

R808 Rev 2

September 2016

City of Wanneroo

**Two Rocks Beach Access Stairs
Inspection Report**

marinas

boat harbours

canals

breakwaters

jetties

seawalls

dredging

reclamation

climate change

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currents

tides

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1. Introduction

Storm events between May and June 2016 have resulted in significant erosion to the beach and dune profile at the beach access stairs near Sceptre Ct, Two Rocks. The location of the beach access stairs is shown in Figure 1.1.

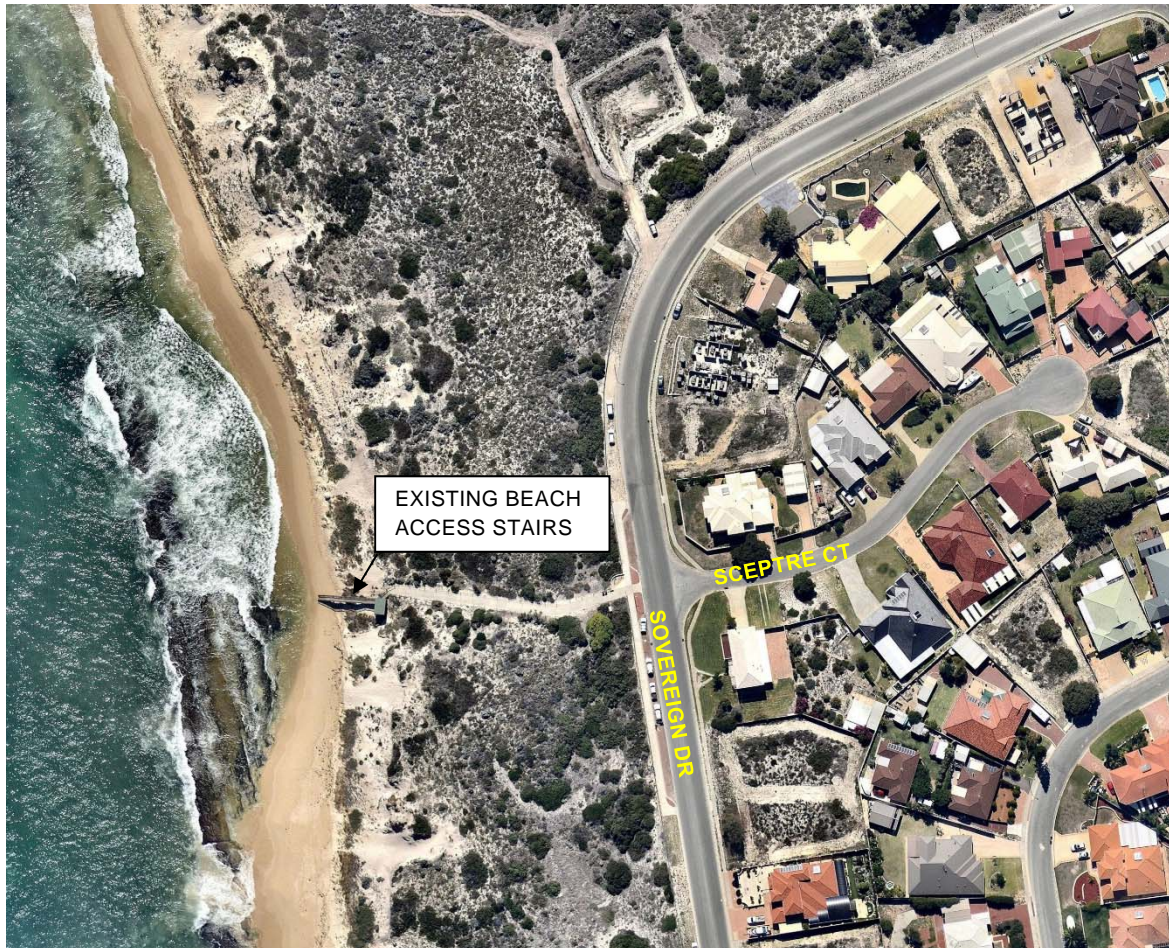


Figure 1.1 Beach Access Stairs Location (Nearmap April 2016)

The City of Wanneroo (City) engaged M P Rogers & Associates Pty Ltd (MRA) to complete an independent condition assessment on the safety and stability of the stairs and to provide recommendations on remedial works. The scope of the assessment includes the following.

- Complete site inspection, including condition and safety assessment of the stairs and comments on coastal stability of the area.
- Consider options for repair, replacement or relocation of stairs.
- Provide recommendations on short and long term solutions.

The assessment considered the overall stability of the structure rather than detailed assessment of individual elements. This report presents a summary of the outcomes and recommendations of the condition assessment.

1.1 Background

The beach access stairs were constructed in 2002, with a design life of 15 years. The City has confirmed that no large scale maintenance work has been undertaken on the stairs to date. This suggests that they are nearing the end of their design life and should be considered for replacement or upgrade shortly.

The shoreline north of the marina at Two Rocks has been eroding since the construction of the marina in the early 1970's. MRA has previously completed investigations into this erosion and evaluated potential coastal management options for the area (MRA 2007, 2015). MRA (2015) noted that the Sceptre Court beach access stairs were located on the eroding face of the dune and that they were vulnerable to severe storm erosion and further shoreline recession through coastal processes. This study also provided allowances to account for ongoing shoreline recession and storm erosion in this area.

2. Condition Assessment

A visual inspection of the beach access stairs and site was completed by Principal Coastal Engineer, Trent Hunt and Experienced Coastal Engineer Johnson Chen on 11 August 2016. This inspection assessed the overall structural stability and extent of erosion after the recent storm events.

The outcomes of this inspection are summarised in the following sections.

2.1 Structural Stability

From the site inspection, MRA note the following on the structural stability of the stairs after the recent storm erosion and damage.

- The foundation of the concrete path leading to the beach access stairs has been undermined as a result of the dune erosion (refer Figure 2.1). The end section of this path is currently partially supported and therefore there is a risk of collapse if repair or removal works are not undertaken immediately.
- The pile foundations of the stairs have been exposed, and the design pile embedment has been reduced (refer Figure 2.1). Therefore the structure has a high risk of collapse if it is not repaired or removed immediately.
- Two piles under the platform have experienced significant deflection (refer Figure 2.2), likely due to reduced pile embedment as a result of the beach and dune erosion. It is expected that further pile deflection is likely to result in collapse of the stairs. Immediate repair or removal will be required.
- A number of connections from the platform to the steel piles have experienced damage as a result of the pile deflection (refer Figure 2.2). Immediate repair or removal will be required to prevent further damage.



Figure 2.1 Undermined Concrete Footpath & Pile Foundations



Figure 2.2 Pile Deflection & Damage to Pile Connections

It is considered that the stairs are currently a hazard to public safety and should be removed or repaired immediately. Further storm damage may result in collapse of parts of the structure. While repair of the stairs is an option, due to the age of the structure, cost and functionality issues, it is not recommended. Should the stairs be repaired in their current location, they would be unlikely to be functional due to ongoing erosion and shoreline recession.

2.2 Coastal Erosion

The erosion that has occurred at the beach access stairs was a result of ongoing erosion and specific storm events that occurred between May and June 2016. These storm events have the potential to cause increased erosion to a shoreline, through the combination of higher, steeper waves generated by sustained strong winds, and increased water levels. These two factors acting in concert allow waves to erode the upper parts of the beach not normally vulnerable to wave attack.

It is anticipated that the current location of the stairs is vulnerable to ongoing coastal erosion, as is evident in the following photographs showing the change in beach profile between 2004 and 2016 at the site.



Figure 2.3 Photograph of Stairs in July 2004 (Left) & June 2016 (Right)

It is expected that this erosion trend will continue to an extent into the future.

The extent of storm erosion between May and June 2016 was estimated using survey profiles provided by the City. The location of these survey profiles are presented in Figure 2.4. The survey profiles before and after the storm events are presented in Figure 2.5 and 2.6 respectively.

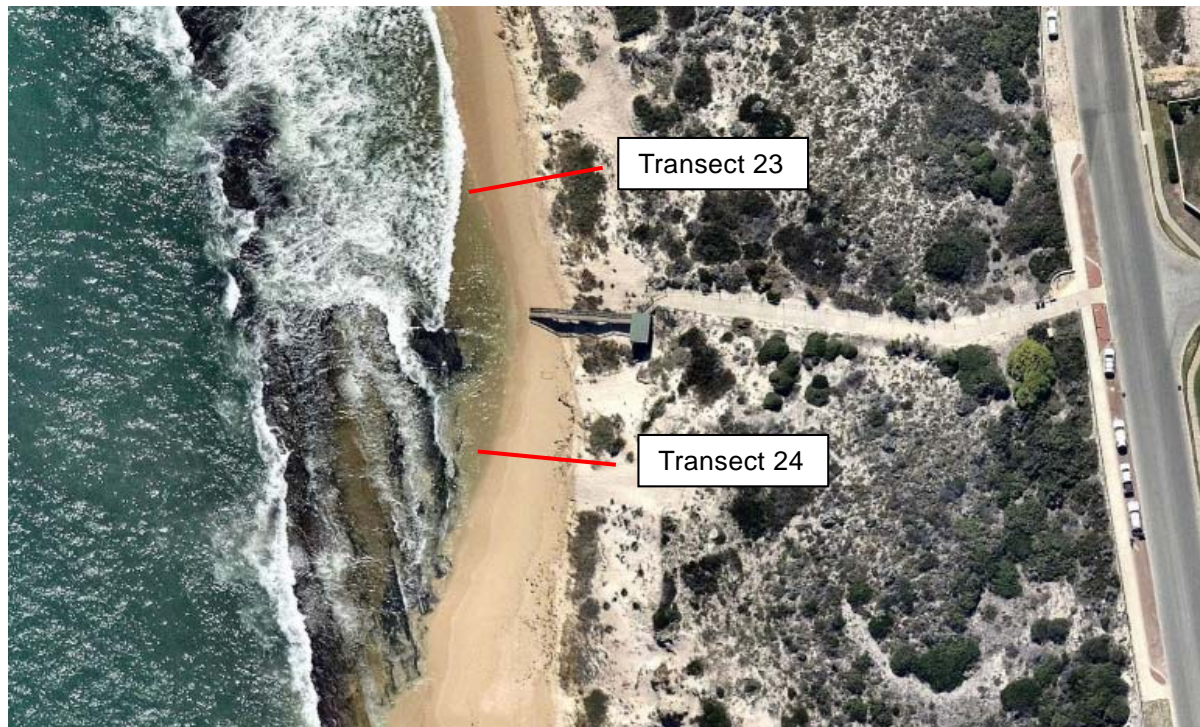


Figure 2.4 Location of Survey Profiles Provided by the City

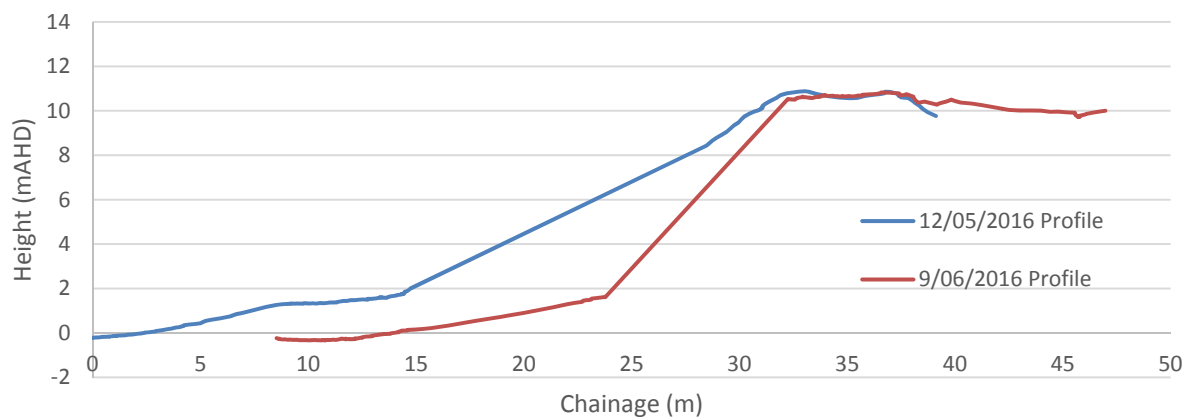


Figure 2.5 Beach Profile at Transect 23

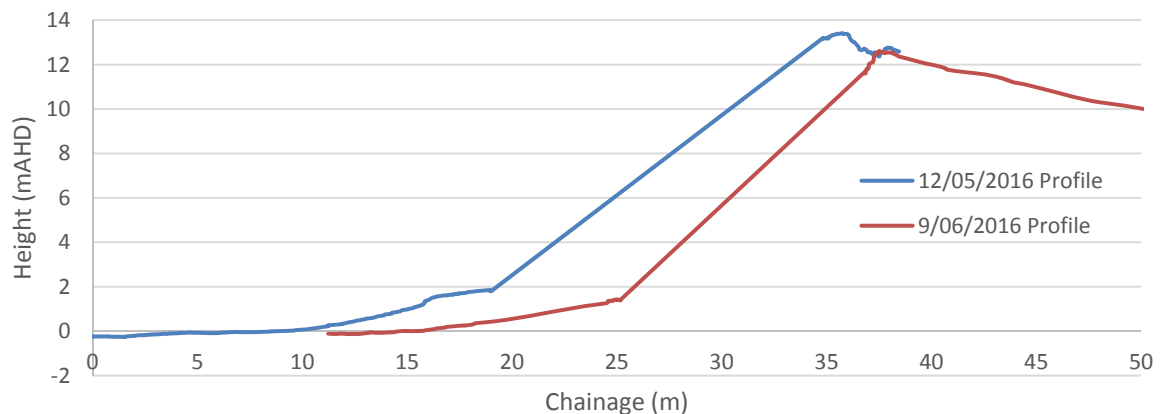


Figure 2.6 Beach Profile at Transect 24

From the survey data, it is evident that the storms generally resulted in a beach/dune recession in the order of 5 m. It is anticipated that similar erosion may occur in the future should similar storm conditions be experienced. In addition, the ongoing trend in shoreline erosion experienced over a number of years at the site is likely to continue into the future.

MRA (2015) assessed appropriate shoreline allowances to account for storm erosion, shoreline movement trends and sea level rise at different timeframes into the future. These allowances can be used to determine the vulnerability of the stairs into the future if they were to be replaced or re-located. In the coming 15 years (design life of the existing stairs) the following allowances were recommended:

- Severe storm erosion – 20 m.
- Shoreline movement trends – 0.7 m/yr = 10.5 m.
- Recession due to sea level rise – 3 m.

This suggests that any access stairs located within approximately 35 m of the current shoreline position may be vulnerable to coastal processes in the coming 15 years.

It is noted that to locate replacement access structures behind the current dune profile would require a significant level of earthworks and vegetation clearing. The City would need to consider this in detailed design of any replacement structures. However, this would ensure that the access is functional and useable over the design life of the structure.

3. Safety

Based on the outcome of the condition assessment on the beach access stairs, the following aspects on public safety are noted.

- The foundation of the concrete path leading to the beach access stairs has been undermined and is only partially supported. This section of concrete path should be repaired or removed immediately to eliminate risk to the public.
- The structural elements of the stairs are at the end of their design life. It is envisaged that further deterioration of these structural elements will result in inadequate structural capacity.
- The pile foundations of the stairs have been undermined and the piles showed sign of instability. The stairs in their current state have a high risk of failure and pose a significant risk to the public.
- Prior to the works at the stairs, access to and around the stairs should be restricted and short term beach access be provided at an alternative location.

It is noted that the City has erected signage and fencing at the top of the concrete path leading to the stairs, and barrier fencing around the structure. This should be maintained to protect public safety.

4. Remedial Options

The relevant short and long term options for the remedial works to the stairs are summarised in the following section.

4.1 Short Term Option

The existing stairs are unsafe to the public in their current condition and access to this area should be restricted.

To provide alternative short-term beach access, it is recommended the informal access track north of the existing stairs is upgraded for temporary access. The upgrade should include minor earthworks to improve the grade of access and provision of wind break fence to formalise the track. This location is believed to be appropriate as minimum earthworks are required to provide a suitable grade for beach access. The location and photograph of the proposed temporary beach access is shown in Figures 4.1 and 4.2 respectively.



Figure 4.1 Location of Proposed Temporary Beach Access



Figure 4.2 Proposed Temporary Access through Sand Blowout

Due to the existing grades in this area, minimal clearing and earthworks would be required. In addition, any further erosion in this area is likely to have less impact on access in this location due to the current low lying elevation of the dunes.

Alternative access immediate north of the Two Rocks Marina was considered and investigated during the site inspection. This location is considered unfeasible for short term access due to existing steep grades of dune, which would require significant level of clearing and large scale earthworks to provide an appropriate grade for access. The shoreline at this location is also likely to experience instability due to storm erosion.



Figure 4.3 Informal Access Immediately North of Two Rocks Marina

All other locations along this section of shoreline would require significant earthworks and vegetation clearing and are not appropriate in the short term.

4.2 Long Term Options

4.2.1 Repair Option

This option would carry out the necessary repair works on the stairs to maintain the functionality of the structure until a replacement or other long term option can be implemented. The repair works would consist of remedial work on the concrete footpath, pile foundations and replacement of some structural elements.

It should be noted that in order to maintain the stability and safety of the stairs, the pile foundations would need to be driven deeper. This would involve temporary removal of the deck structure and pile foundations, re-drive the piles and rebuild the deck structure. It is envisaged that the repair works would cost in excess of \$100,000, and that even after the repair works, the ongoing coastal erosion in this area is likely to result in the stairs not being functional. It is expected that the landing could be in the ocean following the next significant storm erosion event.

Due to the poor level of beach access associated with this option it is not considered appropriate.

4.2.2 Replacement Option

The replacement option involves the removal of the existing stairs and replacement with a new access structure. It is not recommended to replace the stairs in the exact same location, which would result in the stairs not being functional after erosion. As a minimum they should be moved further east (approximately 35 m for a replacement structure with 15 years design life), to provide a functional access point. This would require significant earthworks and clearing to land the stairs further from the active shoreline.

The appropriate location of the stairs should be considered carefully by the City. This will need to consider the effect of coastal erosion and the required earthworks and clearing to accommodate this. This ensures the functionality of the replacement stairs is not undermined by ongoing coastal erosion.

The City may wish to consider the use of fibre reinforced polymer (FRP) for the new stairs. FRP products are less susceptible to corrosion and therefore will significantly reduce the maintenance required over the life of the structure. It is envisaged that a replacement stair structure could cost in the order of about \$200,000 plus any additional cost for earthworks, vegetation clearing and revegetation.

4.2.3 Alternative Access Location

The City should also investigate in detail beach access at alternative locations. The main considerations when selecting an alternative beach access include.

- Coastal stability over the design life.
- The type of access to provide (e.g. universal access or assisted access).
- The required level of earthworks and/or clearing of vegetation to provide an appropriate grade for the beach access.

The above provide long term solutions for beach access which the City should review and consider in detail.

5. Recommendations

MRA have completed a condition and stability assessment of the beach access stairs near Sceptre Ct, Two Rocks. Based on the outcomes of this assessment, the following are recommended.

- The foundation of the end section of concrete path leading to the stairs has been undermined. This section of concrete path should be removed immediately.
- The structural elements of the stairs are at the end of their design life, and the pile foundations of the stairs have been undermined and showed sign of instability.
- The stairs should be removed immediately for public safety.
- Short term access should be provided through the sand blowout area to the north. This will require minor earthworks to improve grade of access. Wind break fence could also be installed to formalise the track.
- Long term options for access include replacement of the structure landward of the current staircase location or at an alternative location, noting that significant earthworks and clearing will be required to position the structure at least 35 m inland to minimise the risk of ongoing erosion. Repair of the structure is not recommended. The City should review and investigate long term options via a feasibility and options assessment study including consideration of community needs, coastal engineering, risk assessment and cost.

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