

CONDITION REPORT

Australind Jetty



Government of **Western Australia**
Department of **Water and Environmental Regulation**

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Australind Jetty

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2.0 Introduction

WML were engaged to report on the condition of what is known as Australind Jetty, which is located adjacent to the Leschenault Waterways Discovery Centre.

The scope for the inspections includes for a below water inspection of the piles and support structure that is unable to be accessed from the jetty itself, and an inspection of the above water structure.

Our report gives a brief outline of the structural arrangement of each bridge and jetty, such as the pile arrangement and material and the beam/joist arrangement and material. Plus, any non-structural items, for example, toe boards and fenders, where applicable.

Following this outline, we have identified any observed damage and /or deterioration of the structural members, with subsequent recommendations on how to rectify the items in question.

The below water inspections and reporting has been carried out by Shorewater Marine Pty Ltd, and the above water inspections carried out by our Mr Rob Jarman, Senior Structural Engineer and Mr. Himanshu Agrawal, Graduate Structural Engineer.

3.0 Boardwalk

3.1 Description

The boardwalk provides access from the shore to the earth bank that forms the majority of the pathway into the inlet.

It has approximately 60 circular concrete piles encased with a wrapping or liner, with timber stumps, half-caps and joists spanning between them (Figure 1). The timber joists are located at approximately third points across the width of the walkway. These half-caps are fixed to the timber stumps via two bolts. Also, the joists are bolted to the half-caps (Figure 7). Supported on these timber joists are the deck boards, which have a toe board bolted around the edge.

One side end of the bridge has a timber handrail that is bolted to the timber joists.

3.2 Observations

The first impression of the boardwalk is that it is showing signs of the effects of weathering and corrosion.

Generally, the timber joists and half-caps appear to be okay, although they are a bit weathered. The decking boards appear to be very weathered and have become soft in places (Figure 8). Several boards have cupped and there is the occasional loose one. One has also broken (Figure 2). However, these are not considered to be affecting the structural performance.

The timber barrier seems to be in a good condition due to the paint and were firm when leant against.

All the bolts observed are rusted. The timber stumps appear to be a bit weathered, but are not affecting the structural performance. Concrete piles seem to be in a good condition because of the wrapping encasing the piles (Figure 5).

It should be noted that the handrail doesn't currently conform to Australian Standard AS2156 for this type of structure.

3.3 Recommendations

The recommendations are based on our structural investigation.

Steel work:

All bolts should be replaced. We recommend that all the new bolts be stainless steel. Otherwise, galvanised bolts are acceptable, subject to a regular inspection regime.

All recesses for bolts fixing the deck boards should be sealed to prevent water sitting in the void.

Timber work:

Due to the extent of deterioration to the deck boards. We recommend that they all be replaced. It would be prudent, with the boards removed, to inspect and replace the protective barrier over the joists.

We recommend the handrail arrangement is reviewed by yourselves, with regard to the extent and type of barrier.

4.0 Foot Bridge 1 (Closest to the shore)

4.1 Description

The foot bridge 2 is in the walkway. It consists of two single span steel beams between the two abutments. Timber deck boards are bolted on I beams. One side end of the bridge has a timber handrail that is bolted to the timber deck.

4.2 Observations

The first impression of the bridge is that it is showing signs of the effects of weathering and corrosion.

Generally, all the deck boards, and toe boards appear to be okay, but a bit weathered. Several deck boards have cupped or split and there is the occasional loose one (Figure 9). However, these are not considered to be affecting the structural performance.

Most of the steelwork is showing signs of corrosion. All the bolts and the steel beams observed are rusted and, in several areas, delaminated (Figure 10, Figure 11, Figure 12, Figure 14).

There is degree of erosion of the ground adjacent to the abutment.

4.3 Recommendations

The recommendations are based on our structural investigation.

Steel work:

All bolts should be replaced. We recommend that all the new bolts be stainless steel. Otherwise, galvanised bolts are acceptable, subject to a regular inspection regime.

All steelwork should be appropriately cleaned and, if considered necessary, inspected again. A suitable primer and topcoat can then be applied. A suitably experienced contractor should be engaged to undertake the work and advise the best product for the situation.

Timber work:

Due to the extent of deterioration to the deck boards. We recommend that they all be replaced. It would be prudent, with the boards removed, to inspect and replace the protective barrier over the joists.

We recommend the handrail arrangement is reviewed by yourselves, with regard to the extent and type of barrier.

Abutment

Whilst the abutment is sound, there has been some erosion behind it. We recommend providing a new surface for an extent beyond the abutment to protect the ground from erosion.

5.0 Foot Bridge 2 (Middle one of three)

5.1 Description

The foot bridge 2 is similar to the foot bridge 1. It consists of two single span steel beams between the two abutments. Timber deck boards are bolted on I beams. There is no handrail barrier on either side.

5.2 Observations

The first impression of the bridge is that it is showing signs of the effects of weathering and corrosion.

Generally, all the timber deck boards, and toe boards appear to be okay, if a bit weathered. Several deck boards have cupped or split and there is the occasional loose one (Figure 19). However, these are not considered to be affecting the structural performance.

Most of the steelwork is showing signs of corrosion. All the bolts and the steel beams observed are rusted and, in several areas, delaminated (Figure 16, Figure 17, Figure 18).

There is degree of erosion of the ground adjacent to the abutment.

5.3 Recommendations

The recommendations are based on our structural investigation.

Steel work:

All bolts should be replaced. We recommend that all the new bolts be stainless steel. Otherwise, galvanised bolts are acceptable, subject to a regular inspection regime.

All steelwork should be appropriately cleaned and, if considered necessary, inspected again. A suitable primer and topcoat can then be applied. A suitably experienced contractor should be engaged to undertake the work and advise the best product for the situation.

Timber work:

Due to the extent of deterioration to the deck boards. We recommend that they all be replaced. It would be prudent, with the boards removed, to inspect and replace the protective barrier over the joists.

We recommend the handrail arrangement is reviewed by yourselves, with regard to the provision of an appropriate one.

Abutment

Whilst the abutment is sound, there has been some erosion behind it. We recommend providing a new surface for an extent beyond the abutment to protect the ground from erosion.

6.0 Foot Bridge 3 (Furthest from the shore)

6.1 Description

The foot bridge 3 is similar to the foot bridge 2. It consists of two single span steel beams between the two abutments. Timber deck boards are bolted on I beams. One side end of the bridge has a steel handrail that is bolted to the timber deck.

6.2 Observations

The first impression of the bridge is that it is showing signs of the effects of weathering and corrosion.

Generally, all the deck boards appear to be okay if a bit weathered. Several deck boards have cupped or split and there is the occasional loose one (Figure 23). However, these are not considered to be affecting the structural performance. Steel fenders were found to be firmly fixed when leant upon.

Most of the steelwork is showing signs of corrosion. All the bolts and the steel beams observed are rusted and, in several areas, delaminated (Figure 22, Figure 24, Figure 25, Figure 27).

There is degree of erosion of the ground adjacent to the abutment.

6.3 Recommendations

The recommendations are based on our structural investigation.

Steel work:

All bolts should be replaced. We recommend that all the new bolts be stainless steel. Otherwise, galvanised bolts are acceptable, subject to a regular inspection regime.

All steelwork should be appropriately cleaned and, if considered necessary, inspected again. A suitable primer and topcoat can then be applied. A suitably experienced contractor should be engaged to undertake the work and advise the best product for the situation.

Timber work:

Due to the extent of deterioration to the deck boards. We recommend that they all be replaced. It would be prudent, with the boards removed, to inspect and replace the protective barrier over the joists.

We recommend the handrail arrangement is reviewed by yourselves, with regard to the extent and type of barrier.

Abutment

Whilst the abutment is sound, there has been some erosion behind it. We recommend providing a new surface for an extent beyond the abutment to protect the ground from erosion.

7.0 Jetty Structure (Furthest End)

7.1 Description

The jetty is approximately T shape and is built at the end of the walkway. It has 32 timber piles with a single timber beam spanning from pile to pile. Forming the main jetty walkway is a series of timber joists spanning from the front beam to the walkway. Supported on these timber joists are the deck boards, which have a toe board bolted along the edge.

Along one edge of the jetty is a timber handrail which lines up with the piles. These are bolted to the piles with a timber block providing separation between the fender and the pile.

Furthermore, a detailed underwater inspection of the jetty was conducted by Shorewater Marine Pty Ltd, and the report is attached in Appendix G.

7.2 Observations

The first impression of the jetty is that it is showing signs of the effects of weathering.

All the deck boards and toe boards appear to be weathered (Figure 29, Figure 31, Figure 33, Figure 35). Several deck boards have cupped or split and there is the occasional loose one. However, these are not considered to be affecting the structural performance of the jetty.

A few timber blocks between the piles and fenders have either split or weathered (Figure 30). Concrete encapsulations were found to be damaged (Figure 30). A more detailed report of underwater structure is attached in Appendix G.

Most of the bolts observed are rusted.

There is a fair amount of erosion of the ground adjacent to the abutment.

7.3 Recommendations

The recommendations are based on our structural investigation.

Steel work:

All bolts should be replaced. We recommend that all the new bolts be stainless steel. Otherwise, galvanised bolts are acceptable, subject to a regular inspection regime.

All steelwork should be appropriately cleaned and, if considered necessary, inspected again. A suitable primer and topcoat can then be applied. A suitably experienced contractor should be engaged to undertake the work and advise the best product for the situation.

Timber work:

Due to the extent of deterioration to the deck boards. We recommend that they all be replaced. It would be prudent, with the boards removed, to inspect and replace the protective barrier over the joists.

We recommend the handrail arrangement is reviewed by yourselves, with regard to the extent and type of barrier, and the broken items replaced.

Piles:

The diver's report has identified that pile encapsulations are in very poor condition. It is therefore recommended that these piles are either be repaired or replaced.

It is the diver's recommendation that all the existing encapsulations will need to be removed entirely, from the top of the column down to minimum of 500mm below the seabed. For a detailed recommendation, refer to diver's report in Appendix G.

Abutment

Whilst the abutment is sound, there has been some sizeable erosion behind it. We recommend providing a new surface for an extent beyond the abutment to protect the ground from erosion. Consideration should also be given to renewing/replacing the rock armour around the end of the earth section.

APPENDIX A – Location Map and Jetty Plans



APPENDIX B – Boardwalk Photographs



Figure 1. General at the Shore



Figure 2. Damaged Deck Board



Figure 3. Piles



Figure 4. Piles and Corroded Bolts



Figure 5. Encapsulated Piles



Figure 6. Corroded Bolts



Figure 7. Corroded Bolts



Figure 8. Handrail and Deck Board

APPENDIX C – Foot Bridge 1 Photographs



Figure 9. Weathered Handrail



Figure 10. Rusted and Delaminated Steel Beam



Figure 11. Delaminated and Rusted Steel Beam



Figure 12. Corroded Steel Beam



Figure 13. Abutment



Figure 14. Rusted and Delaminated Steel Beam



Figure 15. Abutment and Rusted Steel Beam

APPENDIX D – Foot Bridge 2 Photographs



Figure 16. Corroded Steel Beam



Figure 17. Steel Beam Underside



Figure 18. Delaminated Steel Beam



Figure 19. Deck Board



Figure 20. Abutment and Corroded Steel Beam



Figure 21. Weathered Deck Board

APPENDIX E – Foot Bridge 3 Photographs



Figure 22. Corroded Steel Beam



Figure 23. Corroded Handrail, Weathered Deck Board and Abutment



Figure 24. Rusted Bolt



Figure 25. Delaminated and Rusted Steel Beam



Figure 26. Rusted Steel Beam



Figure 27. Delaminated Steel Beam



Figure 28. Rusted and Delaminated Steel Beam

APPENDIX F –Jetty Photographs



Figure 29. Weathered Deck Board and Broken Handrail



Figure 30. Damaged Encapsulation in Piles

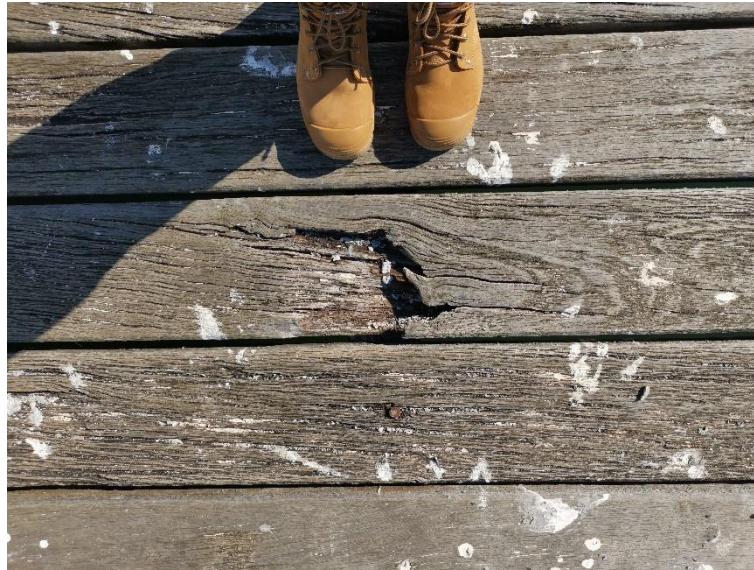


Figure 31. Damaged Deck Board

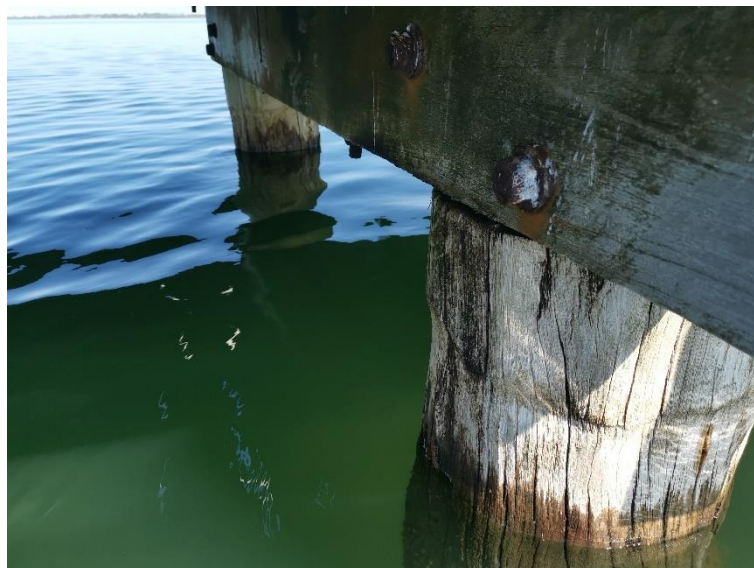


Figure 32. Cracks in Timber Piles, Rusty Bolts



Figure 33. Soft, weathered and Broken Deck Board



Figure 34. Rusted Ladder



Figure 35. Weathered Deck Board

APPENDIX G – Diver's Report



SHOREWATER MARINE PTY LTD
COMMERCIAL DIVING & MARINE
MAINTENANCE



Australind Jetty Inspection Findings

WML



JETTY INSPECTION & REPORT

Shorewater Marine Pty Ltd

SWM1427

Table 1. Record of Document Revisions

REPORT INFORMATION	Revision #	NAME	TITLE	COMPANY	SIGNATURE	DATE
Prepared	A	R. Hawkins	Admin	SWM	RH	16/04/2021
Reviewed	B	P. Daly	Project Management	SWM	PD	06/05/2021
Distributed	0	P. Daly	Project Management	SWM	PD	10/05/2021



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Table 2. Inspection Attendance Roles

Diver name	Position
Adam Thomson	Above water inspector & Dive supervisor
River Austin	Above water inspector & Diver
John Kelly	Above water inspector & Diver

Rob Jarman | Principal Structural Engineer



21 Glassford Road,
Kewdale,
Western Australia 6105

SUBJECT: JETTY INSPECTION & REPORT

Shorewater Marine Pty Ltd would like to thank you for giving us the opportunity to provide the following asset inspection report relating to the outermost Jetty on the Leschenault Inlet Walkway, proximal to Leschenault Waterways Discovery Centre, Australind. The current report has been compiled to provide WML Consultants an overview of the works subcontracted to Shorewater Marine, inclusive of all inspections findings, as well as recommendations based on Shorewater Marine's extensive experience and industry best practice.

This report submission includes an overview of the project, the project delivery methodology, an executive summary of all works, pile specific photos and findings, as well as remediation recommendations.

1 | OVERVIEW

Shorewater Marine was engaged by WML, represented by Rob Jarman, to complete a detailed below water inspection on the submerged components of the outermost Jetty on the Leschenault Inlet Walkway, shown in the image below.

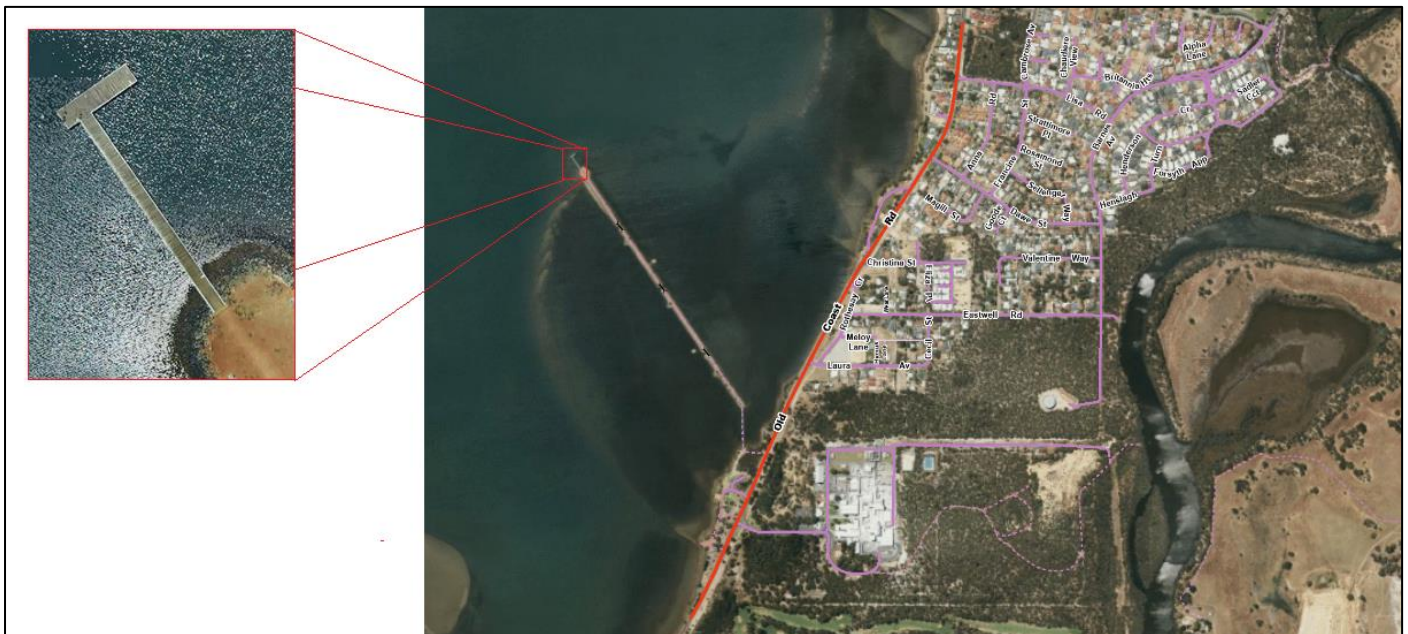


Image 1. Location of Inspected Structure

The required inspection works were completed within one site day on the 13th of April, with a 3-man commercial dive team and a commercially surveyed vessel utilised to complete the works. The scope of the inspection included an assessment of all underwater components of the structure. As the jetty's superstructure is above HAT, this meant only the piles were required to be inspection during the current works. However, while onsite, Shorewater Marine's team also completed a general and brief inspected on the following elements;

- Timber deck boards
- Timber kerbing and handrail
- structural timber members (stringers and halfcaps)



2 | METHODOLOGY

- Prepare relevant documentation prior to mobilization to site, including but not limited to:
 - Safety Management Plan Incorporating Safe Work Method Statement (JSA)
 - Site Signage and proformas
- Preparation of plant and equipment
- Prepare Shorewater Marine Occupational Air Diving Spread on Commercially Surveyed work Vessel and conduct pre-start safety checks on all equipment required for use.
- Launch commercially surveyed vessel at the Australind Boat Ramp
- Utilize commercially surveyed work vessel to erect dive flag and any required signage alerting members of the public to the presence of divers in the area.
- Divers to enter the water and conduct inspection in accordance with proposed criteria.
- Diver to take video footage of any anomalies and images of all findings.
- Diver to exit water and dive team to discuss and review findings to ensure scope completion.



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2.1 CLASSIFICATIONS OF WOOD ROT, MARINE BORER & SPLITTING:

2.1.1 WOOD ROT:



Minor



Moderate



Severe

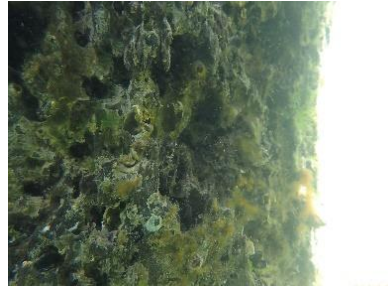
2.1.2 MARINE BORER:



Minor



Moderate



Severe

2.1.3 SPLITTING:



Minor



Moderate



Severe



3 | EXECUTIVE SUMMARY

Shorewater Marine Pty Ltd attended the site on the 13th of April 2021, utilising a 3-man commercial dive team and a commercially surveyed vessel to complete the required inspection. The following information summaries our findings and is broken down into subsections for convenience of information transmission.

3.1 STRUCTURE ORIENTATION

The Jetty is a fixed piled structure, consisting of 32 timber piles all of which appear to have been encapsulated in concrete, although the encapsulation presented in poor condition or entirely absent in some instances. Piles present in pairs of two across 16 bents, 11 of which extend directly out and the remaining 5 running perpendicular to form the foundations of the structures "T Head". In the absence of any As Constructed information relating to the structure, Shorewater Marine has provided a sketch (below), to show the approximate pile locations and labelling convention used throughout this report.

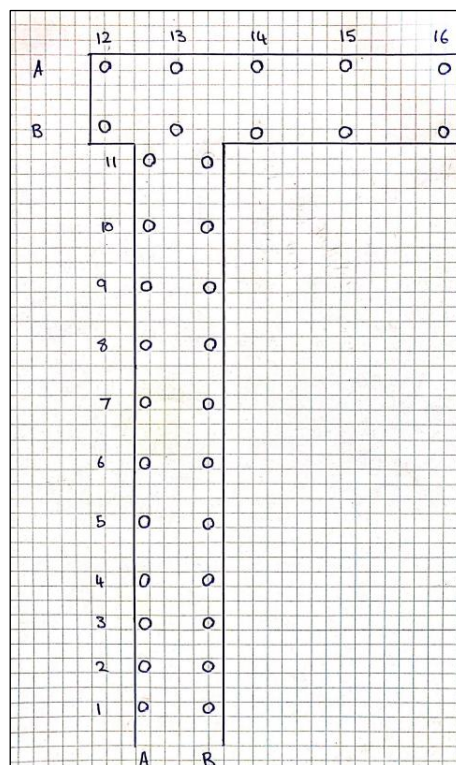


Figure 1. Sketch of Inspected Structure

Piles within each bent share two timber halfcaps that are fastened with a through-bolts on a notch out groove on the tops of each pile, as shown in image 1, below.



Image 2. Example of Typical Halfcap Connection at each pile

4 timber stringers span between each bent on top of the timber halfcaps on the main walkway, and 5 between the bents on the "T Head". Stringers are fastened with vertical through bolts that extend through each stringer and halfcap where they intercept. Deck boards are screwed down to each stringer. A square profile timber kerbing extends around the perimeter of the entire structure, which has vertical through bolts running through the deck boards and outer stringers.

A timber handrail extends down one side of the main walkway, which terminates before the T-Head.

3.2 GENERAL FINDINGS

The inspected structure presented in average condition overall, with severe defects present on nearly all piles, a number of deck boards, kerbing lengths, and a small section of handrail. The severity of defects observed warrants the implementation of a remedial package to be completed in the short term, before costly component replacements are required. Please see the below subsection, for a summary of each element of the structure inspected.

3.3 PILES

In total, there are 32 concrete encapsulated timber piles providing the foundation for the inspected structure. Each pile was inspected individually and provided a condition rating based on the numeric condition scale outlined below:

- Condition 1 – New or very good
- Condition 2 – Minor deterioration is observed but does not affect the structural performance of the element.
- Condition 3 – The observed deterioration has adverse effects on the durability of the element, but not its structural capacity at the time of inspection.
- Condition 4 – Poor, where the integrity of the structural element and its load bearing capacity are adversely affected.
- Condition 5 – Unserviceable where sections are missing or beyond repair and maintenance.

Pile encapsulations presented in very poor condition, with significant section loss, severe cracking and severe spalling present throughout the majority of piles, particularly around the upper sections. In some instances, the encapsulations were missing entirely, or had over 50% missing. Where large sections of the encapsulations were missing, no steel reinforcement was observed within the cross section of the remaining encapsulation. As a result, it can reasonably be presumed that all the encapsulations were installed without steel reinforcement. In the few instances where the encapsulations did not have large sections missing, a gap was observed between the top of the concrete column and the internal timber pile, meaning the underlying timber is still being exposed to marine environment, and the columns are not adequately protecting the timber.



Inspection of the underlying timber piles was partly obstructed by encapsulations where they were still present. However, because of the poor condition of the encapsulations, a comprehensive and representative inspection of the timber piles was able to be completed. The visible sections of timber varied in condition, from average to poor. Typically, the timber sections of each pile presented with moderate to severe towards the top, with moderate to severe rot and evidence of marine borer attack on the subsea sections, particularly throughout the intertidal area on each pile. It is worth noting that the tops of each pile, where they connect to the timber halfcaps generally presented in good condition, with defects typically presenting directly below this level.

For individual findings at each pile location, please see the itemised table of findings, beginning on page 9.

3.4 STRUCTURAL TIMBER MEMBERS.

For the purposes of this report, the term structural timber members refer to the hardwood halfcaps and stringers which form the subframe for the structure. These elements are installed above the intertidal column, and likely receive very little water contact. Additionally, they are largely protected from sun exposure by the deck boards. Throughout the entire structure, the structural timber members presented in good condition, with defects limited to minor end splitting on halfcaps and minor surface splitting on the outer face of the external stringers.

3.5 STRUCTURAL FIXINGS

All structural fixings throughout the entire structure presented in average to poor condition, based on the presence of moderate to severe corrosion.

3.6 LADDER

The ladder on the structure has timber styles with steel bars running between to form the rungs. At the time of inspection, severe corrosion was present on the steel bars.

3.7 TIMBER DECKING, KERBING AND HANDRAIL

Timber decking, kerbing and handrail generally presented in average condition. Deck boards presented with minor to moderate surface splitting throughout, with 25% exhibiting severe rot. Similar defects were present on the kerbing, with rot typically localised to the ends of each member. Two lengths of timber handrail were missing from the "midrail" level of this element.

Itemised Pile Table of Findings begins on the page hereafter.



4 | TABLE OF FINDINGS

Pier	Pile	I/T Circ	Seabed Circ	Encapsulation Circ	Probe Test	Wood Rot	Splitting	Marine Borer	Pile length	Comments	Rating
1	A	1080mm	NA	1910mm	2-4mm	Moderate I/T	Severe I/T 160mm deep on exposed timber	Minor I/T	1030mm	Encapsulation extends below seabed. Severe section loss to encapsulation 300mm x 400mm at top of pile and severe cracking throughout. Plastic wrap/formwork has completely failed around encapsulation.	4
	B	1010mm	NA	1940mm	2-4mm	Moderate I/T	Severe I/T 230mm deep at worst point	Moderate I/T	840mm	Encapsulation extends below seabed. Encapsulation has severe cracking/delamination to top 200mm. Top 150mm of plastic wrap/ formwork has failed completely.	4
2	A	1130mm	1100mm	NA	2-4mm	Minor I/T, Severe at Seabed	Moderate I/T 220mm deep at worst point	Minor I/T, Severe at Seabed	1220mm	Encapsulation has completely failed to seabed level. Minor necking to timber at seabed.	4
	B	1160mm	1160mm	NA	2-4mm	Moderate I/T and Seabed	Moderate I/T 30mm deep at worst point	Moderate I/T and Seabed	1200mm	Encapsulation has completely failed to seabed level.	4
3	A	1150mm	NA	1940mm	2-4mm	Severe I/T	Severe I/T 120mm deep at worst point	Moderate I/T	1460mm	Encapsulation has failed on top 900mm, rest of encapsulation appears to be in good condition and extends below seabed, has patches of failed plastic wrap/formwork throughout. Minor necking I/T.	4
	B	1200mm	1160mm	NA	2-4mm	Severe over entire pile	Moderate I/T 60mm at worst point	Moderate I/T Severe at seabed	1410mm	Encapsulation has completely failed to seabed level. Moderate necking at seabed.	4



Pier	Pile	I/T Circ	Seabed Circ	Encapsulation Circ	Probe Test	Wood Rot	Splitting	Marine Borer	Pile length	Comments	Rating
4	A	1310mm	NA	1940mm	2-4mm	Moderate I/T	Moderate I/T 90mm at worst point	Moderate I/T	1800mm	Encapsulation extends below seabed. Severe section loss to encapsulation at top of pile 800mm x 500mm. Severe loss of plastic wrap/formwork throughout. Severe cracking throughout the rest of encapsulation. Moderate necking I/T.	4
	B	1250mm	1120mm	NA	2-4mm	Moderate I/T and Seabed	Minor I/T 30mm at worst point	Moderate over entire pile	1800mm	Encapsulation has completely failed to seabed level. Moderate necking I/T and Midwater. Circ in Midwater necking 1150mm.	4
5	A	1500mm	NA	1940mm	2-4mm	Minor I/T	Moderate I/T 80mm at worst point	Moderate I/T	2580mm	Encapsulation extends below seabed. Severe section loss at top of encapsulation 900mm wide extending down 1300mm. Moderate necking I/T.	4
	B	1250mm	1170mm	NA	2-4mm	Minor I/T, Moderate at Seabed	Moderate I/T 80mm at worst point	Minor I/T, Moderate Seabed	2610mm	Encapsulation has mostly failed to seabed level.	4
6	A	1000mm	1000mm	NA	2-4mm	Moderate over entire pile	Severe I/T 120mm deep at worst point	Moderate over entire pile	2800mm	Encapsulation has completely failed to seabed level. Moderate necking I/T, Minor necking Seabed.	4
	B	1100mm	NA	1940mm	2-4mm	Severe I/T	Moderate I/T 110mm at worst point	Moderate I/T	2810mm	Encapsulation has failed on top 1200mm, some section loss to next 200mm and then appears solid beneath that and extends below seabed. Severe necking I/T 880mm circ in worst area.	4



Pier	Pile	I/T Circ	Seabed Circ	Encapsulation Circ	Probe Test	Wood Rot	Splitting	Marine Borer	Pile length	Comments	Rating
7	A	1200mm	1100mm	NA	2-4mm	Moderate I/T, Minor Seabed	Moderate I/T 80mm at worst point	Moderate I/T, Minor Seabed	2800mm	Encapsulation has completely failed to seabed level. Minor necking I/T	4
	B	1100mm	1000mm	NA	2-4mm	Severe I/T, Moderate rot Seabed	Moderate I/T 90mm at worst point	Moderate I/T, Severe borer bottom 1m of pile	2800mm	Encapsulation has completely failed to seabed level. Moderate necking I/T	4
8	A	1200mm	1100mm (1200mm above seabed)	NA	2-4mm	Moderate I/T	Moderate I/T 90mm at worst point	Moderate I/T	2870mm	Encapsulation has completely failed to 1200mm above seabed and then failed around one half to seabed level. Moderate necking I/T	4
	B	1300mm	1200mm (400mm above seabed)	1940mm	2-4mm	Moderate I/T	Moderate I/T 110mm at worst point	Moderate over entire pile	2850mm	Encapsulation has completely failed to 400mm above seabed. Very Minor necking I/T.	4
9	A	1200mm	1140mm	NA	2-4mm	Moderate I/T and Seabed	Minor I/T 10mm at worst point	Moderate I/T and Seabed	2820mm	Encapsulation has completely failed to seabed level, One section remains at midwater on one side.	4
	B	1150mm	1100mm (1200mm above seabed)	NA	2-4mm	Moderate I/T and Seabed	Moderate I/T 100mm at worst point	Moderate over entire pile	2850mm	Encapsulation has completely failed to 1200mm above seabed and then failed around one half to seabed level. Moderate necking I/T	4



Pier	Pile	I/T Circ	Seabed Circ	Encapsulation Circ	Probe Test	Wood Rot	Splitting	Marine Borer	Pile length	Comments	Rating
10	A	1180mm	1080mm	NA	2-4mm	Moderate I/T, Minor Seabed	Moderate I/T 140mm at worst point	Moderate over entire pile	2780mm	Encapsulation has completely failed to seabed level. Moderate necking I/T	4
	B	1100mm	1150mm	NA	2-4mm	Severe I/T, Moderate over rest of pile	Severe I/T 260mm at worst point	Severe I/T, Moderate over rest of pile	2810mm	Encapsulation has completely failed to seabed level. Moderate necking I/T	4
11	A	1100mm	1100mm	NA	2-4mm	Severe I/T, Minor rot at seabed	Moderate I/T 200mm at worst point	Moderate over entire pile	2900mm	Encapsulation has completely failed to seabed level. Moderate necking I/T, minor at seabed.	4
	B	1190mm	1170mm (600mm above seabed)	1940mm	2-4mm	Minor over entire pile	Moderate I/T 60mm at worst point	Minor I/T	2900mm	Encapsulation has completely failed to 600mm above seabed. Bottom 600mm feels like loose rubble underneath plastic wrap. There are chunks of encapsulation hanging on to pile at random locations over pile.	4
12	A	NA	NA	1940mm	2-4mm	NO	Minor I/T 10mm at worst point	Minor I/T	2800mm	Encapsulation extends below seabed. Section loss 500mm x 600mm at top of pile. Section loss midwater 220mm x 240mm. The rest of the encapsulation is intact.	3
	B	NA	1100mm	1940mm	2-4mm	Moderate Seabed	Minor I/T 15mm at worst point	Minor Seabed	2820mm	Encapsulation extends to midwater and then has completely failed down to seabed. Section loss 240mm x 300mm at top of pile. Minor necking above I/T and seabed	4



Pier	Pile	I/T Circ	Seabed Circ	Encapsulation Circ	Probe Test	Wood Rot	Splitting	Marine Borer	Pile length	Comments	Rating
13	A	1320mm	1200mm	NA	2-4mm	Moderate Seabed to midwater	Minor I/T 20mm at worst point	Moderate over entire pile	2800mm	Encapsulation has completely failed to seabed level. Minor necking at seabed.	4
	B	1170mm	1080mm (600mm above seabed)	NA	2-4mm	Moderate over entire pile	Minor I/T 10mm at worst point	Minor midwater and seabed	2800mm	Encapsulation has completely failed to 600mm above seabed. Section loss in bottom 600mm around half the pile to seabed.	3
14	A	1220mm	1150mm	NA	2-4mm	Moderate over entire pile	Moderate I/T 40mm at worst point	Moderate over entire pile	2800mm	Encapsulation has completely failed to seabed level. Minor necking at seabed.	4
	B	1150mm	1000mm	NA	2-4mm	Minor I/T	Moderate I/T 100mm at worst point	Moderate I/T	2830mm	Encapsulation has completely failed to seabed level. Minor necking at seabed.	4
15	A	NA	NA	1940mm	2-4mm	No	Moderate I/T 70mm at worst point	No	2900mm	Encapsulation extends below seabed and is completely intact. Wrap appears in good condition. Minor necking above encapsulation.	2.5
	B	NA	NA	1940mm	2-4mm	No	Minor I/T 55mm at worst point	Minor I/T	2900mm	Encapsulation extends below seabed and is completely intact. Wrap appears in good condition	2.5
16	A	NA	NA	1940mm	2-4mm	No	Moderate I/T 120mm at worst point	No	2900mm	Encapsulation extends below seabed and is completely intact other than some small section loss at the top of pile. Minor necking above encapsulation.	3
	B	NA	NA	1940mm	2-4mm	No	Minor I/T 100mm at worst point	No	2900mm	Encapsulation extends below seabed and is completely intact. Wrap appears in good condition	2.5

5 | SITE PHOTOS

5.1 SITE PHOTOS PILE 1A



1.1



1.2



1.3



1.4

1.1 – Encapsulation failure with cracking and spalling

1.2 – Encapsulation failure with severe section loss, no rebar present

1.3 – Large split in pile (16mm)

1.4 – Severe cracking and spalling on concrete encapsulation

5.2 SITE PHOTOS PILE 1B



2.1



2.2



2.3



2.4



2.5



2.6

2.1 & 2.2 – Encapsulation has severe cracking/and section loss to top 200mm.

2.3 – Typical example of gap between pile concrete column and timber pile

2.4 – Large split in pile

2.5 – Damage to encapsulation formwork near seabed

2.6 – Damage to encapsulation formwork near seabed



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5.3 SITE PHOTOS PILE 2A



3.1



3.2



3.3



3.4

3.1 – Encapsulation has completely failed to seabed level

3.2 – Severe split in pile

3.3 & 3.4 – Encapsulation has completely failed to seabed level, severe wood rot and marine borer attack

5.4 SITE PHOTOS PILE 2B



4.1



4.2



4.3



4.4



4.5



4.6

4.1 – Encapsulation has completely failed to seabed level, upper section of timber pile presenting in good condition

4.2 – Minor necking

4.3 – Severe split in pile

4.4 – Severe split in pile

4.5 – Encapsulation has completely failed to seabed level, wood rot present

4.6 – Encapsulation has completely failed to seabed level, wood rot present



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5.5 SITE PHOTOS PILE 3A



5.1



5.2



5.3



5.4

5.1 – Encapsulation has failed on top 900mm

5.2 – Large split in pile

5.3 – Typical example of wood rot & borer, present on exposed sections of timber pile

5.4 – Seabed encapsulation, with a significant section of the concrete column missing



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5.6 SITE PHOTOS PILE 3B



6.1



6.2



6.3



6.4

6.1 – Encapsulation has completely failed to seabed level, top of pile presenting in good condition

6.2 – Large split in pile

6.3 – Moderate necking on subsea section of timber pile

6.4 – severe wood rot & borer on subsea section of timber pile

5.7 SITE PHOTOS PILE 4A



7.1



7.2



7.3



7.4



7.5



7.6

7.1 – Encapsulation extends below seabed. Severe section loss to encapsulation at top 800mm of pile

7.2 – Large split in pile

7.3 – Severe section loss to encapsulation at top of pile 800mm x 500mm

7.4 – Severe section loss to encapsulation at top of pile 800mm x 500mm

7.5 – Seabed level encapsulation, presenting in fair condition

7.6 – Large split in pile, large section loss to encapsulation

5.8 SITE PHOTOS PILE 4B



8.1



8.2



8.3



8.4



8.5



8.6

8.1 – Encapsulation has completely failed to seabed level, top of pile presenting in good condition

8.2 – Large split in pile

8.3 – Moderate necking present at top of intertidal column

8.4, 8.5 & 8.6 – Severe wood rot & borer present throughout subsea portion of timber pile

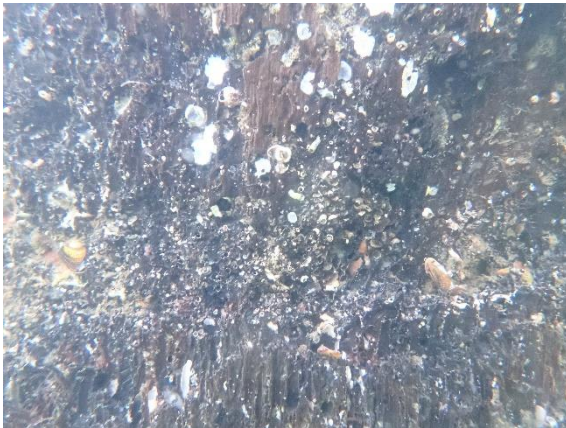
5.9 SITE PHOTOS PILE 5A



9.1



9.2



9.3



9.4



9.5



9.6

9.1 – Severe section loss at top of encapsulation 900mm wide extending down 1300mm, pile presenting with moderate splitting & necking on upper section

9.2 – Moderate necking & rot at I/T

9.3 – Example of moderate wood rot & borer attack on the subsea section of the pile

9.4 – Example of moderate wood rot & borer attack. Complete failure of pile encapsulation evident

9.5 – Example of concrete encapsulation section loss

9.6 – Typical split in timber pile



5.10 SITE PHOTOS PILE 5B



10.1



10.2



10.3



10.4

10.1 – Encapsulation is completely missing down to seabed level. Top above water section of pile presenting in good condition with minor-moderate splitting

10.2 – Example of moderate split in above water section of pile

10.3 & 10.4 – Typical example of minor wood rot



5.11 SITE PHOTOS PILE 6A



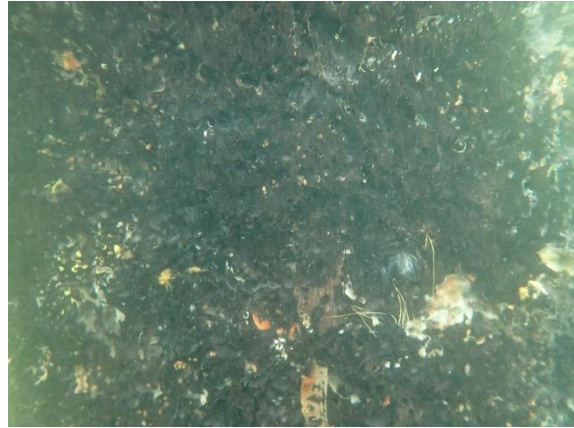
11.1



11.2



11.3



11.4



11.5



11.6

11.1 – Encapsulation is completely missing down to seabed level. Top above water section of pile presenting in good

11.2 – Example of moderate split in above water section of pile

11.3 – Example of timber rot and borer attack on exposed section of subsea timber pile

11.4, 11.5 & 11.6 – Pile encapsulation formwork, presenting in fair condition

5.12 SITE PHOTOS PILE 6B



12.1



12.2



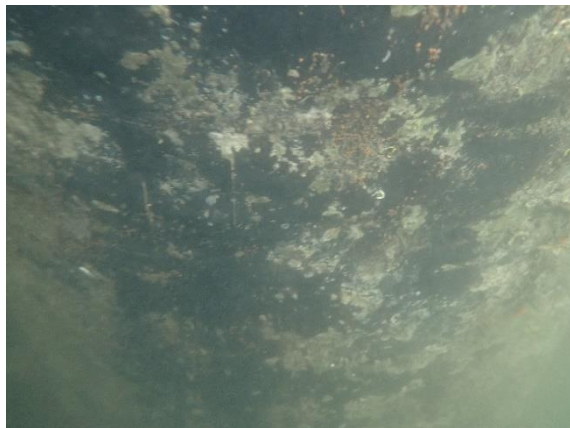
12.3



12.4



12.5



12.6

12.1 – Large split in pile

12.2, 12.3 & 12.4 – Severe necking in intertidal zone, above concrete column. 880mm circumference in worst area

12.5 – Top of pile encapsulation, beginning below LAT

12.6 – Pile encapsulation formwork, presenting in fair condition

5.13 SITE PHOTOS PILE 7A



13.1



13.2



13.3



13.4



13.5



13.6

13.1 – Example of moderate split in above water section of pile

13.2 – 13.6 Typical wood rot and marine borer attacked throughout pile



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5.14 SITE PHOTOS PILE 7B



14.1



14.2



14.3



14.4

14.1 – Example of moderate split in pile

14.2 – Above water section of pile presenting in fair condition, with minor-moderate splitting

14.3 & 14.4 – large section loss of encapsulation below LAT. Underlying timber presenting with minor-moderate rot.



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5.15 SITE PHOTOS PILE 8A



15.1



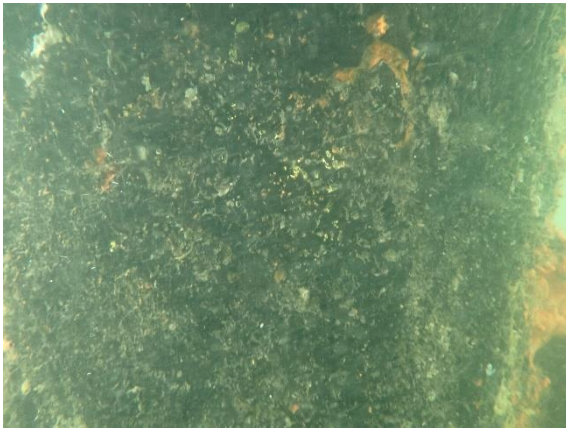
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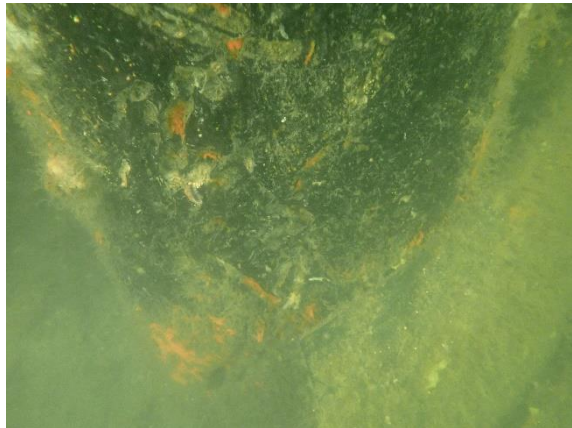
15.3



15.4



15.5



15.6

15.1 – Above water section of pile presenting in fair condition, with minor-moderate splitting

15.2, 15.3, 15.5 & 15.4 – Moderate timber rot and marine borer attack throughout intertidal area

15.6 – Encapsulation has completely failed to 1200mm above seabed and then failed around one half to seabed level

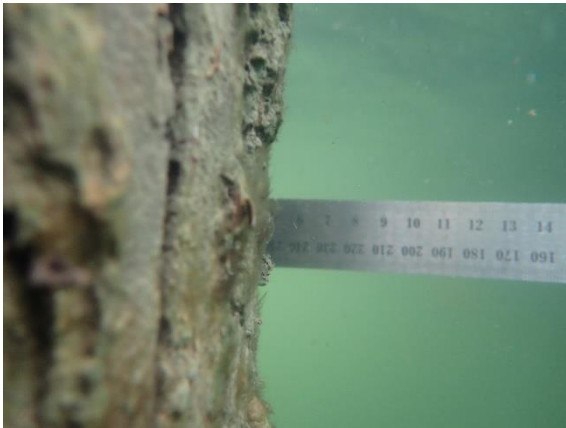
5.16 SITE PHOTOS PILE 8B



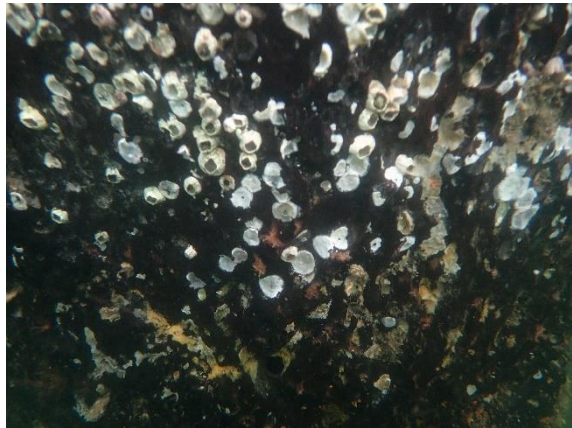
16.1



16.2



16.3



16.4

16.1 – Above water section of pile presenting in fair condition, with minor-moderate splitting

16.2 – example of severe split in pile

16.3 – Moderate timber rot and marine borer attack throughout intertidal area

16.4 – Encapsulation formwork presenting in fair condition



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5.17 SITE PHOTOS PILE 9A



17.1



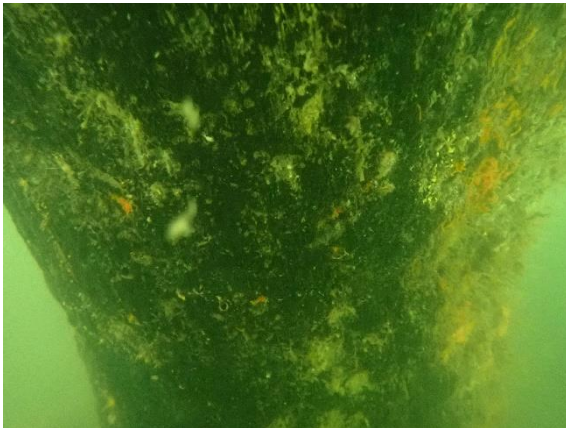
17.2



17.3



17.4



17.5



17.6

17.1 – Above water section of pile presenting in fair condition, with minor-moderate splitting

17.2 – 17.6 Moderate timber rot and marine borer attack throughout intertidal area

5.18 SITE PHOTOS PILE 9B



18.1



18.2



18.3



18.4



18.5



18.6

18.1, 18.2 & 18.3 – Encapsulation has completely failed to 1200mm above seabed, then failed around one half to seabed level. Top of pile presenting in fair condition, with moderate splitting, which worsens towards the intertidal area

18.4 – Evidence of marine borer attack

18.5 & 18.6 – Concrete grout column, presenting with absent formwork, and moderate deterioration of concrete.

5.19 SITE PHOTOS PILE 10A



19.1



19.2



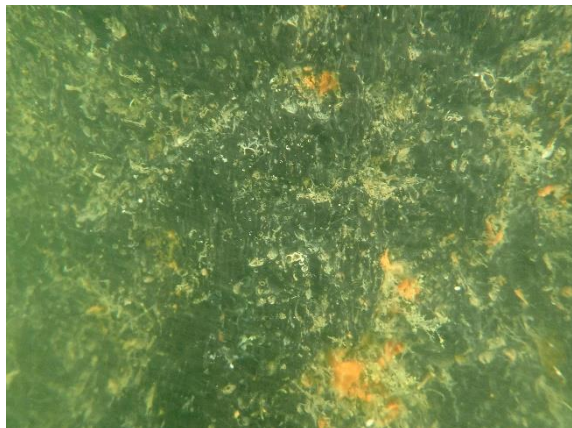
19.3



19.4



19.3



19.4

19.1, 19.2 & 19.3 – Encapsulation has completely failed on upper section of pile. Top of pile presenting in poor condition, with moderate splitting, which worsens towards the intertidal area

19.4 – Evidence of marine borer attack

19.5 & 19.6 – Concrete grout column, presenting with absent formwork, and moderate deterioration of concrete.



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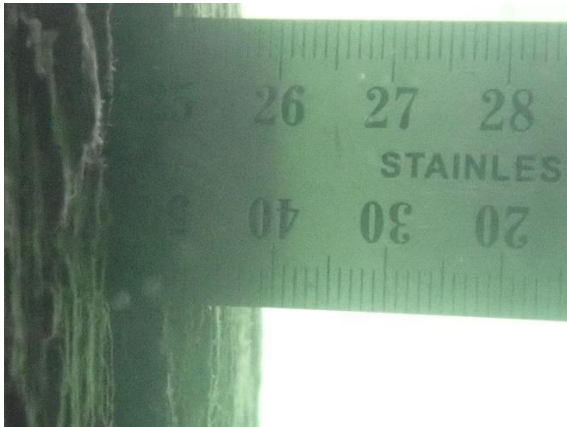
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5.20 SITE PHOTOS PILE 10B



20.1



20.2



20.3



20.4



20.5

20.1, 20.2 & 20.3 – Example of large split in pile

20.4 – Moderate necking at I/T

20.5 – Example of Wood rot & borer on exposed section of timber pile

5.21 SITE PHOTOS PILE 11A



21.1



21.2



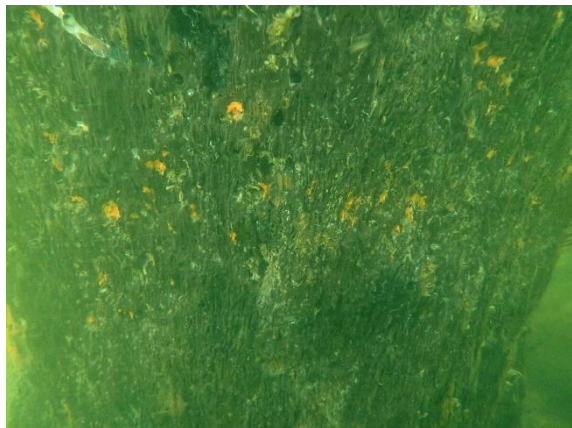
21.3



21.4



21.5



21.6

21.1 & 21.2– Example of large splits in pile

21.3 – Moderate necking, rot and marine borer attacked throughout I/T

21.4 – Moderate necking, rot and marine borer attacked throughout I/T

21.5 – Moderate necking, rot and marine borer attacked throughout I/T

21.6 – Moderate necking, rot and marine borer attacked throughout I/T



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5.22 SITE PHOTOS PILE 11B



22.1



22.2



22.3



22.4



22.5



26.6

22.1 & 22.2– Example of large splits in pile

22.3 & 22.4 – Wood rot & borer

22.5 – There are chunks of encapsulation hanging onto pile at random locations over pile

22.6 – Bottom 600mm feels like loose rubble underneath plastic wrap



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5.23 SITE PHOTOS PILE 12A



23.1



23.2



23.3



23.4

23.1 – Encapsulation extends below seabed. Section loss 500mm x 600mm at top of pile.

23.2 – Encapsulation extends below seabed. Section loss 500mm x 600mm at top of pile.

23.3 – Section loss midwater 220mm x 240mm

23.4 – Section loss midwater 220mm x 240mm



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5.24 SITE PHOTOS PILE 12B



24.1



24.2



24.3

24.1 – Encapsulation extends to midwater and then has completely failed down to seabed. Section loss 240mm x 300mm at top of pile

24.2 – Section loss 240mm x 300mm at top of pile

24.3 – Minor necking above I/T and seabed

5.25 SITE PHOTOS PILE 13A



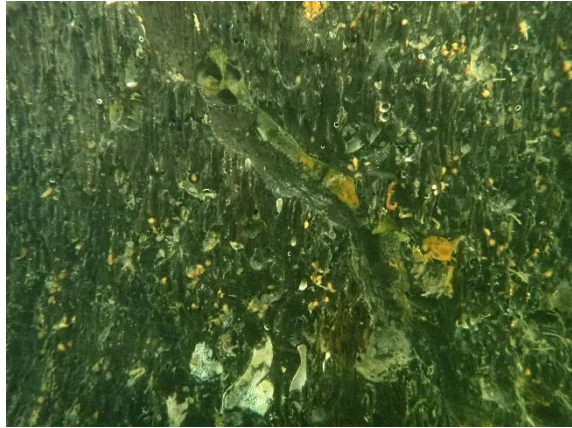
25.1



25.2



25.3



25.4



25.5



25.6

25.1 – Above water section of pile, presenting with minor splitting

25.2 – Example of timber rot and marine borer attack

25.3 – Example of concrete column finishing below required level

25.4 – Example of section loss on timber pile

25.5 – Example of section loss on timber pile

25.6 – Example of encapsulation failure subsea exposing timber pile



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5.26 SITE PHOTOS PILE 13B



26.1



26.2



26.3



26.4

26.1 – Example of minor-moderate splitting on above water section of pile

26.2 – Example of necking present throughout timber pile

26.3 – Example of timber rot on subsea section of pile

26.4 – Encapsulation failure around seabed level



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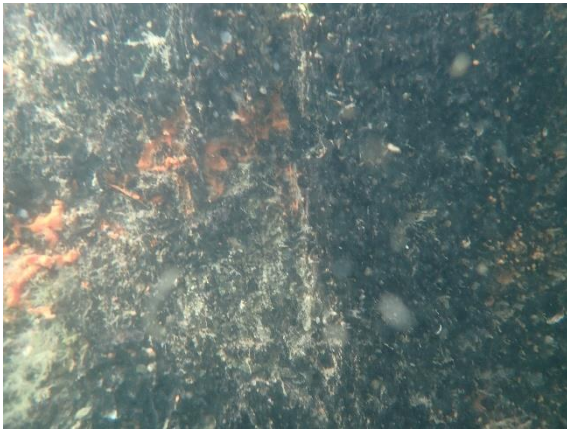
5.27 SITE PHOTOS PILE 14A



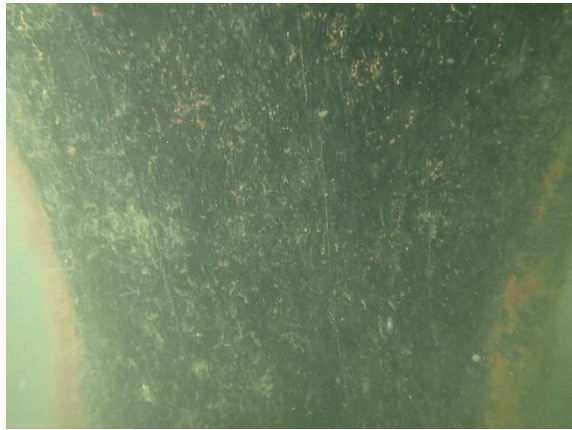
27.1



27.2



27.3



27.4

27.1 – Example of minor-moderate splitting on above water section of pile

27.2 – Example of timber rot and borer on subsea section of pile

27.3 – Example of timber rot and borer on subsea section of pile

27.4 – Example of timber rot and borer on subsea section of pile

5.28 SITE PHOTOS PILE 14B



28.1



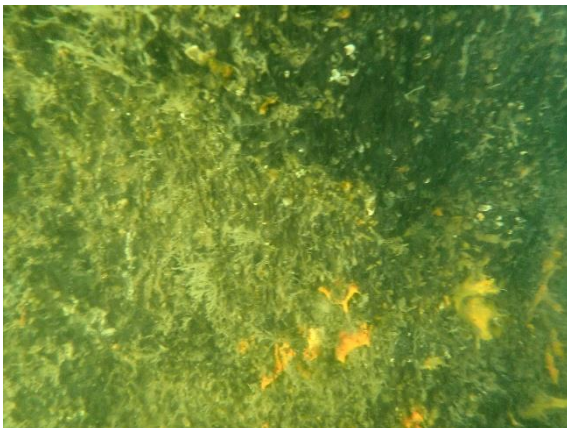
28.2



28.3



28.4



28.5



28.6

28.1 – Example of minor-moderate splitting on above water section of pile

28.2 – Example of minor-moderate splitting on above water section of pile

28.3 – Example of severe timber rot and borer on subsea section of pile 28.4 – Wood rot & borer

28.5 – Example of severe timber rot and borer on subsea section of pile

28.6 – Encapsulation has completely failed to seabed level



5.29 SITE PHOTOS PILE 15A



29.1



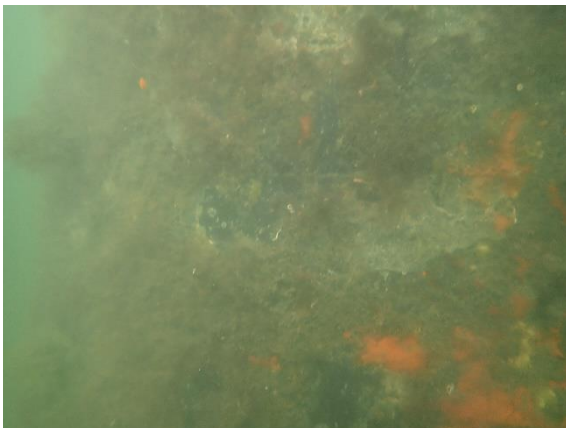
29.2



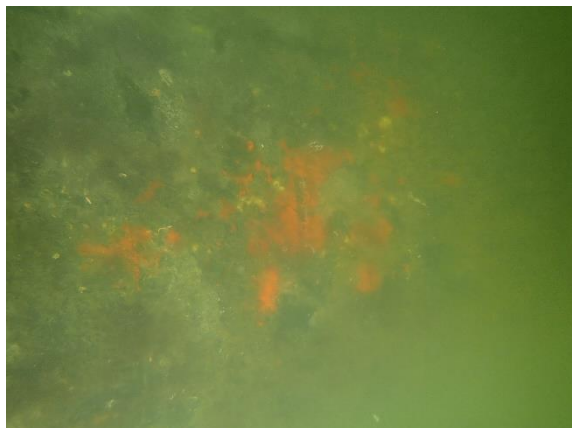
29.3



29.4



29.5



29.6

29.1 – 29.3 Top of timber pile presenting with severe section loss around top of pile where encapsulation terminates

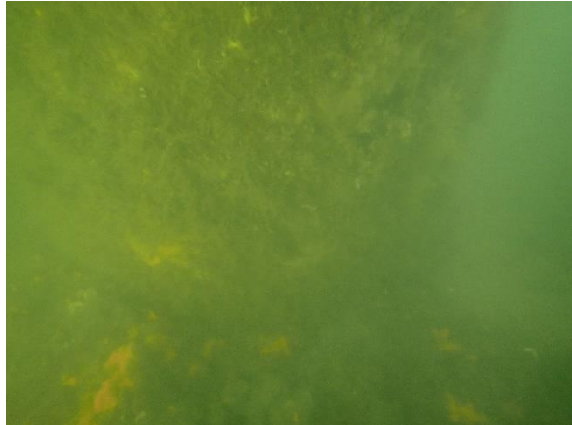
29.4 – 29.6 – Concrete encapsulation on pile around seabed



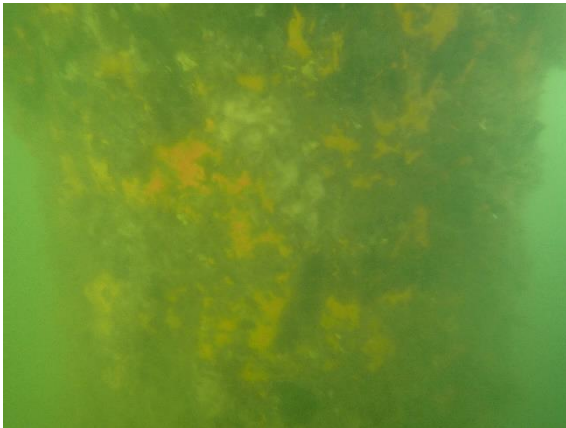
5.30 SITE PHOTOS PILE 15B



30.1



30.2



30.3



30.4

30.1 – Minor necking above encapsulation

30.2 – Encapsulation extends below seabed and is completely intact. Wrap appears in good condition

30.3 – Encapsulation extends below seabed and is completely intact. Wrap appears in good condition

30.4 – Encapsulation extends below seabed and is completely intact. Wrap appears in good condition



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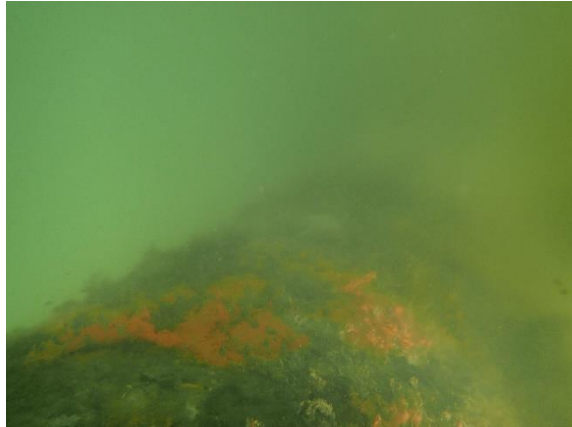
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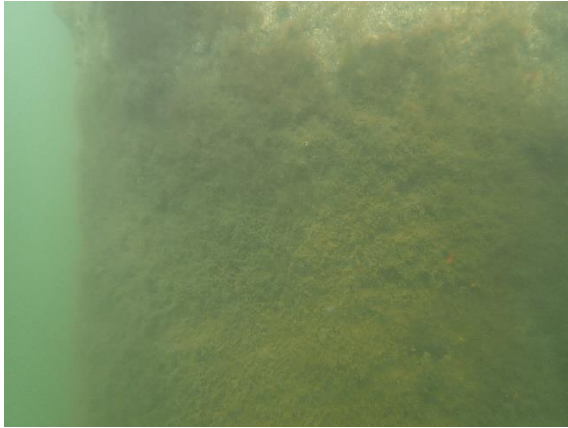
5.31 SITE PHOTOS PILE 16A



31.1



31.2



31.3

31.1 – Minor necking above encapsulation.

31.2 – Encapsulation extends below seabed. Wrap appears in good condition

31.3 – Encapsulation extends below. Wrap appears in good condition

5.32 SITE PHOTOS PILE 16B



32.1



32.2



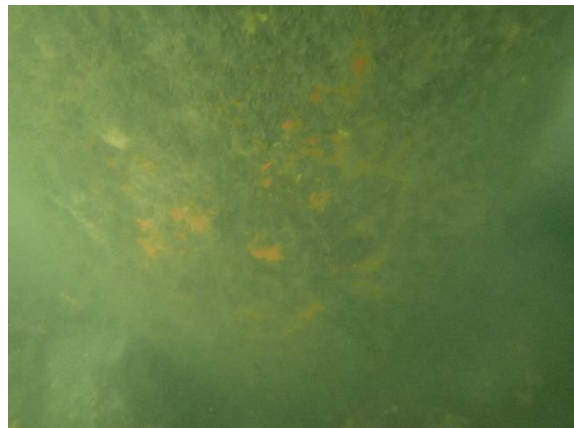
32.3



32.4



32.3



32.4

32.1 – Moderate necking above encapsulation visible on one side of the pile with moderate encapsulation section loss

32.2 – Moderate necking above encapsulation visible

32.3 – Encapsulation extends below seabed and is completely intact. Wrap appears in good condition

32.4 – Encapsulation extends below seabed and is completely intact. Wrap appears in good condition



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5.33 SITE PHOTOS DECKING, KERBING AND HANDRAIL



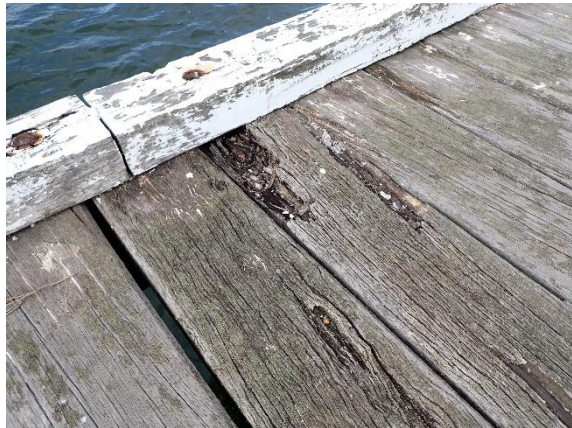
33.1



33.2



33.3



33.4



33.5



33.6

33.1 – Missing sections of handrail

33.2 – Section loss and localised rot on deck boards

33.3 – Example of wood rot on timber kerbing

33.4 – Section loss on walkway timber

33.5 – Section loss on walkway timber

33.6 – Section loss on walkway timber



6 | RECOMMENDATIONS

As a result of the findings from the current inspection, Shorewater Marine recommends the implementation of a capital works package within the short term to ensure the structure remains serviceable and safe for public use. The works package should be targeted at addressing the following issues;

- Near complete failure of the existing concrete pile encapsulations
- Generally poor condition of exposed sections of timber piles
- Moderate to severe corrosion present on structural fixings
- Deterioration of deck boards and kerbing
- Missing section of the timber handrail

6.1 EXISTING ENCAPSULATION AND TIMBER PILES

The majority of existing timber encapsulations have failed entirely and are providing no benefit to the structure. In addition to this, the timber piles have deteriorated past the point wherein a preventative timber protection system would be suitable, such as the Denso Seasheild 80 series system. Instead, it is anticipated that a structural repair is required.

Although no information could be found on the existing encapsulations, they have proved to be unsuitable and were likely installed in the absence of an appropriate specification. To provide a structural repair on the timber piles, the existing encapsulations will need to be removed in their entirety, from the top of the column down to a minimum of 500mm below the seabed. All piles could then have a suitable encapsulation poured, in accordance with the sketch displayed in Image 2, on the following page. Any future encapsulations should utilize specialist underwater high strength grout and incorporate a reinforcement cage.

It was noted during the inspection works that the pile tops where halfcaps attach remain in good condition, any future encapsulations should finish directly below this level, to ensure all vulnerable sections of the pile are adequately protected by the grout column.

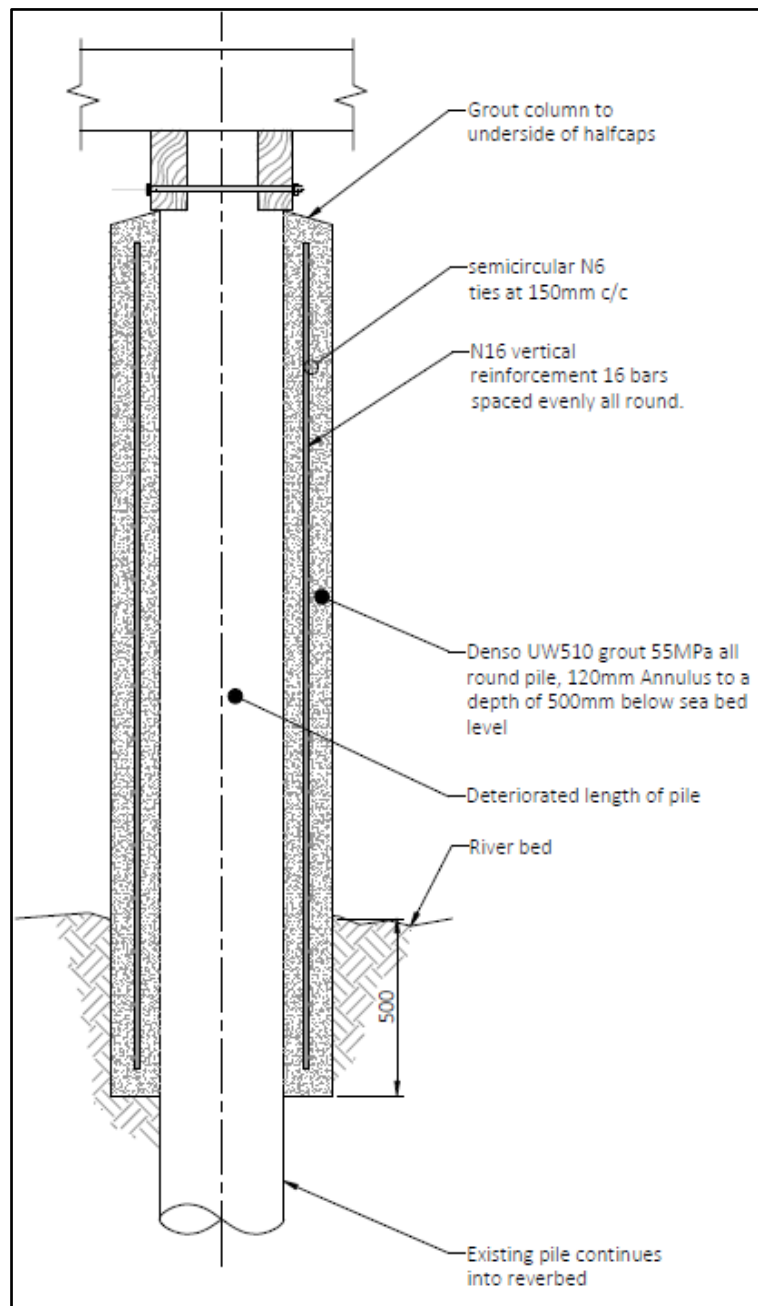


Image 3. Pile Repair Sketch

6.2 STRUCTURAL FIXINGS

It is recommended that the existing corrosion present on the sub-deck structural fixings be removed with the use of mechanical tooling. After all existing corrosion is removed, fixings should be liberally coated with Denso Seasheild Grease, or a similar product.



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6.3 DECKING, KERBING AND HANDRAIL

About 25% of the decking timber presented with severe rot with several ends of kerbing in the same condition. These should be replaced on a like basis.

The two missing handrail sections will need to be replaced asap to avoid the hazard of falling into the water, these can be replaced on a like to like basis to keep with the aesthetic of the jetty.

7 | SUMMARY

Shorewater Marine Pty Ltd would like to thank you for allowing us to provide this Inspection Works report on the outermost jetty along the walkway into the Leschenault inlet, Australind.

We hope the information provided in this report is written in a clear and detailed manner, we are available on the numbers listed should you have any questions or queries regarding this report, or any future works we can assist you with Kind Regards,

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8 | DISCLAIMER & LIMITATIONS

Shorewater Marine Pty Ltd has prepared this report in accordance with the usual care and thoroughness of the consultation profession for the use the WML and only those third parties who have been authorised in writing by Shorewater Marine Pty Ltd to reply on the report.

This report is based on the generally accepted practises and standards relating to inspection procedures at the time it was prepared. All findings and recommendations contained within this document are subject to the limitations of a visual inspection, with no components being removed to facilitate a more in-depth analysis.

This report is submitted on the basis that it remains commercial-in-confidence. The contents of this report are and remain the intellectual property of Shorewater Marine Pty Ltd and are not to be provided or disclosed to third parties without the prior written consent of Shorewater Marine Pty Ltd.