oceanic conditions, varying sediment supply and potential downdrift erosion in part from natural rock outcrops to the south. In recent years a number of erosion mitigation measures have been undertaken to protect private properties including multiple renourishment campaigns, installation of flexmat and a rock revetment in 2016. Armouring the foreshore is likely to cause permanent loss of a beach in front of the revetment, and continued sand loss at the ends of the revetment and further north. The erosion can be expected to continue along the foreshore to the north for up to three times the length of the revetment.</p> <p>Ten publicly owned assets may be at risk of erosion damage in the area and to the north (see attached figure), with six assets at risk of damage in the short-term, including beach access paths, the Tulley View car park, boat ramp and stair access as well as the stair case and boat ramp fronting the caravan park. The Tulley View car park, ramp and stair case were installed in 2010. Thirteen private properties are located behind the revetment constructed as short-term emergency works and are at risk in the medium-term and up to 17 private properties, including the caravan park (built strata titles) in the longer-term. A revetment was constructed in 2016 to protect the three cul de sacs and 15 private properties in the short-term, which has now been proposed to extend north to include the Tulley View car park and stair case. The main recreational uses at the site are boat launching, walking, swimming, fishing and dog exercise. Social pressures at this site relate to maintaining the existing recreational uses as the beach is lost in front of the revetment, and boat ramps, car parks and staircases are damaged to the north. There are multiple community groups and residents with an active interest in the foreshore.</p>
Extent of erosion problem and hotspot characteristics	<p>The southern foreshore of the Cuspate foreland between the beach access in the N and to the south of the Bluewave seafood site</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high. • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: In Progress - Final stages of CHRMAP by Cardno</p> <p>Hazard Assessment: MRA (2016) - Immediate risk of erosion identified (existing buffer <\$1)</p> <p>Management & Adaptation Options: The Shire of Gingin recently constructed a temporary seawall to provide partial protection to the townsite.</p> <p>Additional Comments: Adaptive capacity of seawall not considered in MRA (2016)</p> <p>Reports:</p> <p>MRA (2016) Seabird Coastal Erosion Hazard Mapping Technical Note. Prepared by MP Rogers & Associates for the Shire of Gingin. Report R695, Rev. 1, Jan-2016.</p> <p>Damara (2012) The Coast of the Shires of Gingin and Dandaragan, Western Australia: Geology, Geomorphology and Vulnerability. Prepared by Damara WA Pty Ltd and Geological Survey of Western Australia for the Department of Planning and Department of Transport.</p>

Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Renourishment source, possibly geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	4 public assets susceptible to erosion hazard. * 3 cul-de-sacs, boat ramp, *Tulley View car park and stair access, access paths Private property: *15 on McCormick and Turner Streets (cannot guarantee wall will provide protection). Note: N boat ramp and stair access near caravan park is privately owned
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	8 public assets susceptible to erosion hazard. 3 cul-de-sacs, N stair access, boat ramp, Tulley View car park and stair access, car park, access paths Private property: 16 on McCormick and Turner Streets, including the Caravan Park (built strata titles). Note: N boat ramp and stair access near caravan park is privately owned.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	8 public assets susceptible to erosion hazard. 3 cul-de-sacs, boat ramp, Tulley View car park and stair access, car park, access paths, roads Private property: 17 on McCormick and Turner Streets, including the Caravan Park (built strata titles). N boat ramp and stair access near caravan park is privately owned.
Existing management	A protective seawall has recently been constructed and extended Avoid (N), Retreat (N), Accommodate (N), Protect (Y - 2016 seawall with recent extension northwards)
Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: Loss of beach amenity is anticipated and erosion to transfer to north destabilising stairs and boat launching. Avoid (N), Retreat (Y - stairs and boat ramp at Tulley View will now require partial retreat/construction in this timeframe due to seawall extension N), Accommodate (N), Protect (Y- maintain existing wall. Already extended N in 2016 to Tulley View) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. Review strata agreements with caravan park to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Retreat - L Protect - L Prepare Plans - 50k Review Strata Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Progressive erosion threatening beach access structures to downdrift Monitoring: Beach width Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Coastal retreat is expected to continue, mainly transferring erosion northwards. Loss of existing beach access points will occur due to local downdrift erosion. Erosion may impact caravan park in this timeframe. Avoid (N), Retreat (Y - Relocate & redesign beach access points including boat access (recommended)), Accommodate (N), Protect (Y - (Option) to extend seawall further northwards) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Protect - H Prepare plans - 50k

Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Downdrift erosion due to walling providing acute erosion threat to caravan park to the north Monitoring: Beach width Alternate option: Retreat of strata properties at risk.
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: General coastal retreat expected Avoid (N), Retreat (Y - 17 private properties require consideration to maximise effective use of the setback for the northern part of the town site. Relocate sections of the caravan park when threatened by acute erosion hazard), Accommodate (N), Protect (Y - Continue to maintain and deepen walling – may provide permission for private landowners to undertake the works. Provide alongshore control structures to transfer downdrift erosion issues away from town site.)
Works to avoid to achieve long-term plans	No additional investment in coast infrastructure; Do not extend the town site north without substantial increase in coastal setbacks; Do not extend protection works until strictly necessary; Avoid cross-shore structures (e.g. headlands). Use of protective works at Seabird is a balancing act. Low density private development is being protected by reducing the effective erosion buffer for the higher density section of the town to the north. A very high loss of beach amenity is expected.

Appendix D.21. Two Rocks northern coast

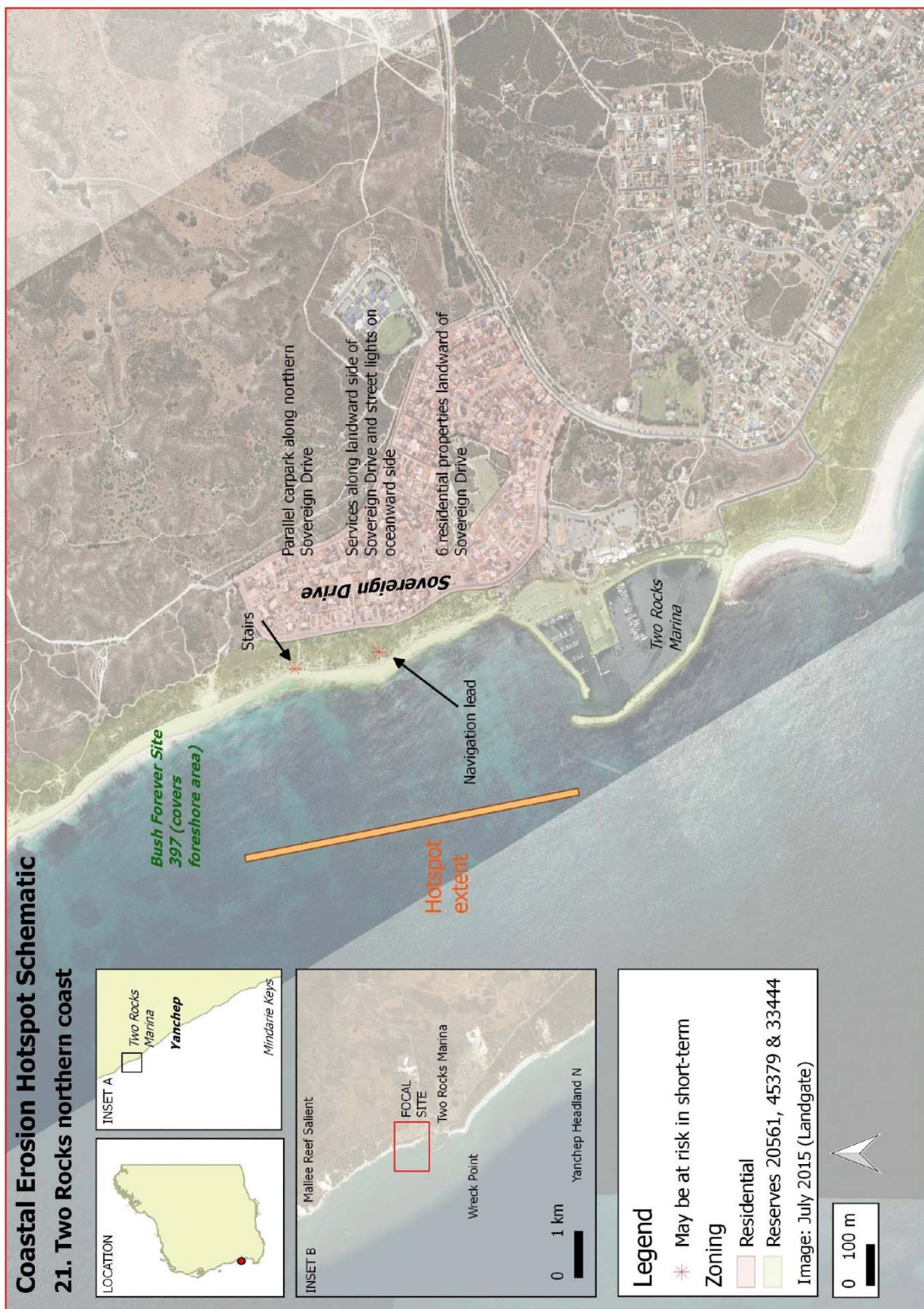


Figure D-21: Two Rocks northern coast schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-21: Two Rocks northern coast summary information

Hotspot No.	21
Hotspot Name	Two Rocks northern coast
Local Coastal Manager	City of Wanneroo
Hotspot issue	<p>The foreshore north of Two Rocks Marina, along Sovereign Drive, has progressively eroded since the marina was constructed in 1973/1974. The erosion is due to an interruption of sediment transport by the marina and transfer of erosion stress due to the breakwater. The foreshore has eroded 100m of a 200m setback in approximately 40 years. There is natural rock underlying the whole length of the housing development along Sovereign Drive, although the level of erosion protection offered by this rock is not yet known.</p> <p>Five publicly owned assets may be at risk of erosion damage in the area (see attached figure); two of these assets, the Navigation Lead and a staircase for beach access, are at risk of damage in the short-term. In the longer-term, more than 500m of Sovereign Drive and its associated assets (critical water pipes, power, street lights) are high-value assets that may be at risk, along with the private properties on the landward side. Bush Forever Site 397 covers the foreshore area. This is a beach with moderate use that experiences periods of restricted access following storms. The main recreational uses are walking, swimming and fishing. There is limited community group pressure at the moment; however, this is expected to increase as erosion progresses towards the road and during periods of restricted beach access.</p>
Extent of erosion problem and hotspot characteristics	<p>North of Two Rocks Marina to the northern extent of Sovereign Drive</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer).
CHRMAP status and findings	<p>CHRMAP Status: In Progress</p> <p>Hazard Assessment: MRA (2015) - Erosion risk identified in 30-40 years</p> <p>Management & Adaptation Options: Values assessment recently completed</p> <p>Additional Comments: Not identified as a priority area in current CHRMAP (in-progress)</p> <p>Reports:</p> <p>MRA (2015) CHRMAP Part 1 Coastal Vulnerability Study & Hazard Mapping. Prepared by MP Rogers for the City of Wanneroo. Report R607, Rev. 1, Nov-2015</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Further geotechnical (if required) and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>2 public assets susceptible to erosion hazard. 1 Navigation Lead 1 set of stairs for access.</p> <p>Note: Bush Forever Site 397</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>3 public assets susceptible to erosion hazard. Possible 50m of Sovereign Drive, Navigation Lead, 1 set of stairs.</p> <p>Note: Bush Forever Site 397</p>
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>5 public assets susceptible to erosion hazard. >500m of Sovereign, Navigation Lead, 1 set of stairs and 1 parallel car park (both in the N).</p> <p>Services: water, power, street lights.</p> <p>Private property: 6 on Sovereign Drive.</p> <p>Note: Bush Forever Site 397</p>
Existing management	<p>Avoid (Y - Downdrift buffer to development has been identified),</p> <p>Retreat (N),</p> <p>Accommodate (N),</p> <p>Protect (N)</p>

Management options for Imminent timeframe (0–5 years)	Avoid (Y - Downdrift buffer to development), Retreat (Y - relocate beach access stairs), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Avoid - None Retreat - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Buffer width and length is inadequate to provide protection against moderate acute erosion. Monitoring: Buffer width, measured along the coast. Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Continued downdrift erosion will progressively remove the existing buffer Avoid (N), Retreat (Y - Navigation aid to be relocated), Accommodate (N), Protect (Y - Construction of 'back-up' seawall)
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - L Protect - H
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Exposure of back-up seawall for >24 months (i.e. inadequate natural recovery) Monitoring: Photographic monitoring Alternate option: N/A
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: General coastal retreat and continued downdrift erosion will result in loss of the existing buffer and pressure on existing facilities landward of the buffer Avoid (N), Retreat (N), Accommodate (N), Protect (Y – Construct erosion mitigation structures (e.g. revetment), noting it will transfer downdrift erosion pressure further along the coast)
Works to avoid to achieve long-term plans	High value facilities west of Sovereign Drive, beach access installations capable of impounding sand, Northerly extension of Sovereign Drive development

Appendix D.22. Quinns Beach

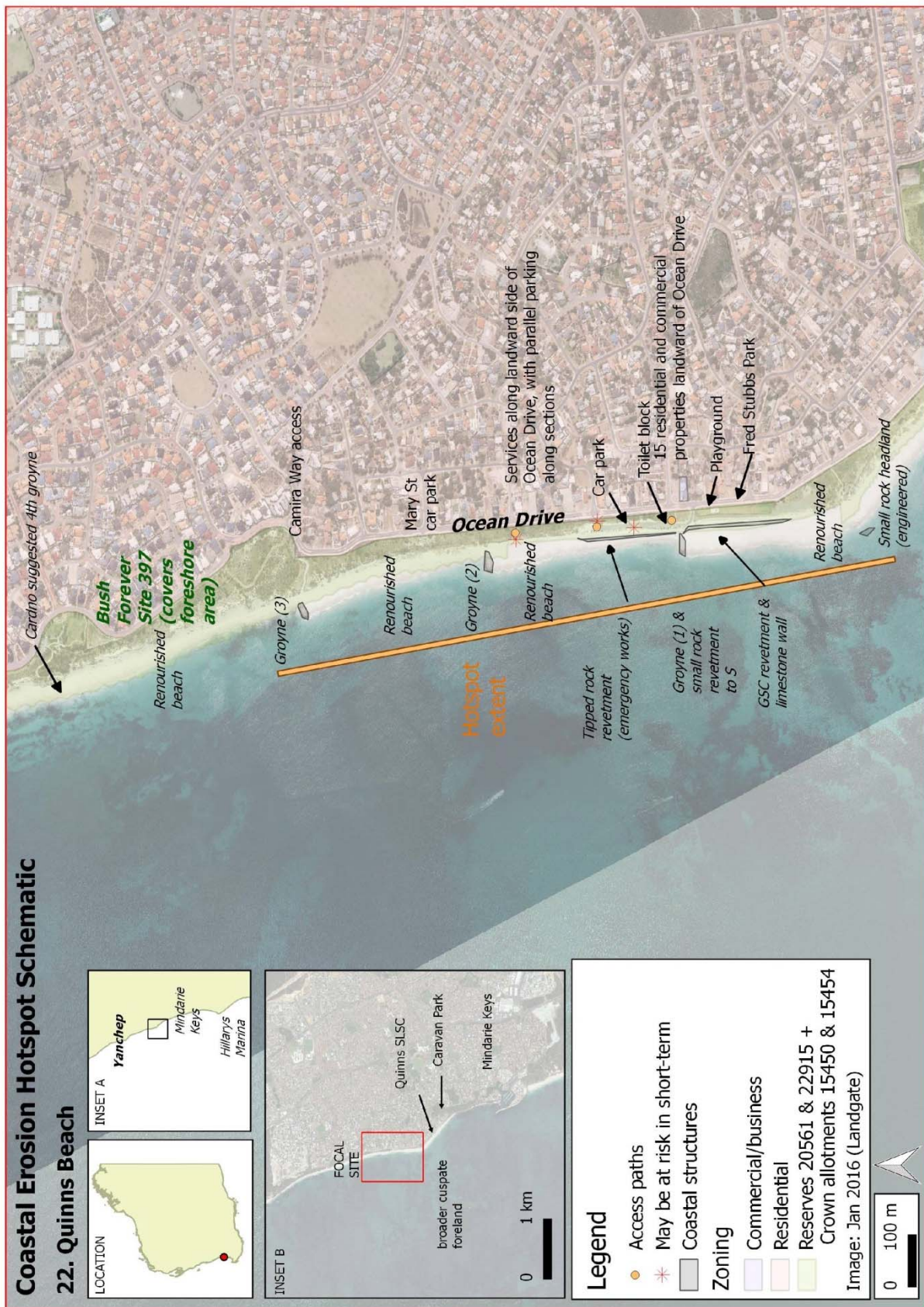


Figure D-22: Quinns Beach schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-22: Quinns Beach summary information

Hotspot No.	22
Hotspot Name	Quinns Beach
Local Coastal Manager	City of Wanneroo
Hotspot issue	<p>Quinns Beach is located on the western side of a sandy foreland, and has experienced erosion from the southern end of the sandy beach since before 1970. The site was originally beach shacks, with ongoing development in proximity to the coast and increased recreational use. Erosion at this site has been managed by a sequence of works including: initial removal of beach cottages from the low dune area through to the headland; a detached rock headland; groyne field; renourishment; and most recently a geotextile seawall. A medium-term plan is being developed by the City of Wanneroo with two options released for public consultation. Erosion has been progressive, linked to landform response to storminess and variability of available coastal sediments; with erosion pressures transferred, primarily to the north, by protective works.</p> <p>Twelve publicly owned assets may be at risk of erosion damage in the area (see attached figure), with only two unprotected assets at risk of damage in the short-term, being the car park behind the tipped rock revetment and the seaward end of beach access paths. In the longer-term, Ocean Drive, the services under the roadway and private properties to landward are high-value assets at risk unless protective works are maintained or improved. This is a highly valued recreational beach, with social pressure relating to maintaining existing recreational use (swimming, walking, fishing, Fred Stubbs Park) and the car park. It should be noted that protective engineering works have the potential to conflict with the desire for a recreational beach, i.e. seawalls may cause loss of their fronting beach. Beach use is focussed next to car parks and Fred Stubbs park. There are active community groups and residents in the area.</p>
Extent of erosion problem and hotspot characteristics	<p>Tip of cusped foreland to northern of the three groynes (western side of cusped foreland)</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high. • Very highly valued by the community, as nominated by local government (community).
CHRM status and findings	<p>CHRM Status: In Progress</p> <p>Hazard Assessment: Cardno (2015) - Immediate risk of erosion identified (existing buffer <S1)</p> <p>Management & Adaptation Options: Being undertaken separate to CHRM. The City has just completed selection of a preferred protection option to extend the mid and north groyne and construct a new groyne to the north, together with sand nourishment. Detailed design will determine the requirements for an additional 5th groyne.</p> <p>Additional Comments: Nil</p> <p>Reports:</p> <p>Cardno (2015) Quinns Beach Long Term Coastal Management Coastal Processes and Preliminary Options Assessment Report. Prepared for City of Wanneroo. Report 59915802, 3-Aug-2015.</p> <p>Cardno (2016) Quinns Beach Long Term Coastal Management Conceptual Options Assessment. Prepared for City of Wanneroo. Report no. 59915802, 5 Feb 2016. NOT REVIEWED. Provided subsequent to the assessment of this hotspot.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Renourishment source and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>2 public assets susceptible to erosion hazard. *Car park (questionable revetment reliability), *Fred Stubbs Park, *playground, access paths</p> <p>Note: Bush Forever Site 397.</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>8 public assets susceptible to erosion hazard. Path, car park, Mary St access, Camira Way access at groyne, *Fred Stubbs park, *toilet block, *playground, access paths</p> <p>Note: Bush Forever Site 397.</p>

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>12 public assets susceptible to erosion hazard. Ocean Drive with services to landward, path, car park, Mary St access, Camira Way access at groyne, parallel parking along Ocean Drive, Fred Stubbs park, toilet block, playground, access paths. Services: Gas, telecommunications and water.</p> <p>Private properties: 15 on Ocean Drive</p> <p>Note: Bush Forever Site 397.</p>
Existing management	<p>Existing strategy is in the process of being implemented.</p> <p>Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Renourishment between the groynes. Rock groynes to reduce alongshore transport loss. Recent construction of seawall)</p>
Management options for Imminent timeframe (0–5 years)	<p>Avoid (N), Retreat (Y - Relocate carpark), Accommodate (N), Protect (Y - Rock groynes (new groyne). Maintain seawall) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.</p>
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	<p>Retreat - M Protect - M Prepare Plans - 50k</p>
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	<p>Trigger for next level management: Facilities threatened by acute erosion following progressive retreat. Monitoring: Buffer width Alternate option: N/A</p>
Management and adaptation options for Expected timeframe (5–25 years)	<p>Anticipated behaviour: Progressive general retreat will not be wholly halted by groynes, but will result in rotation, with erosion on the northern side of the groynes. Downdrift erosion likely highest at northern end of groyne field.</p> <p>Avoid (N), Retreat (Y - Remove remaining facilities seaward of Ocean Drive, including park, playground, toilet block), Accommodate (N), Protect (Y - some renourishment for emergency response. Renourishment focused for amenity at ongoing high cost. Maintain rock groynes)</p>
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	<p>Retreat - M Protect - H</p>
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	<p>Trigger for next level management: Ocean Drive threatened by acute storm erosion following continued retreat. Monitoring: Buffer width Alternate option: N/A</p>
Management and adaptation options for Projected timeframe (25+ years).	<p>Anticipated behaviour: Long-term retreat (and continued rotation) will threaten sections of Ocean Drive.</p> <p>Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Provide seawall structure to protect Ocean Drive)</p>
Works to avoid to achieve long-term plans	<p>High value or long-term facilities seaward of Ocean Drive, 'infill' development near Camira Way</p>

Appendix D.23. MAAC Seawall, Joondalup

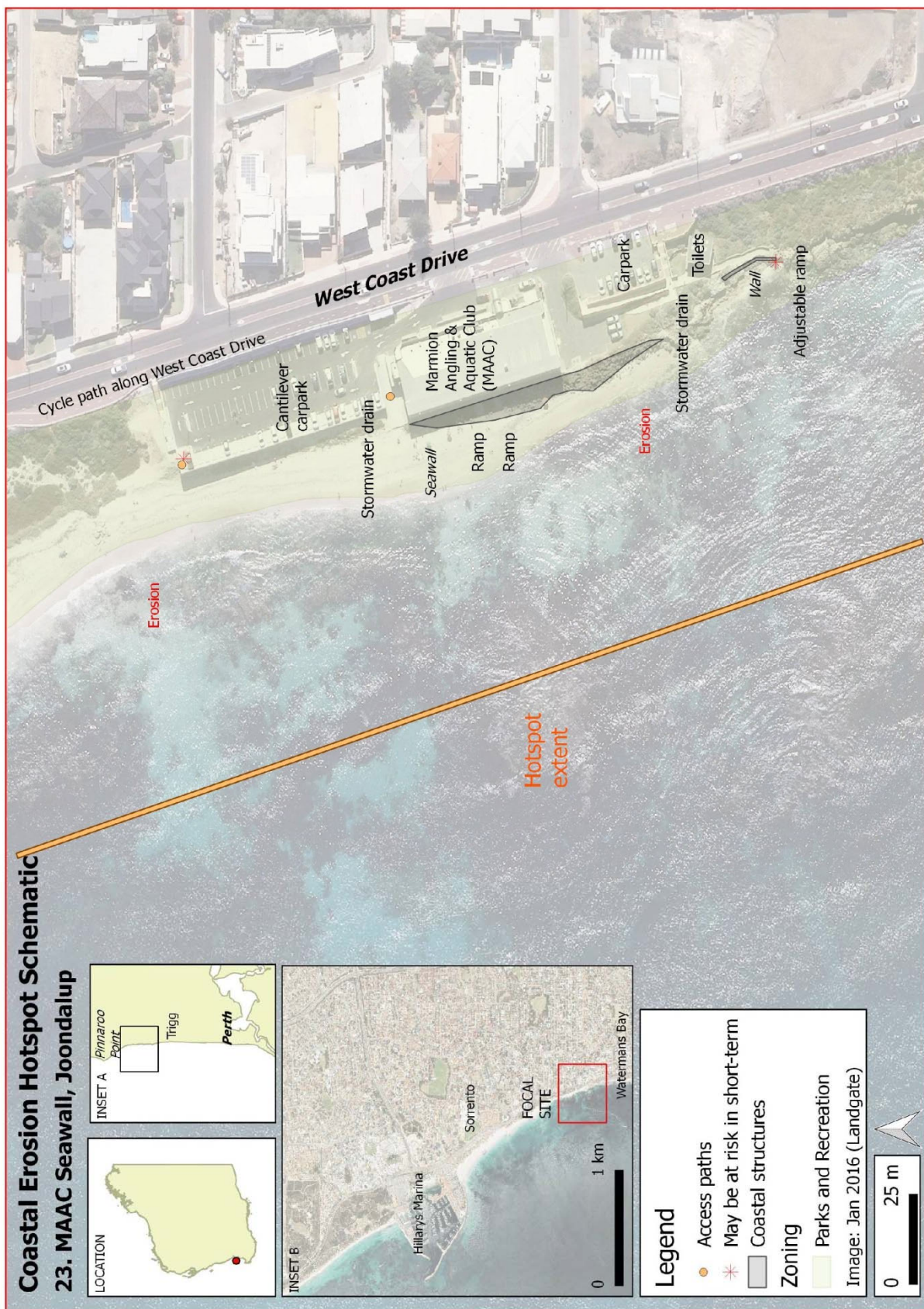


Figure D-23: MAAC Seawall, Joondalup schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-23: MAAC Seawall, Joondalup summary information

Hotspot No.	23
Hotspot Name	MAAC Seawall, Joondalup
Local Coastal Manager	City of Joondalup
Hotspot issue	<p>The Marmion Angling and Aquatic Club (MAAC) has been in its present location since the 1950s when it transitioned from fishing shacks to a leasehold club. The club is built on a small perched beach on a rocky coast, fronted by a rock revetment. The site is susceptible to damage during periods of severe storm activity, with many assets protected by existing seawalls, and is under threat from projected sea level rise. The car park to the north was upgraded in 2015 to accommodate the increase in beach use in the area.</p> <p>Ten publicly owned assets may be at risk of erosion damage in the area (see attached figure), two of which are not protected by seawalls and are at risk of damage in the short-term, including the northern access point from the northern carpark and the adjustable ramp to south. In the longer term, West Coast Drive, services under the road, stormwater drains and the leasehold MAAC building and access ramps are high-value assets at risk. This is a high recreational use site with MAAC activities, swimming and parking. The MAAC represent a local stakeholder group with a large membership base.</p>
Extent of erosion problem and hotspot characteristics	<p>Car park N of Marmion Angling and Aquatic Club to the toilet block at the S</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: Not Scheduled</p> <p>Hazard Assessment: MRA (2011) - Erosion risk dependent on integrity of existing seawall</p> <p>Management & Adaptation Options: Nil</p> <p>Additional Comments: MRA (2011) identified that the existing seawall is only in 'reasonable' condition.</p> <p>Reports:</p> <p>MRA (2011) Marmion - Sorrento Coastal Protection Study. Prepared by MP Rogers and Associates for City of Joondalup. Report R284, Rev 1, May-2011.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>4 public assets susceptible to erosion hazard. N access path from N car park, adjustable ramp at S end, two leasehold MAAC access ramps</p> <p>Leasehold: two MAAC access ramps.</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>7 to 9 public assets susceptible to erosion hazard. 2 fixed access paths from N car park (N and S ends), *S access path from toilet block to beach, adjustable ramp at S end, cantilever carpark [check foundations], *S carpark (lower) on rock, two leasehold MAAC access ramps, leasehold MAAC building</p> <p>Leasehold: two MAAC access ramps and MAAC building.</p>
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>13 public assets susceptible to erosion hazard. *West Coast Drive, cycle path, 2 fixed access paths from N car park (N and S ends), *S access path from toilet block to beach, adjustable ramp at S end, cantilever carpark [check foundations], *S carpark (lower) on rock, *toilet block on rock, two leasehold MAAC access ramps, leasehold MAAC building</p> <p>Services: Gas, power, water, and 2 stormwater drains.</p> <p>Leasehold: two MAAC access ramps and MAAC building.</p>
Existing management	<p>Avoid (N),</p> <p>Retreat (N),</p> <p>Accommodate (N),</p> <p>Protect (Y - Seawall constructed in front of building and carpark)</p>

Management options for Imminent timeframe (0–5 years)	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Maintain seawall in front of building and S carpark) Review lease agreements with MAAC to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - L Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Damage to seawall Monitoring: Annual structural inspection of seawall Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Structural degradation of seawall will occur over time, amplified by increasing sea level Avoid (N), Retreat (N), Accommodate (N), Protect (Y -Strengthening of seawall and modification to reduce wave overtopping likely to be required) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Protect - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: End of structure life or lease Monitoring: Structural assessment of building every 5-10 years. Alternate option: N/A
Management and adaptation options for Projected timeframe (25+ years).	Avoid (N), Retreat (Y - Remove all facilities and services at the end of the building's structural life or lease, whichever comes first. It is worth considering reconstructing facilities on the same location with narrower footprint and further landward with more accommodation measures), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	Structural renovation or extension of the building

Appendix D.24. Waterman's Bay, Stirling

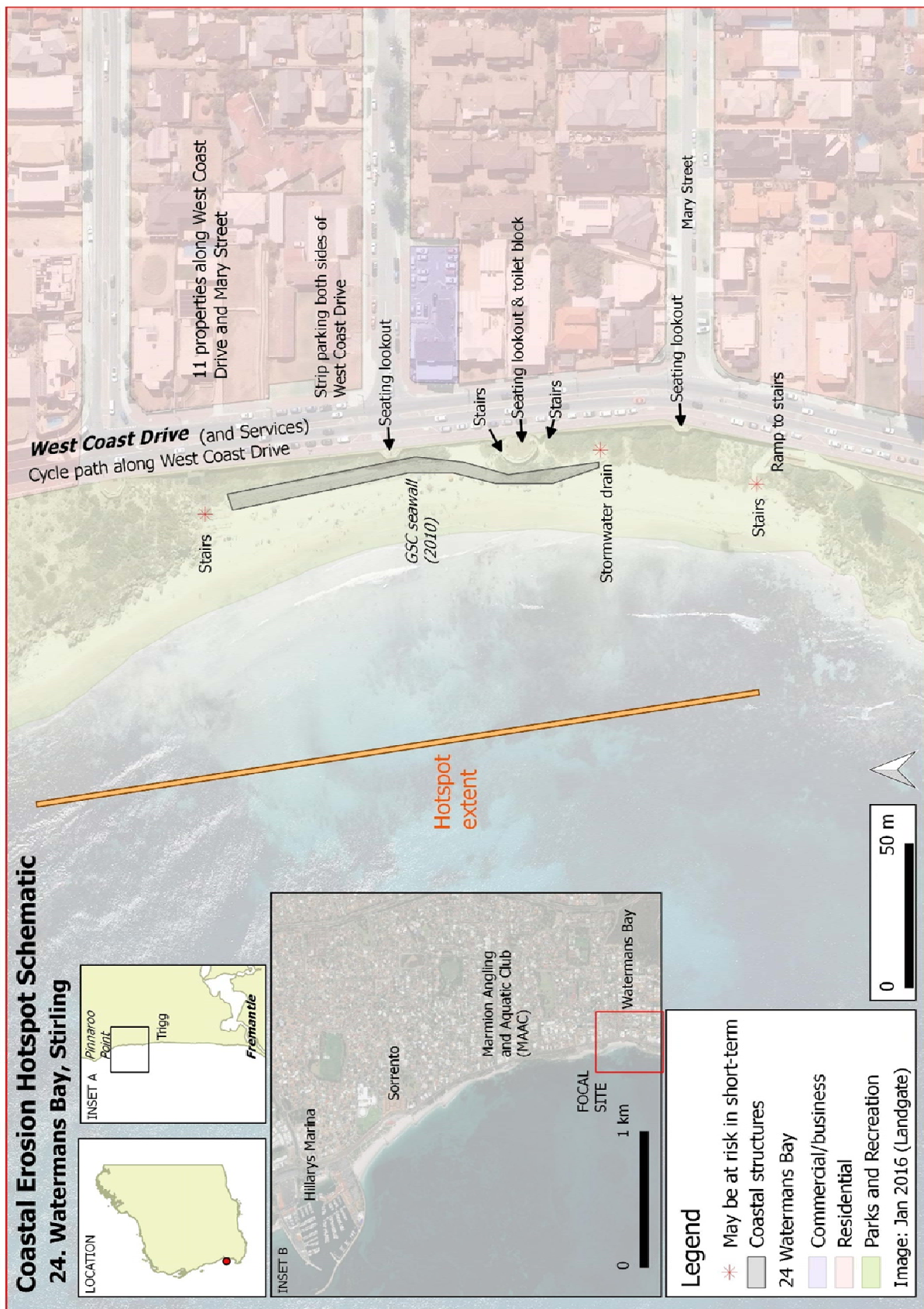


Figure D-24: Waterman's Bay, Stirling schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-24: Waterman's Bay, Stirling summary information

Hotspot No.	24
Hotspot Name	Watermans Bay, Stirling
Local Coastal Manager	City of Stirling
Hotspot issue	<p>Watermans Beach is a pocket sandy beach and foredune overlying a rock pavement, which has been a site of erosion pressure for more than a decade. Facilities have been established at this site too close to the shoreline with ongoing encroachment as the road and path have been widened. A geosynthetic sand container seawall was constructed in 2010 as an emergency management measure following the 2009 storms, which is subject to vandalism and likely to have a short design life. As Watermans is a pocket beach, permanent reflective seawalls are likely to cause the beach to lose its sand, which is the asset for which the public facilities have been built. Some monitoring programs have been undertaken, with further understanding required on the underlying rock stratigraphy and its impact on post-storm recovery and stability of the assets.</p> <p>Fourteen publicly owned assets may be at risk of erosion damage in the area (see attached figure), three of which are at risk of damage in the short-term, including two staircases and a drain. In the longer term, if projected sea level rise occurs, West Coast Highway, associated services (power, water, communications fibre) and private properties along West Coast Highway and Mary Street are high-value assets at risk. The high-use site is valued for swimming, snorkelling and surfing.</p>
Extent of erosion problem and hotspot characteristics	<p>Watermans Bay beach along West Coast Drive between Beach Road and south of Mary Street</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high. • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRM status and findings	<p>CHRM Status: Not Scheduled</p> <p>Hazard Assessment: Nil</p> <p>Management & Adaptation Options: Nil</p> <p>Additional Comments: Seawall exists protecting a portion of the site.</p> <p>Reports:</p> <p>BMT JFA produced a report in 2015 on a strategic coastal study solely funding by the City of Stirling. Not reviewed.</p> <p>UWA (2006) Coastal Foreshore Action Plan Trigg Point to Watermans Bay. Prepared by Institute for Regional Development School of Earth and Geographical Sciences University of Western Australia prepared for City of Stirling. May-2006</p> <p>SKM (2004) Coastal Hazard Remediation: Geotechnical Assessment. Prepared by SKM Consulting for the City of Stirling.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possible geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>3 public assets susceptible to erosion hazard. 2 stairs access.</p> <p>Services: Drain</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>9 public assets susceptible to erosion hazard. 3 stairs access, 3 outlooks from path with seating/shower, toilet block.</p> <p>Services: drain</p>
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>14 public assets susceptible to erosion hazard. West Coast Drive parallel to coast, cycle path with lights, 3 outlooks from path with seating/shower/powerbox, 4 stairs access, strip parking both sides of West Coast Drive, toilet block,</p> <p>Services: Power, water, fibre, drain.</p> <p>Private property: 11 on West Coast Drive (including 2 vacant lots) and Mary Street</p>



Existing management	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Geosynthetic sand container revetment)
Management options for Imminent timeframe (0–5 years)	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Maintain GSC revetment) Prepare plans to implement retreat for next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - L (if storms) Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: GSC revetment reaching end of functional life (>5% damage per annum) Monitoring: Annual structural inspection of GSC revetment Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Avoid (N), Retreat (Y - Remove toilet block), Accommodate (N), Protect (Y - Replace GSC revetment with high rock revetment tie-in to rock and beach renourishment for amenity. High cost for maintenance of beach) Prepare plans to implement retreat for next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - L Protect - H Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Underground services reaching end of functional life. Monitoring: Not required Alternate option: Install groynes to reduce beach mobility and renourish beach
Management and adaptation options for Projected timeframe (25+ years).	Avoid (N), Retreat (Y - Any opportunity to relocate the underground services to a less coastal position should be taken), Accommodate (N), Protect (Y - Maintain rock revetment) Option: Install groynes to reduce beach mobility and renourish beach
Works to avoid to achieve long-term plans	Renewal of underground services in the same location; Any high value or long-life assets landward of West Coast Drive

Appendix D.25. Mettams Pool

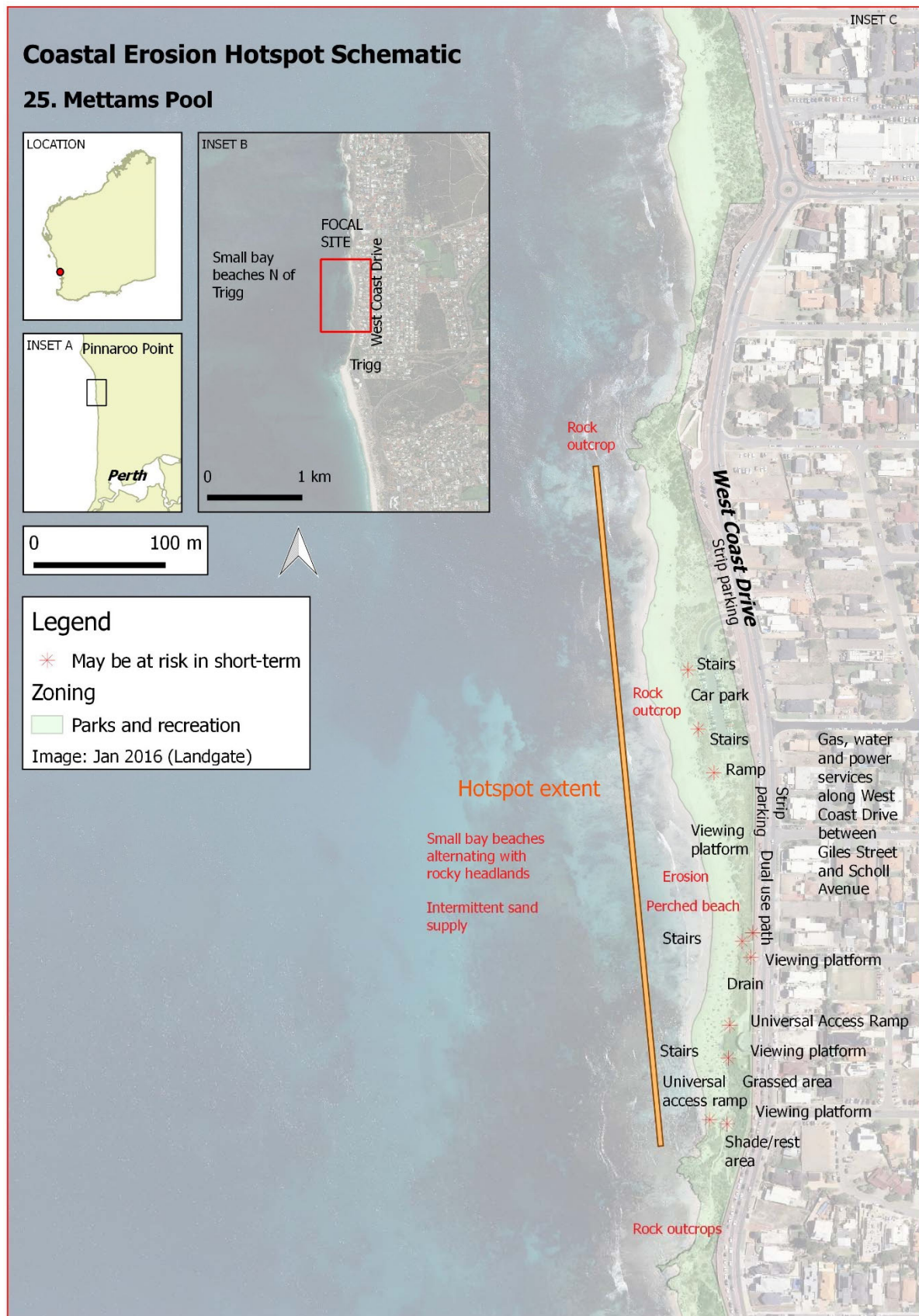


Figure D-25: Mettams Pool schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-25: Mettams Pool summary information

Hotspot No.	25
Hotspot Name	Mettams Pool
Local Coastal Manager	City of Stirling
Hotspot issue	<p>Mettams Pool is one of a series of small bay beaches along West Coast Drive, located between the rock outcrops at the south of the beach to the rock outcrop north of the car park. Fringing reef sits just offshore at about mean sea level. Sand supply to the beaches is principally from inshore bioproduction or alongshore sediment transport from offshore pathways. Sediment loss from the beaches, through episodic storm attack, can lead to increased embaymentisation. The coast road is a major tourism corridor used for walking, cycling and vehicular traffic, widened seawards to allow pavement, parking and walkway that which also acts as a distributor route providing direct frontage access to high-value residential subdivision. Present management includes dune reshaping and planting, and a minor amount of protection of coastal paths. Geotechnical investigations have recently been undertaken to design a longer-term solution for erosion at the site.</p> <p>Twenty-two publicly owned assets may be at risk of erosion damage in the area (see attached figure), 10 of which may be at risk in the short-term. These include two universal access ramps, a shade structure, four sets of stairs, dual-use path, one viewing platform and a pedestrian access ramp. In the medium- to longer-term additional public assets that may be at risk include more of the dual use path, section of West Coast Drive and associated services (gas, power, water), two extra viewing platforms, the car park to the north, strip parking and a grassed park area. This is a high use recreation site with board riding, snorkelling, diving, swimming, exercise (walking and running) and beach photography. The Stirling Natural Environment Coastcare is the main non-government organisation likely to have an active interest in how this foreshore is managed.</p>
Extent of erosion problem and hotspot characteristics	<p>Small bay beaches along West Coast Drive between the rock outcrops at the south of the beach to the rock outcrop north of the car park.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high. • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: Not Scheduled</p> <p>Hazard Assessment: Nil</p> <p>Management & Adaptation Options: Identified as a critical at risk area by the City of Stirling.</p> <p>Additional Comments: Nil</p> <p>Reports:</p> <p>BMT JFA produced a report in 2015 on a strategic coastal study solely funding by the City of Stirling. Not reviewed.</p> <p>UWA (2006) Coastal Foreshore Action Plan Trigg Point to Watermans Bay. Prepared by Institute for Regional Development School of Earth and Geographical Sciences University of Western Australia prepared for City of Stirling. May-2006</p> <p>SKM (2004) Coastal Hazard Remediation: Geotechnical Assessment. Prepared by SKM Consulting for the City of Stirling.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly renourishment source and ongoing coastal movement data collection. Possibly geotechnical.
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>11 public assets susceptible to erosion hazard. 2 universal access ramps, shade structure within ramp, 4 stairs access, 45m of DUP, 1 viewing platforms, access ramp.</p> <p>Services: Drain.</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>15 public assets susceptible to erosion hazard. 2 universal access ramps, shade structure within ramp, 4 stairs access, 110m of DUP, 30m of West Coast Drive, 2 viewing platforms, access ramp, carpark to N, 55m of strip parking.</p> <p>Services: Drain.</p>

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	23 public assets susceptible to erosion hazard. 2 universal access ramps, shade structure within ramp, 4 stairs access, grassed area, 160m of DUP, 120m of West Coast Drive, 4 viewing platforms, access ramp, carpark to N, 80m of strip parking, 40m DUP (secondary), 1 strip parking bay. Services: All between Giles and Scholl St, 100PVC gas pipeline, LV overhead powerline, 205CI water pipes, drain
Existing management	Avoid (N), Retreat (N), Accommodate (Y - some dune reshaping and planting), Protect (N - minor protection of paths)
Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: Beach access points threatened by storm erosion. Avoid (N), Retreat (N), Accommodate (Y - strengthen dune protection at toilet block and path to N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Within 0.5m level (vertically) of undermining foundations of existing facilities. Monitoring: Critical levels measured relative to structures; Photographic record Alternate option: Accommodate - modify beach access. Renourishment could be considered for amenity (not protection) if beach is eroded to underlying rock.
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Erosion threatens to undermine existing facilities. Avoid (N), Retreat (Y - relocate amenities / toilet blocks (any structures not founded on rock)), Accommodate (Y - realign seaward end of beach access points), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Accommodate - L Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Existing facilities undermined. Monitoring: Visual assessment Alternate option: Renourishment could be considered for amenity (not protection) if beach is eroded to underlying rock. Protect - offshore breakwater construction (offshore from amenities) - strongly not recommended.
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Erosion compromises structural integrity of existing facilities. Avoid (N), Retreat (Y - Retreat the dual use path (e.g. concurrently retreat West Coast Highway by rerouting to a one way road), relocate all amenities not founded on rock), Accommodate (N), Protect (Y - foundation walling for parts of West Coast Drive may be considered; reinforce underlying rock if exposed; renourish if all sand lost)
Works to avoid to achieve long-term plans	Rebuilding toilet block. Allowing high value leasehold/development seaward of West Coast Highway or further seaward than the existing development east of west coast drive, to allow for some change in road alignment/width.

Appendix D.26. Floreat Beach

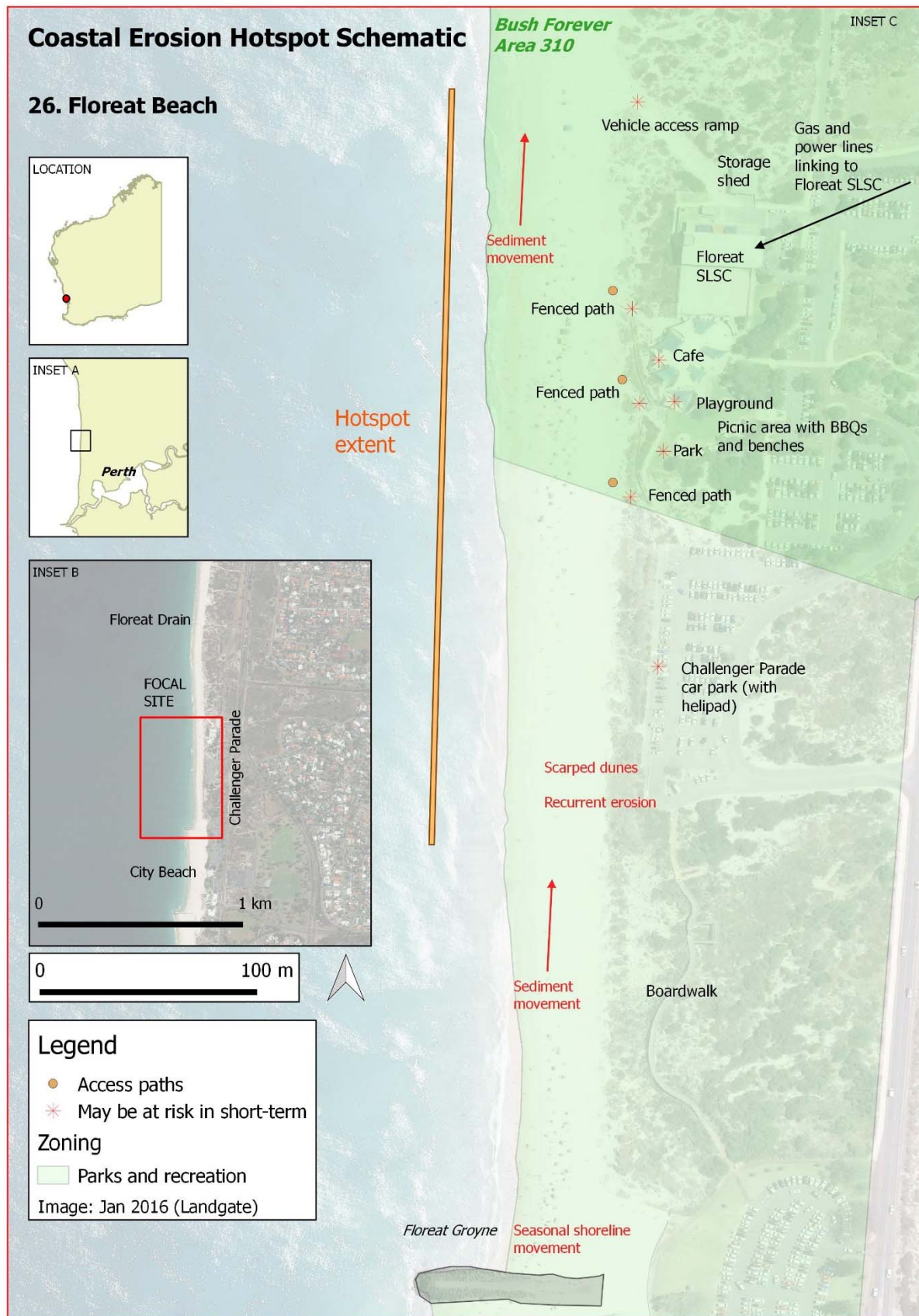


Figure D-26: Floreat Beach schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-26: Floreat Beach summary information

Hotspot No.	26
Hotspot Name	Floreat Beach
Local Coastal Manager	Town of Cambridge
Hotspot issue	<p>Floreat Beach is a recreational beach located in a source area for sediment moving northwards along the coast. Floreat has a history of intermittent erosion, partly in response to installation of two groynes to the south at City Beach. The original surf lifesaving club (SLSC) rooms were constructed in 1948 and moved seaward in 1962 following beach accretion associated with construction of Floreat groyne. A road and two SLSC rooms have been lost to erosion, most recently during Tropical Cyclone Alby in 1978. Existing public assets are vulnerable to storm wave erosion, and the low elevation of the dune means that some recreational assets may be severely damaged if a major storm occurs at the same time as high tide. Past management actions have included moving the SLSC rooms landward and north in 1981, and landward movement of the coastal road, partially converted to a car park, in 1974 and 1978. Aerial imagery indicates renourishment was associated with groyne construction, along with dune reshaping and planting.</p> <p>Fourteen publicly owned assets may be at risk of erosion damage in the area (see attached figure), nine of which may be at risk in the short-term. This includes three fenced paths, a sandy vehicle access ramp, a grassed park area, a shaded café area, a playground, a viewing platform and Challenger Parade carpark which is within 17m of the dune toe. In the longer-term, five additional public assets are at risk including BBQs and picnic tables within the park, the boardwalk between car parks, and gas and power lines to the Floreat SLSC. At this timeframe Bush Forever Area 310 may also be at risk. The Floreat SLSC, the Floreat SLSC storage shed, and the Kiosk at Floreat Beach are leasehold assets at risk in the medium to longer-term. Floreat has amenities set close to shore for convenience of the visitors to the coast. A high number of users visit Floreat for many coastal based activities, including swimming, surfing, fishing, beach games, SLSC activities, sunbathing, and exercise.</p>
Extent of erosion problem and hotspot characteristics	<p>Floreat beach from the southern extent of Challenger Parade car park to the vehicle access rank in the north.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high. • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: Not Scheduled</p> <p>Hazard Assessment: MRA (2012) - Erosion risk identified by 2022</p> <p>Management & Adaptation Options: MRA (2012) recommends managed retreat for the car park.</p> <p>Additional Comments: Nil</p> <p>Reports: MRA (2012) Coastal Processes & Vulnerability Assessment. Prepared by MP Rogers and Associates for the Town of Cambridge. Report R329, Rev. A, Nov-2012</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly renourishment source and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>9 public assets susceptible to erosion hazard. 3 fenced paths, sandy vehicle access ramp, grassed park area, shaded café area, playground, viewing platform, Challenger Parade carpark</p> <p>Note: Bush Forever Area 310</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>13 public assets susceptible to erosion hazard. Challenger Parade carpark, 3 fenced paths, sandy vehicle access ramp, grassed park area, BBQs, picnic benches, shaded café area, playground, viewing platform, Floreat SLSC building, kiosk cafe building</p> <p>Leasehold: Floreat SLSC and Kiosk cafe</p> <p>Note: Bush Forever Area 310</p>

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	17 public assets susceptible to erosion hazard. Boardwalk between carparks, Challenger Parade carpark, 3 fenced paths, sandy vehicle access ramp, grassed park area, BBQs, picnic benches, shaded café area, playground, viewing platform, Floreat SLSC building, Floreat SLSC storage shed, kiosk cafe building Services: 40PVC 70kPa gas line to Floreat SLSC, LV buried cable to SLSC Leasehold: Floreat SLSC, Floreat SLSC storage shed and Kiosk cafe Note: Bush Forever Area 310
Existing management	Existing behaviour: The original SLSC club rooms were constructed in 1948 and moved seaward in 1962 following beach accretion associated with construction of Floreat groyne and renourishment. Floreat groyne to the south contributes to erosion, and efforts to protect the 1962 clubrooms post-Alby failed Avoid (N), Retreat (Y - SLSC club rooms moved landward and north in 1981 (damaged TC Alby 1978), coastal road (converted to carpark) moved landward in 1974/78), Accommodate (Y - some dune reshaping and planting), Protect (Y - renourishment associated with groyne construction)
Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: Storm erosion capable of undermining carpark & affecting building. Avoid (N), Retreat (Y - car park realignment (i.e. move landward approx. 10m). Note plan to be prepared for alternate location of facilities), Accommodate (Y - dune rebuilding and fencing to limit vehicles driving along foredune (e.g. a few rocks to divert traffic lower). Improve surface runoff management from car park to avoid dune damage), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. Review lease agreements with SLSC and kiosk to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Retreat - L Accommodate - M Prepare Plans - 50k Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Threat to café building, with buffer <10m (definition of buffer width to be refined). Monitoring: Buffer width monitoring Alternate option: Protect - build buried seawall.
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Progressive & storm erosion will affect carpark and building. Avoid (N), Retreat (Y - further carpark realignment, modify shape of vehicle access ramp, some lease buildings may require shifting), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - H (assuming new leasehold buildings will be at cost to City and not to surf club) Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: When SLSC is threatened (<10m buffer), with consideration of the service life of the structure. Monitoring: Buffer width monitoring Alternate option: Protect - Extend City Beach groyne field north.
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Progressive erosion providing structural threat to SLSC building. Avoid (N), Retreat (Y - relocate SLSC/café/playground/access tracks), Accommodate (N), Protect (N)



Works to avoid to achieve long-term plans	Limit upgrading of café/SLSC. Avoid erosion mitigation structures. Avoid more access locations.
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Appendix D.27. Port Beach

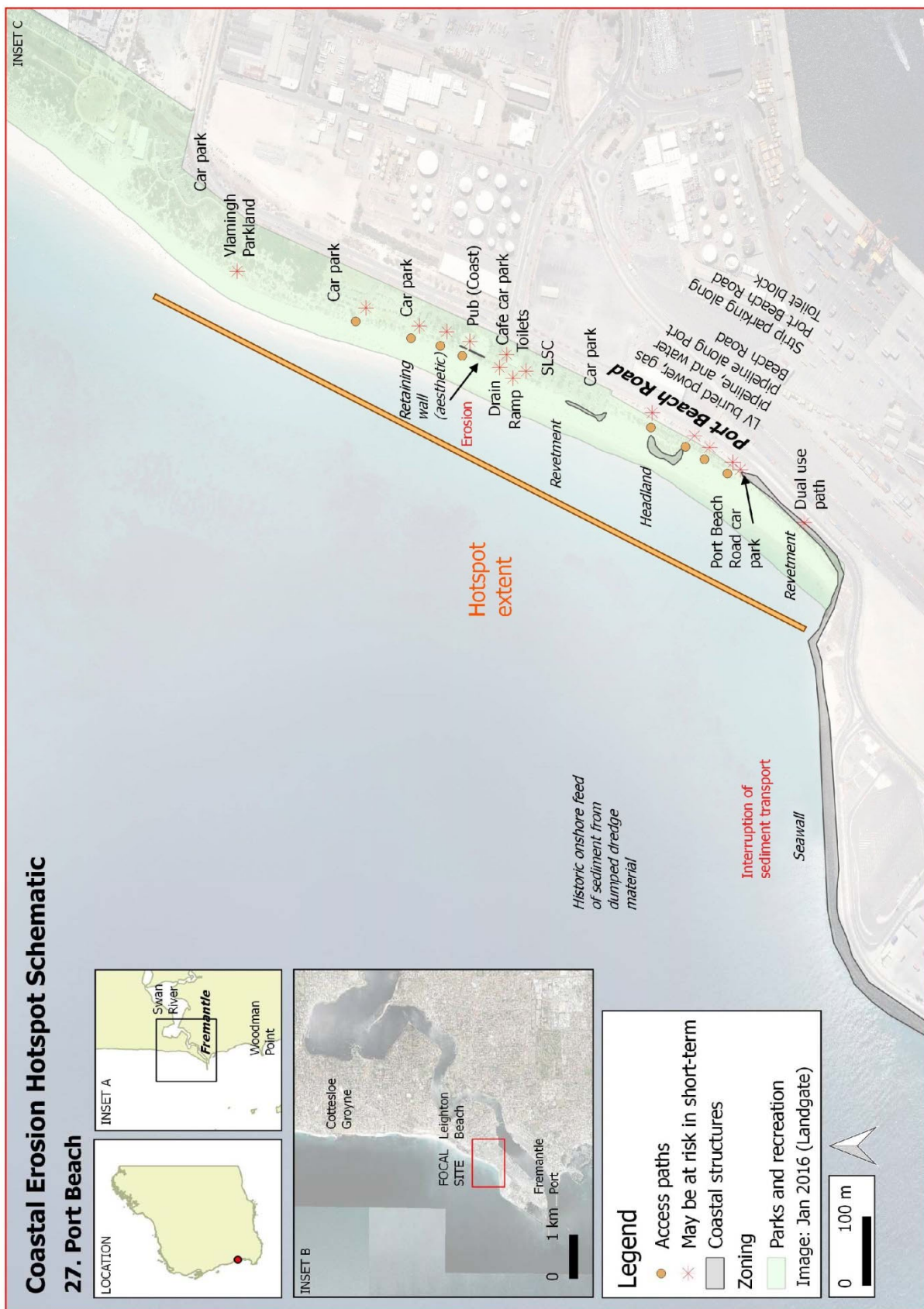


Figure D-27: Port Beach schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-27: Port Beach summary information

Hotspot No.	27
Hotspot Name	Port Beach
Local Coastal Manager	Fremantle Ports & City of Fremantle
Hotspot issue	<p>Port Beach is a shore modified by harbour works and subsequently by rock revetments and sea walls. The sandy beach had previously accreted from sand dredged from Fremantle harbour, dumped offshore and then brought inland and northward by natural wave action (DPI 2004). Several interruptions have changed the alignment of this beach, including progressive extension of Rous Head. It is believed the offshore stockpile of dredged material is no longer available to replenish this beach. The beach is not yet stabilised in response to these changes and is vulnerable to erosion when sand is eroded during major storms. High-investment developments, including the Coast leasehold venue, have been located on a low foredune. These developments are vulnerable to damage as the beach responds to reduced sand supply and is susceptible to major storms, such as occurred in May 2003. As the beach alignment shifts it is expected the northern salient will continue to exist as a landform feature. Fremantle Port Authority undertake offshore profile monitoring at the site to determine the impact of the Rous Head extension.</p> <p>Management actions have included previous retreat of the southern car park, rock revetments, sea walls, beach renourishment and dune restoration. The extent of any seawall construction in front of assets is not well documented. Rock from older seawalls and reclamation is regularly uncovered during lower beach levels, most recently in late 2016. Exposure of contaminated material, including asbestos, requires mitigation and management along with erosion.</p> <p>Twenty eight publicly owned assets may be at risk of erosion damage (see attached figure), 16 of which may be at risk in the short-term. In the short-term the public assets susceptible to erosion hazard are 60m of dual use path, Port Beach Road carpark, 10 fenced access tracks, one bitumen ramp access for SLSC activities, a toilet block, a drain and the Vlamingh Parkland. In the longer-term, an additional 12 public assets may be at risk, including 800m of Port Beach Road, an extra 1km of dual use path (two separate sections), strip parking, two car parks, a bitumen car park and sand car park to the north, Leighton Beach Boulevard car park, and services (power, gas and water along Port Beach Road). The leasehold venue Coast (current lease expires in 2025) is at risk in the short-term with the Fremantle SLSC rooms (current lease expires 2020) at risk in the medium-term. Ownership of both buildings revert to the landowner (Government of Western Australia) at the termination of the lease agreements. Recreational use of this foreshore includes swimming, wind-surfing, kite surfing, sunbathing, exercising and activities related to the SLSC. The main non-governmental stakeholders that are likely to have an active interest in how this foreshore is managed include Friends of Fremantle Beaches, the North Fremantle Community Association Precinct 12, and the Port Beach Polar Bears. The City of Fremantle also work with the Perth NRM Coastal and Marine Program to facilitate community engagement in coastal conservation within coastal reserves.</p>
Extent of erosion problem and hotspot characteristics	<p>Port Beach along Port Beach Road between the northern extent of the Port Beach seawall and Walter Place.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: In Progress. Draft report due by May 2017. CMPAP funded</p> <p>Hazard Assessment: GHD 2016 Port Beach assets identified at extreme risk by 2030.</p> <p>Management & Adaptation Options: The City of Fremantle and the Town of Mosman Park are in the process of completing a CHRMAP</p> <p>Additional Comments: Nil</p> <p>Reports: Draft Port, Leighton and Mosman Beaches Coastal Adaptation Plan</p> <p>Nil</p>

Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly sedimentology, possibly sandbar dynamics and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	18 public assets susceptible to erosion hazard. 60m of DUP, Port Beach Road carpark, 11 sand ramp/fenced pedestrian access, 1 bitumen ramp access for SLSC activities, Vlamingh Parkland, toilet block, drain, Coast building Leasehold: Pub (Coast)
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	23 public assets susceptible to erosion hazard. 220m of DUP, Port Beach Road carpark, strip parking, SLSC carparks, toilet block, drain, 11 sand ramp/fenced pedestrian access, 1 bitumen ramp access for SLSC activities, 2 x car parks to N, Vlamingh Parkland, Coast building, Fremantle SLSC rooms Leasehold: Pub (Coast), Fremantle SLSC rooms
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	32 public assets susceptible to erosion hazard. 820m of Port Beach Road, 820m of DUP, Port Beach Road carpark, strip parking, carparks, 13 sand ramp/fenced pedestrian access, 1 bitumen ramp access for SLSC activities, 2 x car parks to N, Vlamingh Parkland, Leighton Beach Blvd car park, 270m of DUP, toilet block, drain, Coast building, Fremantle SLSC rooms Services: short section of LV buried cable along Port Beach Rd (near Tydeman Road), 160PE1.5MP 70kPa gas pipeline along Port Beach Rd to N, 155PVC1.5MP 70kPa gas pipeline along Port Beach Rd to S, 150PVC-U water pipeline along Port Beach Road. Leasehold: Pub (Coast), Fremantle SLSC rooms
Existing management	Ongoing active management. Avoid (N), Retreat (Y - retreat of southern car park), Accommodate (N), Protect (Y - has been maintained by historic dredge spoil and renourishment, revetments)
Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: Existing structure subject to erosion hazard, with ongoing sand drift issues. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Revetment may be required to protect road at southern end of hotspot and plan for alternate locations for facilities [Note, depends on scheduling with relocation/retreat]) Preparation of planning frameworks for retreat in next level of management, with consideration of management of the contaminated site, and identify funding mechanisms. Review lease agreements with Coast and SLSC to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - M Prepare Plans - 50k Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: No dune buffer present for more than 75% of building length (Coast pub). Monitoring: Aerial imagery Alternate option: Facilitate retreat and reduce requirement for protection
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Moderate erosion causes dune loss and squeeze of the beach against existing coastal defences (i.e. loss of beach amenity). Avoid (N), Retreat (Y - remove carpark revetments; retreat SLSC, Coast pub, carparks by relocating to Leighton Beach. This will require management of the site contamination.), Accommodate (Y - repeatedly build dune to manage sand drift), Protect (N)
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - H Accommodate - M

Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	<p>Trigger for next level management: Inadequate space to maintain dune and prevent sand drift (estimated <20m buffer).</p> <p>Monitoring: Buffer width monitoring</p> <p>Alternate option: Protect - build groynes (with renourishment) to create an artificial shore.</p>
Management and adaptation options for Projected timeframe (25+ years).	<p>Anticipated behaviour: Structures west of Port Beach Road are untenable under progressive erosion, as the key amenity of the beach will be gone. Any development on industrial land needs to note whether sea level rising requires accommodation.</p> <p>Avoid (N), Retreat (N), Accommodate (Y - sand drift management), Protect (Y - construct revetment in front of Port Beach Road)</p> <p>Consider one option of keeping the pub (Coast) using armouring - however, erosion stress will be transferred north, increasing stress on Port Beach Road. Alternate option to be pursued is the re-routing of Port Beach Road to avoid protection.</p>
Works to avoid to achieve long-term plans	<p>Further investment in leasehold properties in existing location, consolidate future development at Leighton where there is more space. Expanding or upgrading car parks.</p>

Appendix D.28. Rottnest – South Thomson Bay

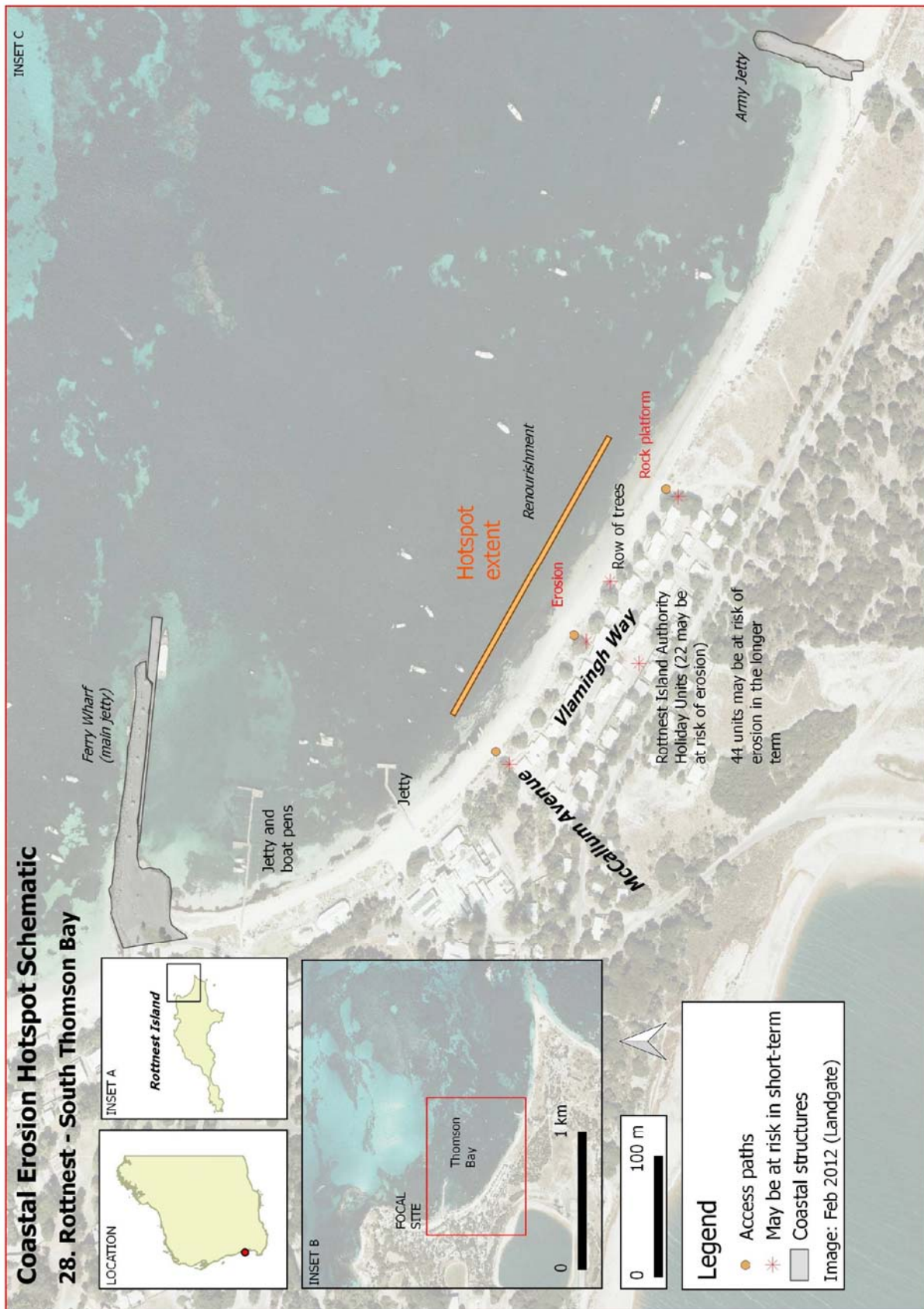


Figure D-28: Rottnest – South Thomson Bay schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-28: Rottnest – South Thomson Bay summary information

Hotspot No.	28
Hotspot Name	Rottnest - South Thomson Bay
Local Coastal Manager	Rottnest Island Authority
Hotspot issue	<p>Thomson Bay is a shallowly arcuate coast in sheltered waters between the main and military jetties. Much of the beach is perched and sits on a rock pavement or rock platform. The beach and frontal dune ridge have been modified, nourished by dredged spoil in the 1960's, when the ferry basin was excavated. The holiday units were constructed close the edge of the dune ridge and erosion scarp. An erosion scarp is present, with sand progressively lost due to pedestrian trampling and occasional storms. The scarp is not a dune-face as it does not receive wind-blown sand from the beach. Episodic retreat is expected to continue at the site. Existing management has included beach renourishment and dune stabilisation including planting and fencing.</p> <p>Forty six publicly owned assets may be at risk of erosion damage in the area (see attached figure), 25 of which may be at risk in the short term. In the short-term the public assets susceptible to erosion hazard include two sand access paths (counted as one combined asset), one fenced pedestrian access, and the front portion of 22 Rottnest Island Authority (RIA) Holiday units. The holiday units are public assets that are managed by the RIA. In the longer-term, an additional 21 assets may be at risk, including 220m of Vlamingh Way, 10m of McCallum Avenue and an additional 19 RIA Holiday units. Recreational use on the beach is linked to the rental of the holiday units, including boating, swimming, snorkelling and exercise.</p>
Extent of erosion problem and hotspot characteristics	<p>South Thomson Bay where holiday units are located along Vlamingh Way.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: Not Scheduled</p> <p>Hazard Assessment: Nil</p> <p>Management & Adaptation Options: Nil</p> <p>Additional Comments: Nil</p> <p>Reports:</p> <p>Nil</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Renourishment source, possibly geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	25 public assets susceptible to erosion hazard. 2 sandy pedestrian access, 1 fenced pedestrian access, single line of trees, Rottnest Island Authority Holiday Units (22 units).
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	27 public assets susceptible to erosion hazard. Vlamingh Way (220m), 10m of McCallum Avenue, 2 soft pedestrian access, 1 fenced pedestrian access, single line of trees, Rottnest Island Authority Holiday Units (22 units)
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	46 public assets susceptible to erosion hazard. Vlamingh Way (220m), 10m of McCallum Avenue, 2 sandy pedestrian access, 1 fenced pedestrian access, single line of trees, Rottnest Island Authority Holiday Units (41 units)
Existing management	<p>Beach historically created from dredged material. Loss has occurred on occasional years, mainly with high water levels. This has been effectively managed to date using minor works.</p> <p>Avoid (N),</p> <p>Retreat (N),</p> <p>Accommodate (Y - Dune planting and fencing. Emergency fencing placed in 2014),</p> <p>Protect (N)</p>

Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: Occasional loss, mainly with high water levels. Avoid (N), Retreat (N), Accommodate (Y - foredune rebuild, focus on area in front of cottages), Protect (Y - renourish, possibly with dredged material from any marina capital works dredging, to rebuild dune scarp face) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L Protect - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Minor works inadequate for protection, lasting less than 3 years before additional works required; OR Structural damage to existing bungalows. Monitoring: Photographic monitoring; distance to bungalows (survey) Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Moderate progressive erosion will eventually mean minor works are ineffective. Given age and state of bungalows, major works are not considered cost-effective. Avoid (N), Retreat (Y - local retreat for at least 3 cottages, up to 12), Accommodate (Y - foredune rebuild), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - H (assumed >6 cottages) Accommodate - L Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: managed retreat based on coastal buffer (typically <5m) and condition of cottages. Monitoring: Buffer width measurement Alternate option: N/A
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Progressive erosion, particularly erosion associated with sea level rise, has the capacity to cause widespread pressure on the front row of cottages. Given the intense value placed on beach access at Rottnest and age of the existing buildings, retreat is recommended ahead of protection. Avoid (N), Retreat (Y - broad scale retreat of front cottages, at least 22), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	Refurbishment of cottages, beyond maintaining serviceability.

Appendix D.29. C.Y. O'Connor Beach, Cockburn

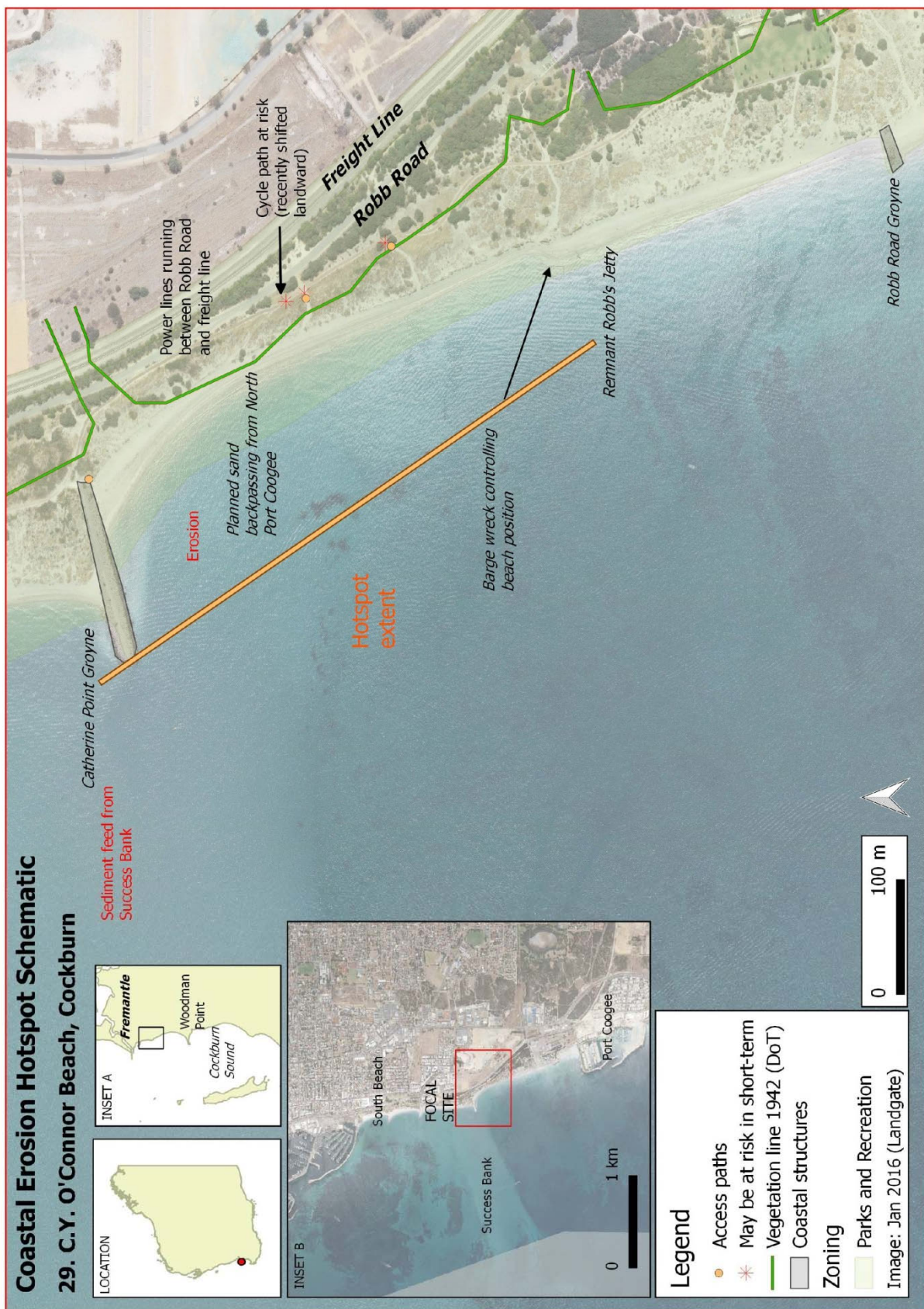


Figure D-29: C.Y. O'Connor Beach, Cockburn schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-29: C.Y. O'Connor Beach summary information

Hotspot No.	29
Hotspot Name	C.Y. O'Connor Beach, Cockburn
Local Coastal Manager	City of Cockburn
Hotspot issue	<p>C.Y. O'Connor Beach is located on the southern side of a foreland and has fluctuated in position by approximately 100m in the past 100 years, mainly in response to historic and contemporary engineering works. These works include construction and lengthening of Catherine Point groyne, South Fremantle Power Station groynes and onshore feed of dumped dredged material (now ceased). The foreshore is presently retreating with over 40m of erosion in the last 10 years immediately south of the recently refurbished (2011), Catherine Point groyne which interrupts the longshore supply of sediment from the north. Sediment supply is also naturally variable from Success Bank. The beach position is locally influenced by the wreck near the remains of Robb's Jetty. The foreshore is presently being managed using retreat, with the path recently shifted landward of the 1976 shoreline, as well as using sand backpassing to reinstate some beach width as was done in 2016. Relevant coastal managers indicate that a structural solution is being discussed as replacement or periodic backpassing; with a focus on identifying a solution to protect coastal assets and maintain beach and reserve access for the community.</p> <p>Five publicly owned assets may be at risk of erosion damage in the area (see attached figure), two of which are at risk of damage in the short-term, including 50m of the cycle path and two beach access points. In the longer term, Robb Road, power lines and the freight line are high-value assets at risk. The freight line is considered to be at greater risk in the longer term if the Catherine Point groyne were to be extended, further limiting sediment supply. Community pressure to maintain recreational values is anticipated to increase if a continuous dual use path is not able to be maintained or the beach is not available due to erosion. These community pressures are expected to increase further with the development of land for subdivisions ~300m behind C.Y. O'Connor Beach through the Landcorp's Cockburn Coast development.</p>
Extent of erosion problem and hotspot characteristics	<p>Catherine Point groyne to old wreck N of Robb's Jetty</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer).
CHRMAP status and findings	<p>CHRMAP Status: Complete</p> <p>Hazard Assessment: CZM (2013)</p> <p>Management & Adaptation Options: GHD (2016) - Study area Cockburn Sound. Recommended immediate adaptation strategy (Catherine Point Groyne running 1km south): installation of groynes or off-shore breakwaters; reactive beach nourishment; investigate shortening of Catherine Point groyne.</p> <p>Additional Comments: Local coastal manager noted in December 2017, shortening of the groyne may not be desirable on account of the benefit it provides to retain beach on its northern side which is also eroding.</p> <p>Reports:</p> <p>GHD (2016) Coastal Adaptation Plan. Prepared by GHD for the City of Cockburn. Rev0, 24-Ju-2016</p> <p>CZM (2013) Coastal Vulnerability Study. Erosion and Inundation Hazard Assessment Report. Prepared by Coastal Zone Management Pty Ltd, the UWA School of Environmental Systems Engineering, Damara WA Pty Ltd and Oceanica Consulting Pty Ltd for the Cockburn Sound Coastal Alliance.</p> <p>Landcorp (2012) Cockburn Coast Foreshore Management Plan - Coastal Vulnerability Assessment & Adaptation, Report prepared by MP Rogers & Associates.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Sedimentology, possibly sandbar dynamics and ongoing coastal movement data collection

Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	2 public assets susceptible to erosion hazard. 50m of cycle path, 2 access paths (toe only)
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	3 public assets susceptible to erosion hazard. <25m Robb Road, <200m Cycle path, 3 access paths
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	5 public assets susceptible to erosion hazard. <150m Robb Road, <150m freight line, <450m Cycle path, 4 access paths. Services: <150m power lines between Robb Rd and freight line.
Existing management	Avoid (Y - Setback buffer established), Retreat (Y - Cycle path relocated), Accommodate (N), Protect (Y – backpassing of sand from north side of Port Coogee in 2016))
Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: Buffer will progressively erode. Predicted reduction in onshore sand supply from Success Bank may reduce sand available for backpassing. Avoid (Y - Use existing buffer), Retreat (N), Accommodate (N), Protect (Y – backpassing of sand from north side of Port Coogee) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Avoid – None Protect - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Cycle path threatened by acute erosion Monitoring: Buffer width Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Beach rotation likely to occur due to reduced sand feed, adding to progressive erosion. Predicted reduction in onshore sand supply from Success Bank may reduce sand available for backpassing. Avoid (N), Retreat (Y - Remove cycle path; Truncate Robb Road), Accommodate (N), Protect (N) It should be noted the local coastal manager is considering the use of a detached headland, groyne or offshore breakwater in combination with periodic sand backpassing and renourishment.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Rail freight line threatened by acute erosion. Monitoring: Buffer widths to rail line and distance to permanent infrastructure north of Catherine Point. Alternate option: The option to shorten Catherine Point groyne as a first step was initially considered if accretion was occurring north of the groyne; however, erosion is also occurring to the north.



Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Sand supply from Success Bank and Catherine Point likely to be reduced by sea level rise and progressive erosion (making the groyne a larger barrier) Avoid (N), Retreat (N), Accommodate (Y -Truncate Catherine Point groyne to increase sand supply, which could transfer problem to the north of the groyne. Extend groyne landward), Protect (Y - Protect rail freight line) It should be noted the local coastal manager is considering the use of a detached headland, groyne or offshore breakwater in combination with periodic sand backpassing and renourishment.
Works to avoid to achieve long-term plans	No substantial (high cost or longevity) coastal infrastructure to be placed between Catherine Point Groyne and Port Coogee; No reliance on backpassing only (high recurrent cost and limited sand supply); No further extension of Catherine Point groyne.

Appendix D.30. Kwinana waterfront industrial

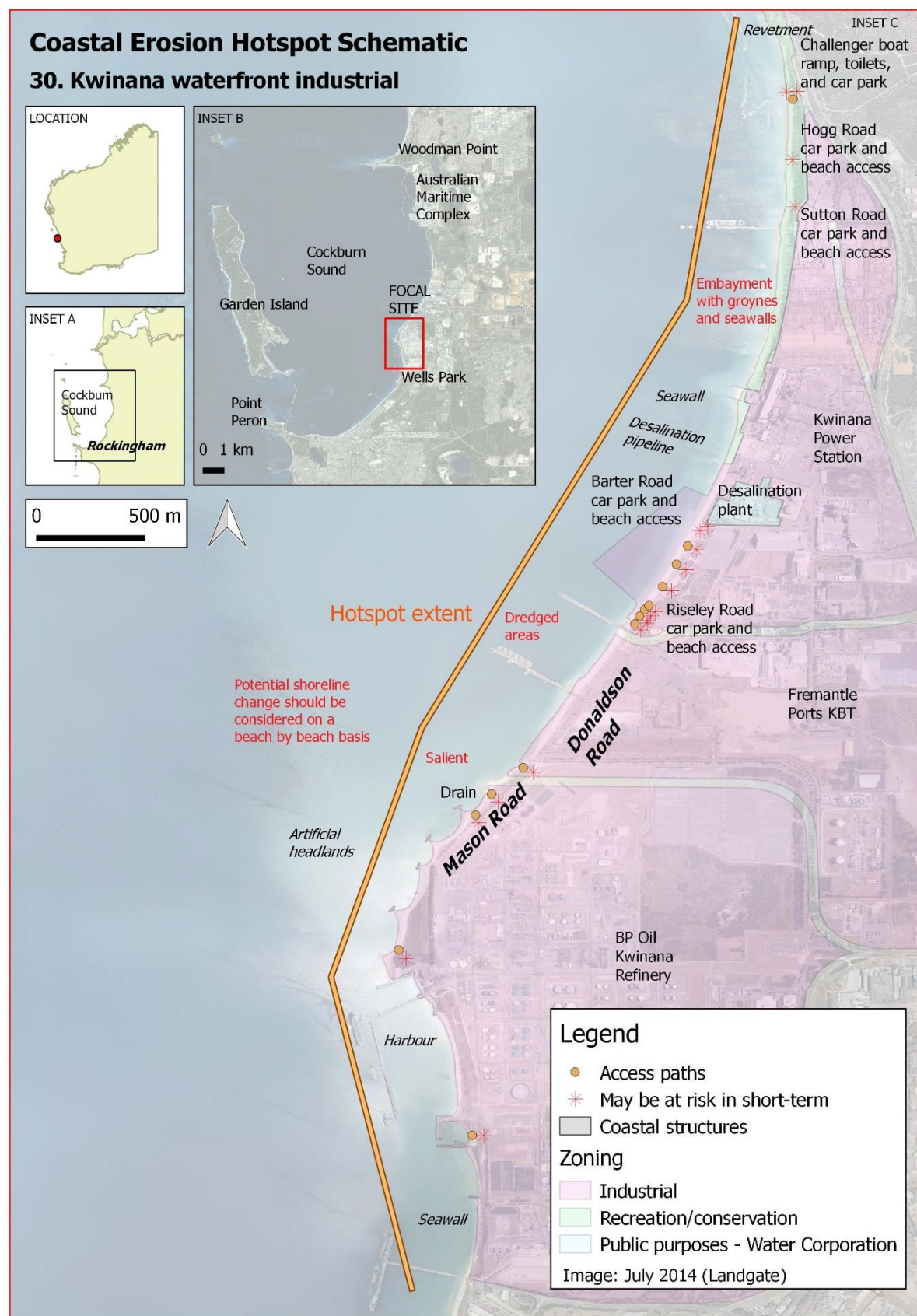


Figure D-30: Kwinana waterfront industrial schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-30: Kwinana waterfront industrial summary information

Hotspot No.	30
Hotspot Name	Kwinana waterfront industrial
Local Coastal Manager	City of Kwinana
Hotspot issue	<p>The coast between Wells Park and Challenger Boat ramp is mainly comprised of waterfront industrial leases fronted by a narrow foreshore reserve. It is one of the larger hotspot sites, maintained as a broader site as any review of the waterfront leases should be considered in conjunction with the other leases. The site encompasses a broad salient in the lee of Garden Island and a submerged rocky ridge which has been modified over the past 60 years by works along the shore and the disposal of dredged material. The shore has been divided into smaller beaches between groynes, breakwaters, seawalls, jetties and water intakes and discharge pipes. The coast is partially exposed to north-westerly and northerly storms, and erosion is often observed following these storms. Erosion is expected to be enhanced immediately adjacent to structures due to transfer of erosion stress. The public beach at Barter Road and the Challenger boat ramp are two focal areas of public use. Any exposure of contaminated material requires mitigation and management along with erosion.</p> <p>Fifteen publicly owned assets may be at risk of erosion damage in the area (see attached figure), seven of which may be at risk in the short term. This includes sand ramp access tracks (counted as one combined asset); four sandy vehicle access points to the beach at Riseley Road, Barter Road, Sutton Road and Hogg Road; Barter Road car park (sand); and the Challenger boat ramp. In the longer-term, an additional eight public assets may be at risk including the Riseley Road car park, 100m of Sutton Road, 600m of Mason Road, 600m of Donaldson Road, Hogg Road car park, the Challenger boat ramp car park, toilet block and the ramp itself. Land at the BP Oil Kwinana Refinery lease may be at risk in the short-term subject to maintenance of the series of rock breakwaters. In the longer term, land associated with the Fremantle Ports Kwinana Bulk Terminal and the Kwinana Power Station leases may be at risk without protection. Recreational use of the beaches includes boat launching, walking, swimming, fishing, and horse riding/exercise. Local recreational users and leaseholders are the main non-governmental stakeholders that are likely to have an active interest in how this foreshore is managed.</p>
Extent of erosion problem and hotspot characteristics	<p>Broader foreshore area with waterfront industrial leases from Challenger boat ramp in the north through to the northern extent of Wells Park in the south.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high. • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer).
CHRM status and findings	<p>CHRM Status: Complete</p> <p>Hazard Assessment: CZM (2013)</p> <p>Management & Adaptation Options: GHD (2016) - Study area Cockburn Sound. Recommended immediate and ongoing adaptation strategy (entire industrial area) is the staged implementation of a seawall</p> <p>Additional Comments: Nil</p> <p>Reports:</p> <p>GHD (2016) Coastal Adaptation Plan. Prepared by GHD for the Town of Kwinana. Rev0.</p> <p>CZM (2013) Coastal Vulnerability Study. Erosion and Inundation Hazard Assessment Report. Prepared by Coastal Zone Management Pty Ltd, the UWA School of Environmental Systems Engineering, Damara WA Pty Ltd and Oceanica Consulting Pty Ltd for the Cockburn Sound Coastal Alliance.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly renourishment source and ongoing coastal movement data collection
Assets susceptible to erosion hazard in imminent timeframe (0–5 years)	<p>8 public assets susceptible to erosion hazard. Informal access tracks, Riseley Road vehicle beach access, Barter Road car park, Barter Road beach access, Sutton Road beach access, Hogg Road beach access, Challenger Boat Ramp.</p> <p>Services: Drain</p>

	Leasehold: 1 leasehold industrial property, BP Oil Kwinana Refinery.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>11 public assets susceptible to erosion hazard. Informal access tracks, Riseley Road car park, Riseley Road vehicle beach access, Barter Road car park, Barter Road beach access, Sutton Road beach access, 110m of Sutton Road, Hogg Road beach access, car park at Challenger Boat Ramp, Challenger Boat Ramp</p> <p>Services: Drain</p> <p>Leasehold: 3 leasehold industrial properties, including BP Oil Kwinana Refinery, Fremantle Ports KBT, and Kwinana Power Station</p>
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>16 public assets susceptible to erosion hazard. Informal access tracks, 620m of Mason Road, 640m of Donaldson road, Riseley Road car park, Riseley Road vehicle beach access, Barter Road car park, Barter Road beach access, Sutton Road beach access, 110m of Sutton Road, Hogg Road car park, Hogg Road beach access, car park at Challenger Boat Ramp, Challenger Boat Ramp, toilet block, services along Mason Road and Donaldson road.</p> <p>Services: Drain</p> <p>Leasehold: 3 leasehold industrial properties, including BP Oil Kwinana Refinery, Fremantle Ports KBT, and Kwinana Power Station</p>
Existing management	<p>Avoid (Y - Foreshore reserve provides buffer to coastal movement in sections), Retreat (N), Accommodate (N), Protect (Y - Groynes, artificial headlands and seawalls (Sutton Rd through to Challenger Beach boat ramp and at power station))</p>
Management options for Imminent timeframe (0–5 years)	<p>Avoid (Y - Existing buffer likely to remain viable), Retreat (N), Accommodate (N), Protect (Y - Maintain existing structures)</p> <p>Strategic review of lease arrangements with regard to erosion mitigation</p> <p>Review lease agreements with 3 industrial leases to clarify responsibilities for coastal erosion mitigation</p>
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	<p>Avoid - None</p> <p>Protect - M</p> <p>Review Lease Agreement - 50k</p>
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	<p>Trigger for next level management: Infrastructure threatened by acute erosion</p> <p>Monitoring: Width of foreshore reserve</p> <p>Alternate option: N/A</p>
Management and adaptation options for Expected timeframe (5–25 years)	<p>Anticipated behaviour: Moderate coastal retreat is considered likely to affect the southern section first as it has smaller foreshore reserve. The efficiency of artificial headlands will reduce with moderate erosion.</p> <p>Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Maintain existing structures. Beach rotation between groynes, leading to installation of revetments where foreshore reserve is lost. Extension of artificial headlands. Note: renourishment may partly extend life of artificial headlands)</p> <p>Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.</p>
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	<p>Protect - H</p> <p>Prepare plans - 50k</p>
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	<p>Trigger for next level management: Artificial headlands losing effectiveness. Deepening in front of seawalls</p> <p>Monitoring: Shoreline profiles.</p> <p>Alternate option: N/A</p>



Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Progressive erosion due to sea level rise, including deepening in front of seawalls. Avoid (N), Retreat (Y - Relocation / removal of limited facilities which are not coastally dependent, including those presently within the foreshore reserve landward of the artificial headlands), Accommodate (N), Protect (Y - Strengthening and extension of existing seawalls. Replacement of artificial headlands with coastal revetment (located landward of the headlands).
Works to avoid to achieve long-term plans	Freeholding leasehold land

Appendix D.31. Kwinana Beach

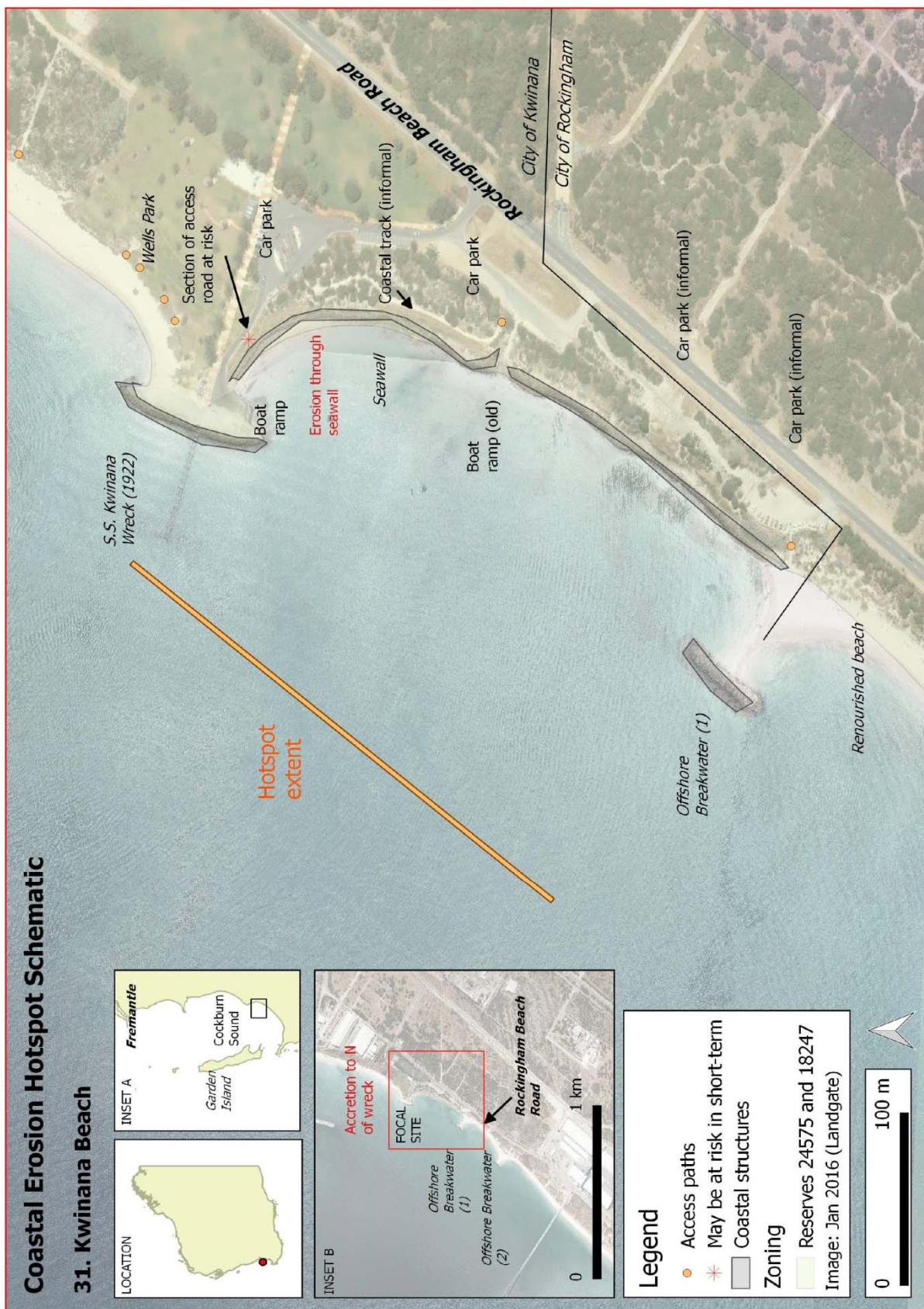


Figure D-31: Kwinana Beach schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-31: Kwinana Beach summary information

Hotspot No.	31
Hotspot Name	Kwinana Beach
Local Coastal Manager	City of Kwinana
Hotspot issue	<p>The broader Kwinana foreshore has changed over a long period due to the stabilisation of the SS Kwinana wreck (1922), which formed a tombolo and interrupted sediment transport pathways in the area. Recreational facilities were added to the accreting foreshore on the tombolo, which were then impacted by erosion south of the wreck. An ad hoc, and poorly constructed, seawall was constructed south of the wreck in the 1980s to protect the foredune from erosion.</p> <p>Eight publicly owned assets may be at risk of erosion damage in the area (see attached figure), one of which, a car park, is at risk of minor damage in the short-term. In the longer term, the boat ramp next to the wreck is a high-value asset at risk of damage, along with Rockingham Beach Road if the seawall is removed without other mitigation works. The boat ramp within the revetment was poorly built and has not been usable for years. A contaminated site exists landward of the existing road. The main recreational uses at the site are boat launching, walking and dog exercise.</p>
Extent of erosion problem and hotspot characteristics	<p>Between the wreck seawall and tombolo S of Wells Park. Focus on the old ad hoc seawall. Hotspot characteristics:</p> <ul style="list-style-type: none"> • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: Complete Hazard Assessment: CZM (2013) Management & Adaptation Options: GHD (2016) - Study area Cockburn Sound. Recommended long-term (2030 to 2110) adaptation strategy (Wells Park) managed retreat. Additional Comments: Nil Reports: GHD (2016) Coastal Adaptation Plan. Prepared by GHD for the Town of Kwinana. Rev0, 01-Nov-2016 CZM (2013) Coastal Vulnerability Study. Erosion and Inundation Hazard Assessment Report. Prepared by Coastal Zone Management Pty Ltd, the UWA School of Environmental Systems Engineering, Damara WA Pty Ltd and Oceanica Consulting Pty Ltd for the Cockburn Sound Coastal Alliance.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	None recommended
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	1 public asset susceptible to erosion hazard with minor damage. *1 car park (access to boat ramp 6.3m landward of erosion behind failed wall).
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	4 public assets susceptible to erosion hazard. 2 boat ramps, *1 car park access to boat ramp 6.3m behind failed wall longer area, *1 coastal track. Contaminated site landward of old road
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	6 public assets susceptible to erosion hazard. *Rockingham Beach Road, 2 boat ramps, 2 car parks, coastal tracks. Contaminated site landward of old road
Existing management	<p>Continuation of the existing strategy will require rebuilding of the revetment and renourishment for the breakwaters.</p> <p>Avoid (N), Retreat (N), Accommodate (N), Protect (Y - limestone revetment, breakwaters, Renourishment of the breakwaters to the S)</p>

Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: There is a comparatively low cost for rebuilding of the existing revetment. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - The existing revetment requires rebuilding to improve stability. Renourishment of the breakwaters to the S.) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - M Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Renourishment ineffective due to beach retreat Monitoring: Renourishment volumes & storage volume from breakwater to the Kwinana wreck (aerial survey) Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: The cost to rebuild the revetment will increase due to deepening. The breakwaters and revetment will become less effective. Avoid (N), Retreat (Y - Reduced effectiveness of the offshore groynes will require removal of southern carparks), Accommodate (N), Protect (Y - Part of the revetment is likely to remain, requiring strengthening. Renourishment of the breakwaters to the S [increasing].) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - L Protect - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Breakwaters and revetment no longer effective. Monitoring: Beach widths (shoreline position) from revetment to 300m south of breakwaters Alternate option: extend one more breakwater between wreck and first breakwater
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Under a scenario of general retreat of Kwinana Beach due to sea level rise, the breakwaters and revetment will become ineffective. Retreat of Rockingham Beach Road is required. Avoid (N), Retreat (Y - Retreat of Rockingham Beach Road is required), Accommodate (N), Protect (N - Part of the revetment is likely to remain, requiring strengthening)
Works to avoid to achieve long-term plans	Revetment between breakwaters further S, as this reduces the area exposed to downdrift erosion and therefore will increase the distance of retreat.

Appendix D.32. Rockingham Townsite to Causeway

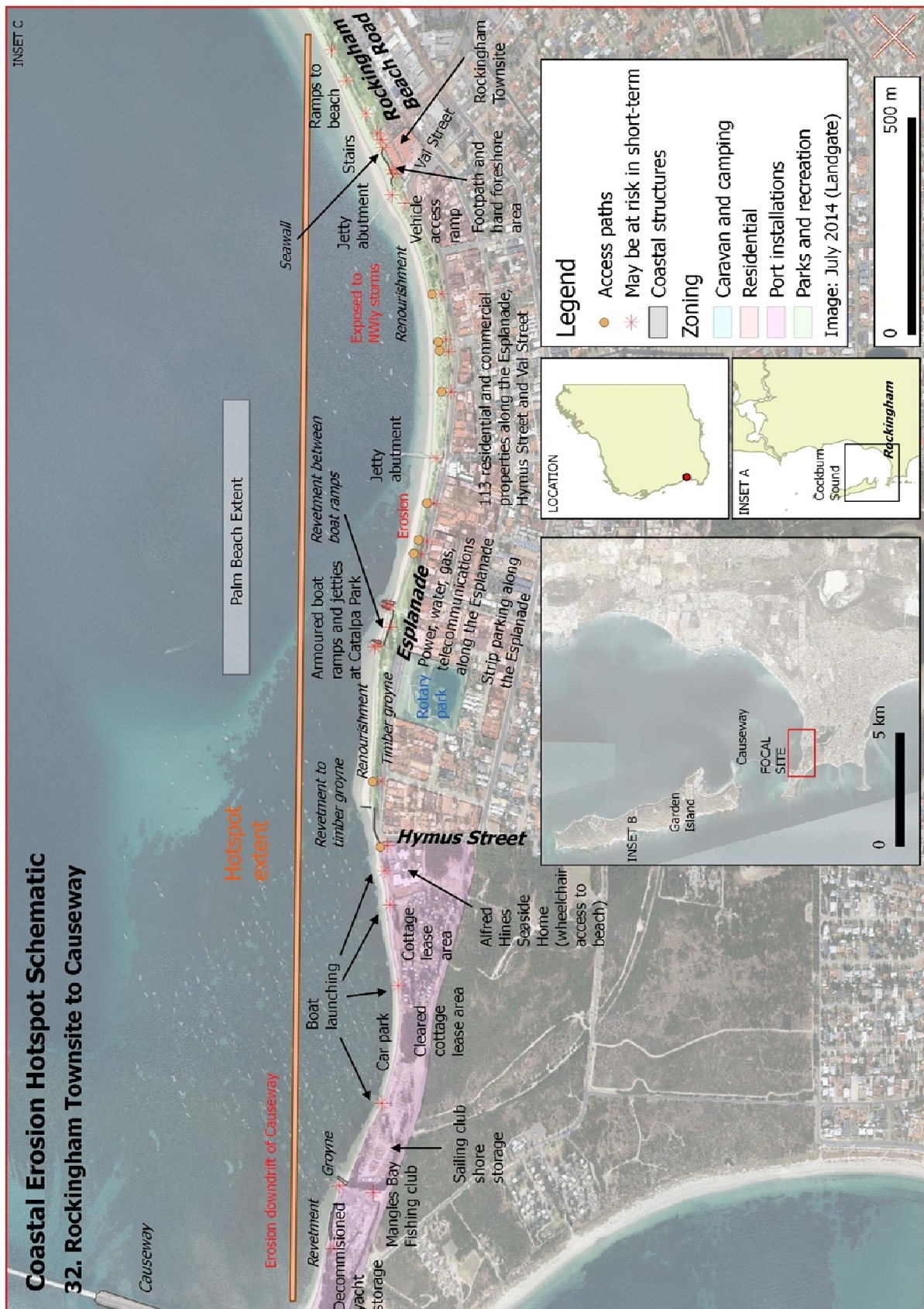


Figure D-32: Rockingham Townsite to Causeway schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-32: Rockingham Townsite to Causeway summary information

Hotspot No.	32
Hotspot Name	Rockingham Townsite to Causeway
Local Coastal Manager	City of Rockingham
Hotspot issue	<p>The hotspot includes the north facing shores of Cockburn Sound from the Garden Island Causeway to the Esplanade Park at Rockingham Beach. The developments associated with the original jetty and railway (pre-1950's) removed the foredune and built a scarp which was susceptible to erosion during storms. The installation of the Causeway in the 1970's caused retreat of the foreshore to the east. Development along the coast has continued to encroach with time and there is limited space for the natural fluctuations in foreshore position over time on this sheltered foreshore. The broad foreshore is susceptible to episodic erosion associated with storms (such as May 2003). Retreat is anticipated in areas not protected by structures, with enhanced rates of erosion immediately adjacent to the structures.</p> <p>A mix of foreshore uses include recreational and commercial, with 50 publicly owned assets that may be at risk of erosion damage in the area (see attached figure). Twenty three of these may be at risk in the short term; sand boat ramps and small jetty abutments, sand boat launching sites, sand access tracks, three sand boat launching areas (ex. boat ramps from holiday parks and yacht clubs), three boat ramps and two jetty abutments at Catalpa Park, Catalpa Park, a concrete platform at Fisher Street jetty, Val Street jetty abutment, a vehicle access ramp, a footpath, a landscaped/paved foreshore area, two staircases, a universal access ramp, and three ramps to the beach. Some access paths are associated with erosion mitigation structures; with risk dependent upon the integrity of these structures. In the longer-term, a further 27 assets may be at risk of erosion including 1.6 km of the Esplanade, 40m of Hymus Street, 290m of Rockingham Beach Road, services along the Esplanade and Hymus Street (power, water, gas, NBN), a concrete boat ramp, the Rotary Park, Catalpa park (including gazebos, a playground, lighting, a toilet block, and BBQs), a dual use path, Catalpa Park car park, strip parking along the Esplanade, a garden feature, a staircase to a sandy access track, the Railway Terrace car park, strip parking along Rockingham Beach Road, Churchill park (including gazebos, BBQs, picnic tables, and three playgrounds) a viewing platform, and Flinders Lane car park. The leasehold Mangles Bay Fishing Club that may be at risk in the short term, dependent on the integrity of any protective structures. In the long term, approximately 113 private properties may be at risk, including a café (Sunsets), residential and commercial areas along the Esplanade.. The coast related recreational uses in this area include boat launching, boating/yachting, fishing, swimming, kite surfing, walking and picnicking.</p>
Extent of erosion problem and hotspot characteristics	<p>Southern Cockburn Sound foreshore between the Causeway and east of Rockingham Town Beach.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).

CHRMAP status and findings	<p>CHRMAP Status: Complete</p> <p>Hazard Assessment: CZM (2013)</p> <p>Management & Adaptation Options: GHD (2016) - Study area Cockburn Sound - Recommended adaptation strategy:</p> <p>Northeast of Palm Beach - Immediate (up to 2030) reactive beach nourishment long term (2030 to 2110) investigate offshore breakwaters.</p> <p>Palm Beach - Immediate (up to 2030) reactive beach nourishment and installation of additional groynes</p> <p>West of Palm Beach - Immediate (up to 2030) reactive beach nourishment and long-term (2030 to 2110) investigate additional groynes.</p> <p>Additional Comments: West of Palm Beach - Mangles Bay interim protection with long-term retreat decision pending.</p> <p>Reports:</p> <p>GHD (2016) North Rockingham Coastal Adaptation Plan. Prepared by GHD for the City of Rockingham. Rev0, 01-Nov-2016</p> <p>CZM (2013) Coastal Vulnerability Study. Erosion and Inundation Hazard Assessment Report. Prepared by Coastal Zone Management Pty Ltd, the UWA School of Environmental Systems Engineering, Damara WA Pty Ltd and Oceanica Consulting Pty Ltd for the Cockburn Sound Coastal Alliance.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	23 public assets susceptible to erosion hazard. boat ramps and jetties (leasehold), informal boat launching, informal access tracks (length of hotspot), informal boat launching (ex. boat ramps from holiday parks and yacht, boat ramp x3, jetty x2 (Catalpa Park), Catalpa Park, concrete platform at Fisher Street jetty, connection to Val Street jetty, vehicle access ramp, footpath, landscaped/paved foreshore area, two sets of stairs, universal access ramp, 3 ramps to beach.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>30 public assets susceptible to erosion hazard. boat ramps and jetties (leasehold), informal boat launching, informal access tracks (length of hotspot), informal boat launching (ex. boat ramps from holiday parks and yacht clubs), concrete boat ramp, Catalpa Park car park, fixed dual use path along foreshore, 170m of the Esplanade, boat ramp x3, jetty x2 (Catalpa Park), Catalpa Park, concrete platform at Fisher Street jetty, strip parking, connection to Val Street jetty, garden feature in foreshore, stairs to non-fixed access track, vehicle access ramp, footpath, landscaped/paved foreshore area, two sets of stairs, universal access ramp, 3 ramps to beach.</p> <p>Services:</p> <p>Private Property: 8 private properties, including residential and commercial areas.</p> <p>Leasehold: Mangles Bay Fishing Club</p>
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>50 public assets susceptible to erosion hazard. boat ramps and jetties (leasehold), informal boat launching, informal access tracks (length of hotspot), informal boat launching (ex. boat ramps from holiday parks and yacht clubs), concrete boat ramp, 40m of Hymus Street and 1600m of the Esplanade (non 7.1, 7.2 and 7.6 asset SPP2.6), strip parking along Esplanade, Catalpa Park car park, Rotary Park, fixed dual use path along foreshore, boat ramp x3, jetty x2 (Catalpa Park), Catalpa Park (gazebos, playground, lighting, toilet block, BBQs), concrete platform at Fisher Street jetty, strip parking, connection to Val Street jetty, garden feature in foreshore, stairs to non-fixed access track, vehicle access ramp, footpath, landscaped/paved foreshore area, two stairs, universal access ramp, Railway Terrace car park, strip parking along Rockingham Beach Road, 290m of Rockingham Beach Road, Churchill Park, gazebos, BBQs, picnic tables, 3 playgrounds, viewing platform, Flinders lane carpark, 3 ramps to beach, leasehold café.</p> <p>Services:</p> <p>Private Property: 113 private properties, including residential and commercial areas.</p> <p>Leasehold: Mangles Bay Fishing Club, cafe</p>
Existing management	<p>Avoid (N),</p> <p>Retreat (Y - some leasehold shacks have been removed),</p> <p>Accommodate (N),</p> <p>Protect (Y - Partial management using rock groynes, timber groynes, walling and sections of 'back-up' GSC revetment, Rock revetment built to protect path where updrift (nearfield) erosion occurred. Renourishment in parts)</p>

Management options for Imminent timeframe (0–5 years)	Avoid (N), Retreat (N), Accommodate (Y - Continued use of sand extraction from Point Peron boat ramp), Protect (Y - continued use of minor renourishment. Maintain existing structures) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. Review lease agreements with Mangles Bay Fishing Club and cafe to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L Protect - L Prepare Plans - 50k Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Boat ramps or 'back-up' revetments causing localised erosion Monitoring: Photographic Monitoring Alternate option: Protect - short groynes (timber or sandbag) to control sediment distribution.
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Minor erosion of Mangles Bay and Palm Beach areas likely to continue, which may be partly balanced through renourishment using sand from Cape Peron boat launching facility Avoid (N), Retreat (Y - Relocate recreational assets subject to damaging recession (i.e. don't armour), Accommodate (Y - Continued use of sand extraction), Protect (Y - continued use of minor renourishment) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Accommodate - L Protect - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Renourishment from Cape Peron boat launching facility inadequate to balance erosion Monitoring: Shoreline monitoring. Sea level monitoring (and consider drainage function) Alternate option: Proposed facilities of Rockingham Marina or Mangles Bay Marina are likely to substantially change coastal management for the coast east of Garden Island Causeway. Protect if marine facility is constructed.
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: In the medium and long-term, incoming sand feed is likely to decline. Progressive erosion in response to sea level rise is expected, with gradual loss from the Mangles Bay and Palm Beach areas through alongshore transport Avoid (N), Retreat (Y - Remove temporary facilities (yacht club)), Accommodate (N), Protect (Y - Sand management through short groyne structures and increased use of sand renourishment)
Works to avoid to achieve long-term plans	Avoid permanent development seaward of current development (e.g. in greenfield foreshore reserve) – undertake temporary/relocatable development as per SPP2.6 instead.

Appendix D.33. N Point Peron (W of Causeway)

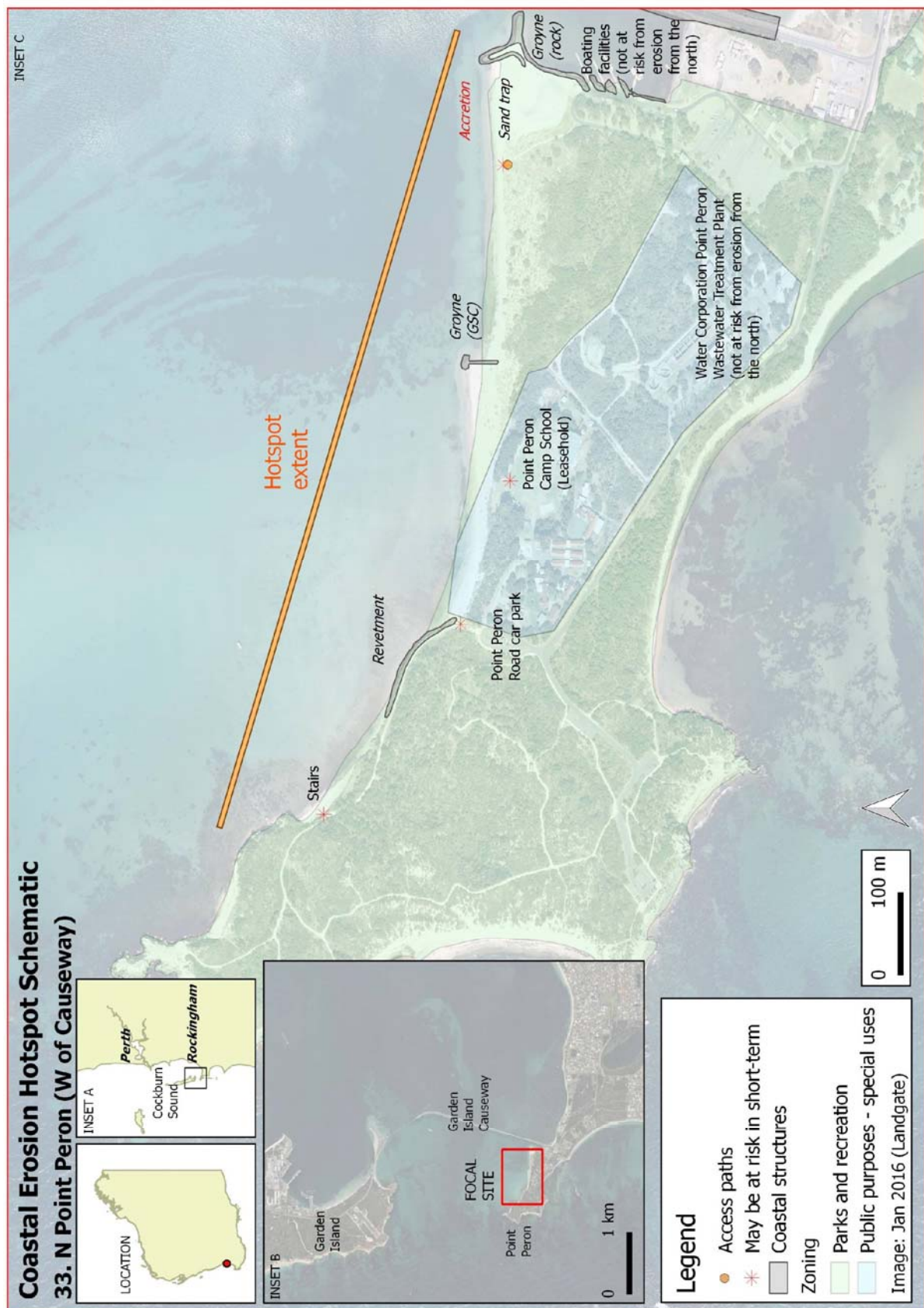


Figure D-33: N Point Peron (W of Causeway) schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-33: N Point Peron (W of Causeway) summary information

Hotspot No.	33
Hotspot Name	N Point Peron (W of Causeway)
Local Coastal Manager	City of Rockingham and DBCA
Hotspot issue	<p>The northern side of Point Peron has been disturbed through the installation of Garden Island Causeway and subsequent groynes and sand extraction. Accretion has occurred on the western side of the Causeway, with ongoing sand extraction from the sand trap west of the boat launching facility. Rock groynes have been installed in the west to reduce sedimentation of the boat launching facility and a rock revetment has been installed to protect the path where updrift erosion has occurred. A geosynthetic groyne was installed in 2013 following removal of a failed limestone seawall near the Point Peron Camp School. This groyne was built to maintain a beach along the western edge of the Camp School, providing increased functionality and amenity for the camp school, as well as an increased erosion buffer to this asset. The accretion at the sand trap provides a source of renourishment material for other beaches in the broader area.</p> <p>There are four publicly owned assets that may be at risk of erosion damage (see attached figure), with three in the short-term. These assets include stairs, a dual use path and a sand path around the sand trap. In the longer term, the Point Peron Road car park also may be at risk. The Point Peron Camp School site is a leasehold site with land that may be at risk of erosion in the short-term. No buildings in the leasehold are anticipated to be at risk of erosion. The main recreational foreshore uses are boat launching, walking, cycling, snorkelling, diving, swimming, paddling and fishing.</p>
Extent of erosion problem and hotspot characteristics	<p>From 200m W of Point Peron Camp School car park to the sand trap groyne.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	<p>CHRMAP Status: Complete</p> <p>Hazard Assessment: CZM (2013)</p> <p>Management & Adaptation Options: GHD (2016) - Study area Cockburn Sound. Recommended long-term (2030 to 2110) adaptation strategy (Causeway to Point Peron) to investigate upgrade of existing groynes.</p> <p>Additional Comments: Nil</p> <p>Reports:</p> <p>GHD (2016) North Rockingham Coastal Adaptation Plan. Prepared by GHD for the City of Rockingham. Rev0, 01-Nov-2016</p> <p>CZM (2013) Coastal Vulnerability Study. Erosion and Inundation Hazard Assessment Report. Prepared by Coastal Zone Management Pty Ltd, the UWA School of Environmental Systems Engineering, Damara WA Pty Ltd and Oceanica Consulting Pty Ltd for the Cockburn Sound Coastal Alliance.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Records of sand extraction and where the material is used for renourishment, ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>3 public assets susceptible to erosion hazard. Stairs access, fixed dual use path, non-rigid track around sand trap.</p> <p>Leasehold: Point Peron Camp School site (not buildings)</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>3 public assets susceptible to erosion hazard. Stairs access, fixed dual use path, non-rigid track around sand trap.</p> <p>Leasehold: Point Peron Camp School site (not buildings)</p>
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>4 public assets susceptible to erosion hazard. Stairs access, fixed dual use path, Point Peron Road carpark (school site), non-rigid track around sand trap.</p> <p>Leasehold: Point Peron Camp School site (not buildings)</p>

Existing management	Avoid (N), Retreat (N), Accommodate (Y - Sand extraction), Protect (Y - Rock revetment built to protect path where updrift (nearfield) erosion occurred. New GSC groyne)
Management options for Imminent timeframe (0–5 years)	Anticipated behaviour: Storm erosion threat is to access and amenity assets only. Avoid (N), Retreat (N), Accommodate (Y - Continued use of sand extraction), Protect (Y - extend revetment to provide longer duration for path use. Backpassing/nourishment between revetment and groyne to maintain useable beach.) Note it is recommended to develop a strategic allocation of the sand at the sand trap to ensure it is available for projects where required, rather than opportunistic use. Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. This includes path relocation to landward considering topographic constraints. Review lease agreements with camp school to clarify responsibilities for coastal erosion mitigation and consider revising lease area boundaries.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L Protect - L Prepare Plans - 50k Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Damage to existing defences; Constraint to access Monitoring: Photographic Monitoring; structural assessment (2-3 years) Alternate option: If path is relocated, revetment does not require extension.
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Moderate erosion pressure will seasonally constrain beach access for existing configuration Avoid (N), Retreat (Y - Relocate path subject to damaging recession i.e. don't armour), Accommodate (Y - Continued use of sand extraction), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - L Accommodate - L Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Protected path no longer useable due to overtopping Monitoring: Shoreline monitoring; Structural assessment (annual) Alternate option: Protect - extend GSC groyne
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Sustained erosion pressure will prevent access through existing pathways Avoid (N), Retreat (Y - relocate access paths), Accommodate (Y - Dune management), Protect (N)
Works to avoid to achieve long-term plans	Further extension of the Sand trap groynes. Additional buildings constructed in the erosion hazard area at the camp school Avoid further construction of revetments, so a useable beach can be maintained.

Appendix D.34. Point Peron (N Shoalwater Bay)

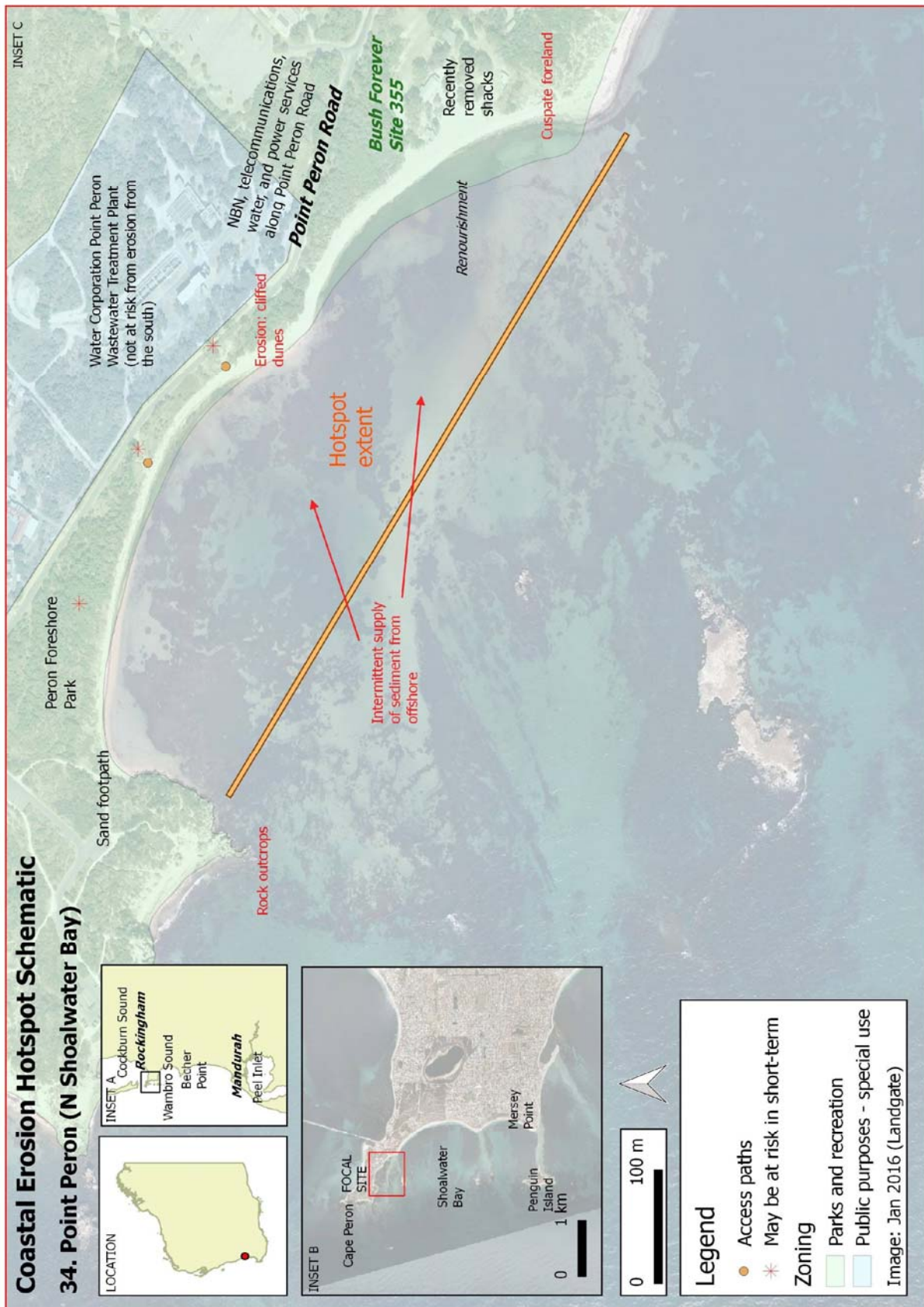


Figure D-34: Point Peron (N Shoalwater Bay) schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-34: Point Peron (N Shoalwater Bay) summary information

Hotspot No.	34
Hotspot Name	Point Peron (N Shoalwater Bay)
Local Coastal Manager	City of Rockingham and DBCA
Hotspot issue	<p>North Shoalwater Bay is the southern flank of the Point Peron tombolo and is inside the reef chain connecting the point with Penguin Island to the south. The land is managed by the Department of Biodiversity, Conservation and Attractions (DBCA). The area has been experiencing high rates of historic erosion with salient migration. The south-west facing beaches of the bay are narrow and backed by scarped dunes. Point Peron Road and leasehold recreational camps have been built close to the shore, with a major waste water outfall built across the nearshore seabed. Existing management at the site has involved renourishment in front of Point Peron Road and removal of shacks. The Water Corporation are a stakeholder at the site because of the Point Peron Wastewater Treatment Plant.</p> <p>Ten publicly owned assets may be at risk of erosion damage in the area (see attached figure), with two possibly at risk in the short-term; two sand access tracks (counted as one combined asset) and the Peron Foreshore Park. In the medium- to longer-term, eight additional assets may be at risk include 300m of Point Peron Road and associated services (NBN, telecommunications, water and three different power services) and 40m of dirt track near Point Peron dive site carpark. The Bush Forever Area 355 may start to be impacted in the short-term. The area has high recreational value, with activities including boating, fishing, swimming, scuba diving, snorkelling and walking.</p>
Extent of erosion problem and hotspot characteristics	<p>Northern Shoalwater Bay along Point Peron Road between a cusped foreland and rock outcrops.</p> <p>Hotspot characteristics:</p> <ul style="list-style-type: none"> • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability).
CHRMAP status and findings	<p>CHRMAP Status: Not Scheduled</p> <p>Hazard Assessment: Regional hazard assessment contained within Damara (2012)</p> <p>Management & Adaptation Options: Nil</p> <p>Additional Comments: The City has recently undertaking sand nourishment at this site on behalf of DBCA</p> <p>Reports:</p> <p>Damara (2012) Coastal Hazard Mapping for Economic Analysis of Climate Change Adaptation in the Peron-Naturaliste Region. Prepared by Damara WA Pty Ltd for Peron-Naturalist Partnership. Report 169-01, Rev. 0, Oct-2012.</p>
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Geotechnical, renourishment source, sandbar dynamics (complex bathymetry) and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	<p>2 public assets susceptible to erosion hazard. 2 sand access tracks, Peron Foreshore Park.</p> <p>Note: Bush Forever Site 355.</p>
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	<p>9 public assets susceptible to erosion hazard. 100m of Point Peron Road, Peron Foreshore Park, 2 sand access tracks.</p> <p>Services: in-service NBN cable along Point Peron Road, fibre optic telecommunications cables along Point Peron Road, 159RC water main along Point Peron Road, LV buried cable along Point Peron Road, LV overhead cable to W of Point Peron Rd, HV overhead cable to E or Point Peron Rd.</p> <p>Note: Bush Forever Site 355.</p>
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	<p>10 public assets susceptible to erosion hazard. 40m of dirt track near dive site carpark, 310m of Point Peron Road, Peron Foreshore Park, 2 sand access tracks.</p> <p>Services: in-service NBN cable along Point Peron Road, fibre optic telecommunications cables along Point Peron Road, 159RC water main along Point Peron Road, LV buried cable along Point Peron Road, LV overhead cable to W of Point Peron Rd, HV overhead cable to E or Point Peron Rd.</p> <p>Note: Bush Forever Site 355.</p>

Existing management	Avoid (N), Retreat (Y - shacks most at risk have been removed in 2016), Accommodate (N), Protect (Y - renourishment across Point Peron Road and shack areas)
Management options for Imminent timeframe (0–5 years)	Part of the existing storm erosion hazard has been managed through removal of shacks Avoid (N), Retreat (Y - shacks already removed), Accommodate (N), Protect (Y - renourishment as mitigation for the road (assume external source))
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - M
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Erosion providing stress to road (sand drift). Likely to occur for buffer width <15m. Monitoring: Visual inspection following severe storm events. Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	Anticipated behaviour: Moderate erosion pressure will put pressure on the narrow strip of land between the road and the coast. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - renourishment as mitigation for the road with locally sourced sediment) Prepare plans to implement retreat for next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Protect - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	Trigger for next level management: Buffer width <10m. Monitoring: Buffer width measurement Alternate option: protect road with hard structure, but not recommended due to sediment supply variability
Management and adaptation options for Projected timeframe (25+ years).	Anticipated behaviour: Sustained erosion pressure will put local pressure on the roadway. Avoid (N), Retreat (Y - purchase lease to trim corner of the road and shorten exposure of the road), Accommodate (N), Protect (Y - rock revetment for the modified road corner (subsequent to retreat))
Works to avoid to achieve long-term plans	Protect road with hard structure due to the variability in sediment supply and beach position.