WALLBRIDGE GILBERT AZTEC

The District Council of Tumby Bay

Jetty Condition Assessment Reports

TUMBY BAY JETTY

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Revision History

Rev	Date	Issue	Originator	Checker	Approver
A	12/05/2020	For Internal Review	A. Oliver	U. Singh	
B	14/05/2020	Preliminary Issue	A. Oliver	U. Singh	
C	19/05/2020	Final Issue	A. Oliver	U. Singh	D. Windsor

CONTENTS

EXECUTIVE SUMMARY

Wallbridge Gilbert Aztec (WGA) has been engaged by The District Council of Tumby Bay to undertake a Basic Visual Assessment of the Tumby Bay Jetty based on the procedures outlined by Ports Australia's Wharf Structures Condition Assessment Manual (WSCAM). This report describes the scope of assessment (refer to Section 1) and provides a detailed component summary and recommendations (refer to Section 3).

A high level component summary including the corresponding strategic recommendations is shown in the table below. The recommendations in the summary table are categorized as follows, with further detail provided within the detailed component summary and recommendations in Section 3.

- Replace
- Repair
- Further Investigation
- Monitor

Component Type	Average Rating	Worst Rating	Condition Rating 5 and Under Recommendations	Condition Rating 6 – 7 Recommendations
Piles (Timber)	5.0	7	Monitor / replace condition 4-5 components if remedial works undertaken	Replace or Repair
Piles (Steel)	4.3	6	Monitor / replace condition 4-5 components if remedial works undertaken	Repair
Piles (Concrete)	4.5	7	Monitor / replace condition 4-5 components if remedial works undertaken	Replace or Repair
Crossheads (Timber)	4.4	6	Monitor / replace condition 4-5 components if remedial works undertaken	Replace
Crossheads (Concrete)	6.0	6	N/A	Replace
Corbels	4.8	6	Monitor / replace condition 4-5 components if remedial works undertaken	Monitor / replace condition 6 components if increase in splitting occurs or remedial works undertaken
Bearers	4.6	6	Monitor / inspect top condition 4-5 components if remedial works undertaken. Replace if rotting occurring	Replace

Component Type	Average Rating	Worst Rating	Condition Rating 5 and Under Recommendations	Condition Rating 6 – 7 Recommendations
Cross-Braces	6.9	7	Monitor / replace condition 4-5 components if remedial works undertaken	Structural assessment be conducted to determine if cross-bracing is required. Further information may be required to inform the structural assessment
Cross Beams	5.0	7	Monitor / replace condition 4-5 components if remedial works undertaken	Replace/Refix
Deck (Top)	5.0	5	Replace/refix lifted and loose members. Monitor / replace remaining condition 4-5 components if remedial works undertaken	N.A.
Kerbing	3.9	4	Monitor / replace condition 4-5 components if remedial works undertaken	N.A.
Handrailing	4.1	5	Refix loose stanchions. Monitor / replace remaining condition 4-5 components if remedial works undertaken	N.A.
Access Ladders	3.3	4	Monitor condition 3 & 4	N/A
Lights	3.4	4	Monitor condition 3 & 4	N/A
Shelter	4.0	4	Monitor condition 4	N/A
Sign	4.0	4	Monitor condition 4	N/A
Navigation Beacon	3.0	3	Monitor condition 3	N/A
Access Stairs	4.0	5	Monitor. Replace condition 5 handrails if remedial work undertaken	N/A
Landing Piles (Steel)	5.0	5	Monitor / repair condition 5 components if remedial works undertaken	N/A
Landing Bearers	4.4	5	Monitor / replace condition 4-5 components if remedial works undertaken	N/A

Component Type	Average Rating	Worst Rating	Condition Rating 5 and Under Recommendations	Condition Rating 6 – 7 Recommendations
Landing Fender & Walers	5.5	7	Monitor condition 4	Replace
Landing Deck (Top)	4.0	4	Monitor / replace condition 4-5 components if remedial works undertaken	N.A.
Landing Kerbing	4.5	5	Monitor / replace condition 4-5 components if remedial works undertaken	N.A.
Landing Stairs	3.7	4.0	Monitor condition 3 & 4	N/A

1 INTRODUCTION

1.1 SCOPE OF CONDITION INSPECTION

Wallbridge Gilbert Aztec (WGA) has been engaged by The District Council of Tumby Bay (Council) to undertake a condition assessment of the Tumby Bay Jetty. The intent of the assessment was to undertake a Basic Visual Assessment to determine condition states and provide maintenance / repair recommendations to further extend the structures life. WGA carried out the above water condition assessment on the 30th of January 2020 and a subsequent below waterline by Southern Ocean Dive and Marine on the 24th to 26th of April 2020.

As requested by DPTI, the inspection was conducted to the guidelines set out in the Wharf Structures Condition Assessment Manual (WSCAM), developed and published by Ports Australia. The intent of the WSCAM is to promote the use of best practice methods for the inspection and condition assessment of wharf structures and be able to produce consistent results.

The scope of the assessment included the following components related to the Tumby Bay Jetty:

- Steel, concrete and timber piles (above and below water)
- Timber crossheads, corbels, cross braces, walers and bearers
- Timber deck planks and kerbing
- Handrailing
- Stairs and ladders
- Ancillary items (shelter, lights, signs, navigation beacon)

The components excluded in this inspection is as follows:

- Lighting coverage/amount emitted and electrical components
- Cranes
- Rails

1.2 INSPECTION METHODOLOGY

The Tumby Bay Jetty inspection was generally of a visual nature with comparison to the Basic Visual Assessment condition rating photos and descriptions in the WSCAM. The above waterline inspection was carried out over a half day resulting in the structure being assessed through a half tide cycle (low to high tide). The below deck inspection was carried out by boat and the above deck from deck level, with close inspection and on-site condition rating. The underwater inspection used limited hand tool cleaning to remove marine growth from the piles. Representative condition rating photos were taken and are included in Section 3 of this report.

1.3 ASSESSMENT TO WSCAM

The assessment conducted in this report was carried out to the Wharf Structures Condition Assessment Manual (WSCAM) at a Basic Visual Assessment level. In the basic visual assessment, the condition of a structural element is given a condition state based on condition state descriptions (with the assistance of comparison photographs in the manual). The basic visual assessment generic condition rating scale is shown in Table 1. Where appropriate, bays of similar component condition for above deck elements (deck top, kerbing and handrailing) were grouped. When this was done the grouping size along the length of the jetty was kept consistent to ensure even weighting.

Table 1 – Basic Visual Assessment Generic Condition Rating Scale (extract from WSCAM)

CONDITION STATE	GENERIC DESCRIPTION	EXPECTED REM. LIFE (% of original design life)	ACTIONS
1	New with no visible defects/damage.	100	No repairs required. Inspection at next scheduled inspection.
2	No or very minor defects which do not affect the overall integrity or durability of the element or component	55-100	No repairs required. Inspect at next scheduled inspection.
3	Limited defects present may affect the long term durability of the element or component. Minor deterioration of protective coating or parent material is evident.	40-55	Inspect at next scheduled inspection Continue planned and preventative maintenance. No repairs required.
4	Defects present may have minor impact on integrity. The short term durability of the element of component may be affected. Localised areas of moderate to advanced deterioration may be present.	25-40	Further testing is recommended and mostly reactive maintenance and some minor upgrades. Priority of repairs is low.
5	Advanced deterioration present. Defects present may have a moderate impact on integrity. The immediate durability of the element or component may be affected.	15-25	Maintenance; upgrade or rehabilitation works are required within 5 years or as dictated by expected remaining life. Structural assessment is recommended.
6	Advanced deterioration Defects present likely to have major impact on integrity. Further deterioration will compromise the safety of the structure.	0-15	Rehabilitation or renewal required immediately. Structural assessment is recommended.
7	Very advanced deterioration present. Defects present likely to have an extreme impact on integrity and may constitute failure of the element.	0	Rehabilitation required immediately or replace component/asset. Structural assessment is recommended where rehabilitation works are to be undertaken.

2 ASSET DESCRIPTION & NAMING CONVENTION

2.1 GENERAL ASSET DESCRIPTION

The Tumby Bay Jetty is located at Tumby Bay on the Eyre Peninsula, South Australia. The jetty consists of 61 bents with a length of roughly 350 meters and geographical coordinates of -34.378 latitude, 136.009 longitude. The jetty is constructed as follows:

- Steel square hollow section (SHS), circular concrete and circular timber piles suspend the jetty superstructure from the seabed.
- On top of these piles, timber crossheads, corbels bearers and deck planks form the superstructure with kerbing and handrailing present throughout the deck top.

The jetty is primarily used for recreational fishing and water access for people via two landing part way along the jetty with ladders. Refer to Figure 1 and Figure 2 for jetty photo and location respectively.

Figure 1 – Tumby Bay Jetty

Figure 2 – Tumby Bay Jetty Location

2.2 NAMING / NUMBERING CONVENTION

2.2.1 General

The following sections elaborate on the typical component description and naming convention used in this report and WSCAM spreadsheet to identify the jetty structural components. The figures presented in Section 2.2 are used to provide indicative reference to the component naming convention for the assessed maritime structure. They do not necessarily represent the cross sections observed.

2.2.2 Jetty Component Description

The jetty structure sub-components are reported in accordance with the sub-component naming convention presented in Figure 3.

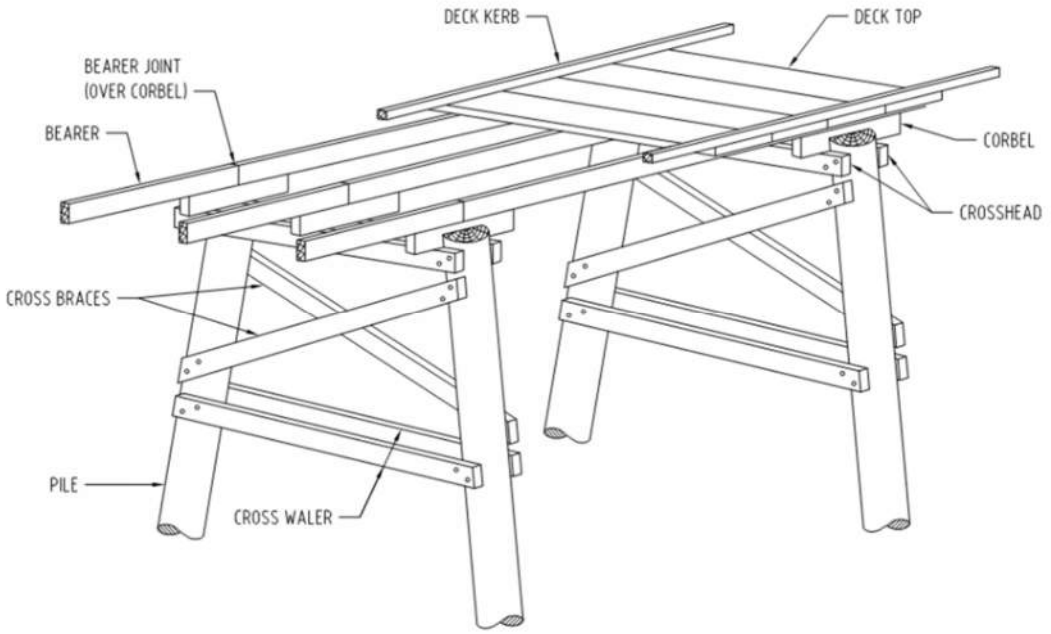

Figure 3 – Jetty Sub – Component Description

2.2.3 Component Naming Convention

The general naming convention used to label components and bents are as follows:

- Bent 0 correlates to the bent at the abutment with subsequent waterside bents increasing in sequential order, refer to Figure 4. Bent numbers are used for piles, crossheads, cross-braces and corbels. Where components are located between bents (i.e. bearers) “Bay” numbers are used. Bay numbers correlate to the nearest landside bent number.

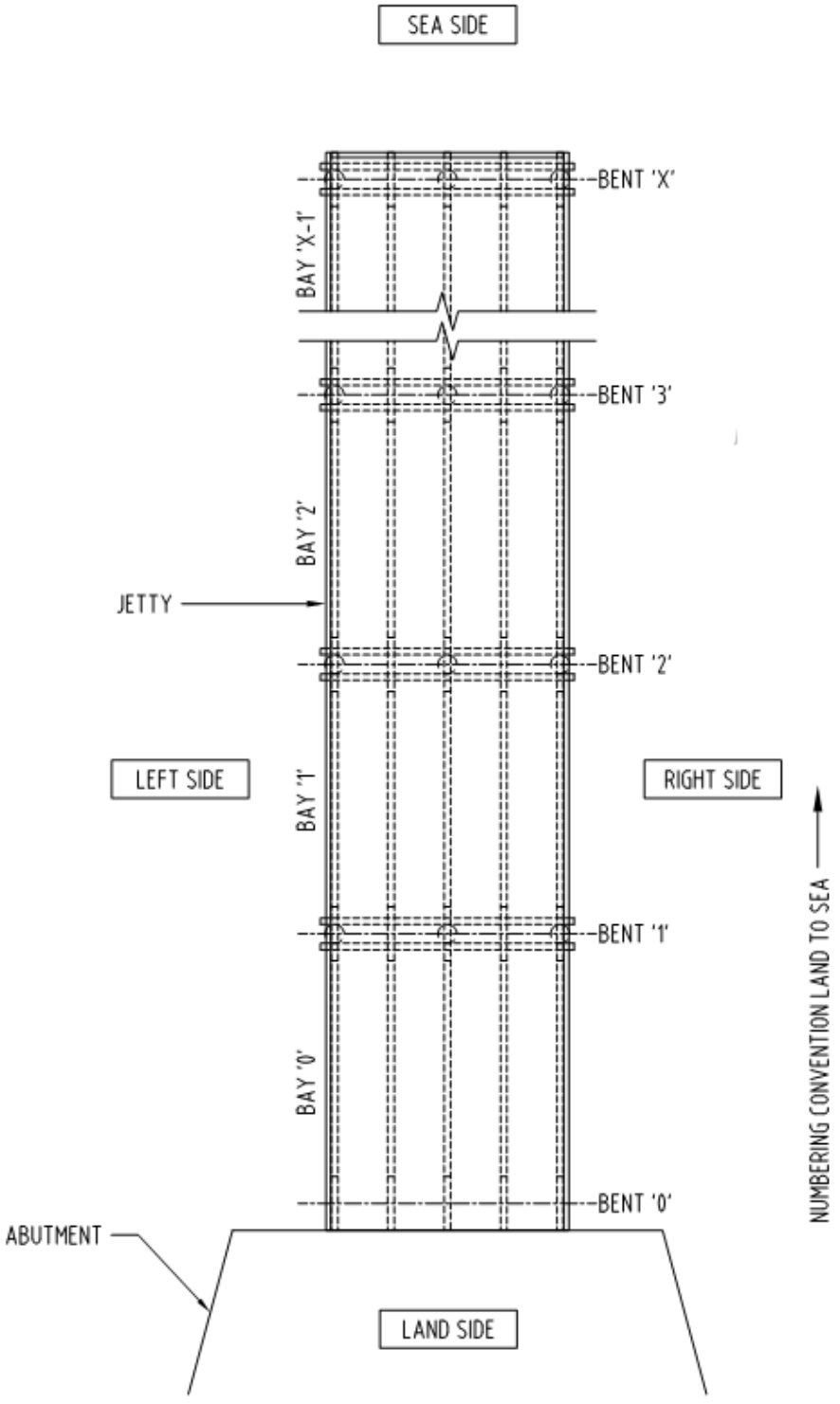

Figure 4 – Bent and Bay Naming Convention

- Facing sea in the direction of the jetty, from left to right component types are labelled from A in sequential letters till the last. E.g. three piles in a bent therefore, left most pile will be labelled as pile A, centre pile will be labelled as pile B and right most pile will be labelled as pile C. The same naming convention is used for corbels, bearers and any structural component that runs parallel to the length of the jetty, refer to Figure 5.

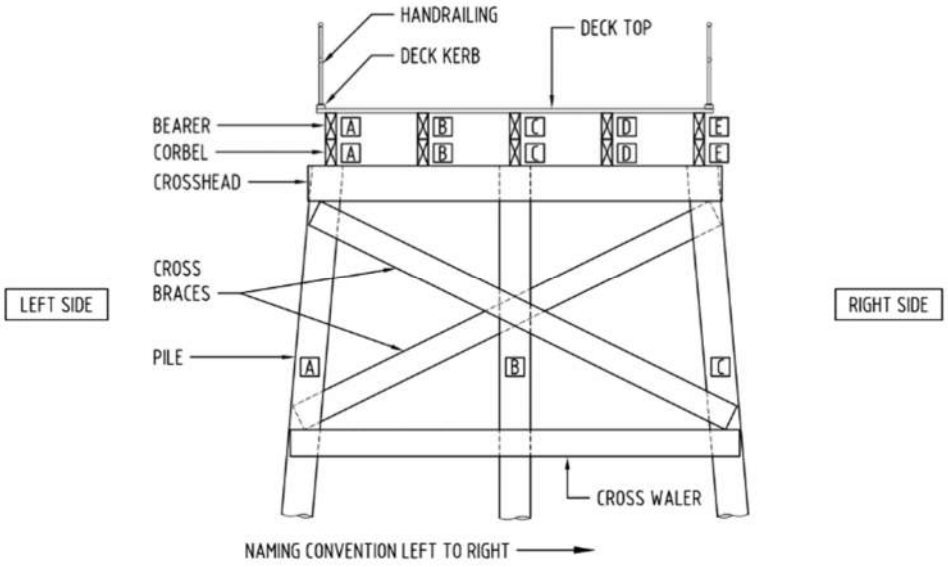

Figure 5 – Component I.D. Naming Convention

- If crossheads either side of pile are present, the crosshead facing land is labelled landside, with the crosshead facing sea being labelled as seaside. The same naming convention is used for any structural component that runs perpendicular to the length of the jetty except for above deck components, refer to Figure 6.

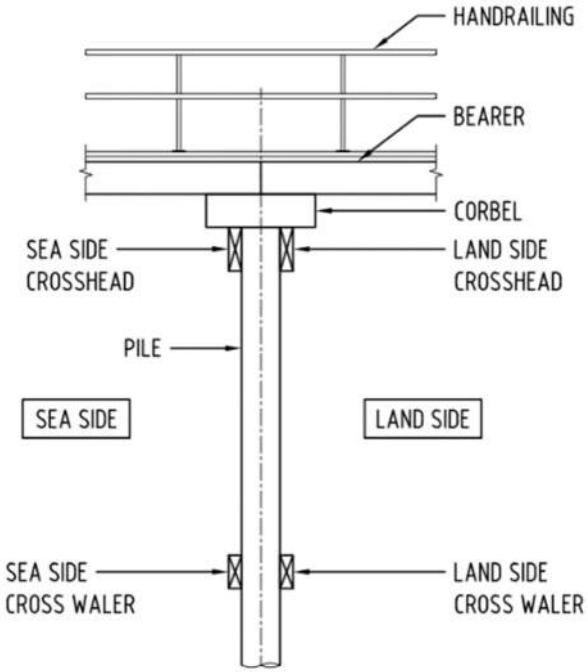

Figure 6 – Component I.D. Naming Convention for Sea and Landside Facing Components

3 CONDITION ASSESSMENT

3.1 COMPONENT CONDITION SUMMARIES

This section summarises the condition rating "spread" for WSCAM assessible component types. Observations not specifically related to WSCAM rated items are described in Section 3.1.182. Detailed "item by item" condition reporting, where applicable can be found in the WSCAM Condition Rating Spreadsheet.

3.1.1 Timber Piles

Table 2 details the condition rating summary for timber piles. Typical timber pile defects are shown in Figure 7, Figure 8 and Figure 9.

Table 2 – Condition Rating Summary for Timber Piles

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Timber Piles	No. of Components (35 Total)				12	13	7	3
					34%	37%	20%	9%
	Comments	• Majority of the original timber piles have been supplemented or replaced with steel piles. Where supplementary steel piles are present the timber pile has been considered redundant and its condition has not been recorded except for where its condition presented a safety concern. • Rotting, splitting and necking of timber piles is typically concentrated in the tidal zone and around bottom cross brace connection. • Majority of timber pile bolted connections were observed to be corroded.						
	Recommended Maintenance	• Replace condition rating 6 & 7 timber piles with 200x16 SHS steel piles or wrap piles with a system capable of restoring original capacity. • Monitor piles with condition rating 5 and below. Replace condition rating 5 piles if other remedial works are undertaken.						

Figure 7 – Typical Condition 5 Timber Pile (Defect: Necking & Damage at cross brace)

Figure 8 – Typical Condition 6 Timber Pile (Defect: Necking & Splitting)

Figure 9– Typical Condition 7 Timber Pile (Defect: Necking & Splitting)

3.1.2 Steel Piles

Table 3 details the condition rating summary for steel piles. Typical steel pile defects are shown in Figure 10, Figure 11 and Figure 12.

Table 3 – Condition Rating Summary for Steel Piles

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Steel Piles	No. of Components (99 Total)				73	25	1	
					74%	25%	1%	
	Comments	• Corrosion of steel piles is typically concentrated at the crosshead support brackets, around the weld of the pile cap and in the spray zone. • All piles ultrasonically thickness tested (3 tests per piles), typical minimum thickness 14.8mm (excluding pile 37C and 39B). Therefore at least 90% of wall thickness remaining. • Pile 37C minimum wall thickness from ultrasonic testing 13mm at bottom. Therefore at least 80% of wall thickness remaining. • 39B has major pitting locally at centre of pile underwater, up to 6mm section loss.						
	Recommended Maintenance	• Replace or grit blast corroded steelwork and repaint condition rating 6 piles. Weld steel new plate to sections where steel thickness loss is greater than 4.0mm prior to painting. • Monitor condition 4 and 5 and grit blast / repaint prior to excessive steel thickness loss (greater than 4.0mm).						

Figure 10 – Typical Condition 4 Steel Pile (Defect: Surface Corrosion)

Figure 11 – Typical Condition 5 Steel Pile (Defect: Surface Corrosion & Pitting)

Figure 12 – Typical Condition 6 Steel Pile (Defect: Surface Corrosion, Pitting & Section Loss)

3.1.3 Concrete Piles

Table 4 details the condition rating summary for concrete piles. Typical concrete pile defects are shown in Figure 13, Figure 14 and Figure 15.

Table 4 – Condition Rating Summary for Concrete Piles

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Concrete Piles	No. of Components (29 Total)				21	3	3	2
					86%	10%	3%	7%
	Comments	• Majority of concrete piles are typically encased in a sleeve and show minor damage in the tidal zone. • Typically, the top of piles have exposed reinforcement that is corroded causing the surrounding concrete to crack and spall. • Majority of steel crosshead connections are corroded. • Piles are installed either vertically or raking outwards from the jetty at various angles. From U/W inspection, piles 39B and 40B appear bent due to impact. • Pile 30B missing sleeve and half concrete at base exposing vertical reinforcement.						
	Recommended Maintenance	• Replace condition rating 6 & 7 concrete piles with 200x16 SHS steel piles. • Remediate crack and spalled concrete at top of condition rating 5 piles ensuring reinforcement is also power toll cleaned to remove corrosion. Alternatively, replace with 200x16 SHS steel piles. • Monitor condition rating 4 and remediate when reinforcement becomes exposed or the concrete cracks/spalls.						

Figure 13 – Typical Condition 5 Concrete Pile (Defect: Minor damage to sleeve, exposed reinforcement and spalled concrete)

Figure 14 – Typical Condition 6 Concrete Pile (Defect: Missing sleeve, cracking and spalled concrete along pile)

Figure 15 – Typical Condition 7 Concrete Pile (Defect: Missing sleeve, exposed reinforcement and missing concrete at seabed)

3.1.4 Timber Crossheads

Table 5 details the condition rating summary for timber crossheads. Typical crosshead defects are shown in Figure 16, Figure 17 and Figure 18.

Table 5 – Condition Rating Summary for Timber Crossheads

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Timber Crossheads	No. of Components (120 Total)			22	51	39	8	
				18%	43%	33%	77%	
	Comments	• Most common defect for crossheads were weathering and splitting at the bolt connection. • The majority of crossheads connecting to timber and concrete piles did not have a sufficient bearing seat (recess in the timber pile or bearing plate) and were heavily reliant on the bolted connections to the pile which were corroded. • Some crossheads had one or more splices along their length, the majority of which have deflected around the connection.						
	Recommended Maintenance	• Replace condition rating 6 crossheads. • Where crosshead are reliant on bolts to timber piles (i.e. no recess in timber pile), the corroded bolts should be replaced with new stainless steel bolts. Alternatively, drive a new steel pile which supports the crosshead directly. • Monitor condition rating 5 and below crossheads to determine if splitting defects or deflections of splices are changing over time.						

Figure 16 – Typical Condition 4 Timber Crosshead (Defect: Weathering)

Figure 17 – Typical Condition 5 Timber Crosshead (Defect: Splitting at Ends and Weathering)

Figure 18 – Typical Condition 6 Timber Crosshead (Defect: Splitting Along Length and Weathering)

3.1.5 Concrete Crossheads

Table 6 – Condition Rating Summary for Concrete Crossheads details the condition rating summary for concrete crossheads. Typical crosshead defects are shown in Figure 19.

Table 6 – Condition Rating Summary for Concrete Crossheads

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Concrete Crossheads	No. of Components (1 Total)						1	
							100%	
	Comments	• Concrete cracking and spalling along underside of member, exposing corroded reinforcement.						
	Recommended Maintenance	• Replace condition rating 6 crosshead with timber crosshead to match the rest of the jetty.						

Figure 19 – Typical Condition 6 Concrete Crosshead (Defect: Cracking & Spalling)

3.1.6 Corbels

Table 7 details the condition rating summary for timber corbels. Typical corbels defects are shown in Figure 20, Figure 21 and Figure 22

Table 7 – Condition Rating Summary for Corbels

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Corbels	No. of Components (259 Total)			6	116	70	67	
				2%	45%	27%	27%	
	Comments	• Most common defect for corbels were weathering and splitting longitudinal splitting at the ends around the bolted connections. • The majority of the bolts connecting the corbel are corroded. • New corbels, condition rating 3 & 4 typically had gangnail plates at each end to reduce splitting.						
	Recommended Maintenance	• Monitor condition rating 6 corbels to ensure bearers are still supported on corbels. Replace corbels if additional splitting occurs or if other remedial works are undertaken at bent. • Monitor condition rating 5 and below corbels to determine if weather and splitting defects are worsening over time.						

Figure 20 – Typical Condition 3&4 Timber Corbel (Defect: Weathering & Minor Splitting of Member)

Figure 21 – Typical Condition 5 Timber Corbel (Defect: Weathering & Splitting at End(s) of Member)

Figure 22 – Typical Condition 6 Timber Corbel (Defect: Weathering & Major Splitting Along Member)

3.1.7 Bearers

Table 8 details the condition rating summary for timber bearers. Typical bearer defects are shown in Figure 23, Figure 24 and Figure 25.

Table 8 – Condition Rating Summary for Bearers

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Bearers	No. of Components (259 Total)			7	117	111	24	
				3%	45%	43	9%	
	Comments	• Most common defect for bearers is weathering and minor splitting. Larger splits around the corbel connections were also common. • The interface between the bearers and decking plank are showing signs of rotting at various locations along the length of the jetty. • Bearers at various locations have been coated in a tar type treatment.						
	Recommended Maintenance	• Replace bearers with a condition rating 6. • Where other works are being undertaken in a bay/bent remove a section of timber decking to inspect the top of bearers rated a condition 4/5 for rotting. If extensive rotting is observed then replace bearer. • Monitor condition rating 5 and below bearers to determine if weather and splitting defects are worsening over time.						

Figure 23 – Typical Condition 3 & 4 Bearer (Defect: Minor Splitting & Weathering)

Figure 24 – Typical Condition 5 Bearer (Defect: Splitting and Weathering along Top)

Figure 25 – Typical Condition 6 Bearer (Defect: Major Splitting & Rotting)

3.1.8 Cross-Braces

Table 9 details the condition rating summary for cross-braces. Typical cross-brace defects are shown in Figure 26.

Table 9 – Condition Rating Summary for Cross-Braces

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Cross-Braces	No. of Components (43 Total)				1			42
					2%			98%
	Comments	• The majority of the bents have either no cross braces or the braces connected to redundant timber piles instead of steel or concrete piles that have been used to supplement/replace degraded timber piles. Where braces have been fixed to a redundant pile were rated a condition 7. • Lack of cross braces is more predominate within the first half of the jetty and braces connected to redundant timber piles more predominate in the second half of the jetty.						
	Recommended Maintenance	• Recommend a structural assessment be conducted to determine if cross-bracing is required. Further information may be required to inform the structural assessment with future works potentially involving repairing / replacing existing and missing cross-bracing.						

Figure 26 – Typical Condition 7 Cross Braces (Defect: Connected to Redundant Pile)

3.1.9 Cross Beams

Table 10 details the condition rating summary for the timber crossbeams. An example of the typical cross beams observed is shown in Figure 27. Due to lack of access no photo of condition rating 7 cross beams were possible.

Table 10 – Condition Rating Summary for Cross Beams

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Cross Beams	No. of Components (4 Total)				2	1		1
					50%	25%		25%
	Comments	• Timber typical defects are weathering and minor splitting. • The condition of the timber of the crossbeam at bent 43 is typically rating 4/5, however the member is connected to a redundant pile, elevating it to a rating of 7.						
	Recommended Maintenance	• Replace/refix condition rating 7 member to non-redundant pile(s). • Monitor condition rating 5 and below cross beams to determine if weather and splitting defects are worsening over time.						

Figure 27 – Typical Condition 4/5 Crossbeam (Defect: Minor Splitting and Weathering)

3.1.10 Timber Decking

Table 10 details the condition rating summary for the timber decking. An example of the typical decking observed is shown in Figure 28.

Table 11 – Condition Rating Summary for Timber Decking

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Timber Decking	No. of Components (61 Lengths Total)				2	59		
					3%	97%		
	Comments	• Minor splitting and weathering observed. • Local defects (holes, splitting, etc) typically filled with asphalt. • Decking timbers loose and lifted at multiple locations creating tripping hazards.						
	Recommended Maintenance	• Refix/replace lifted and loose timber decking planks. • Monitor condition of timber decking to determine the appropriate timing of decking replacement.						

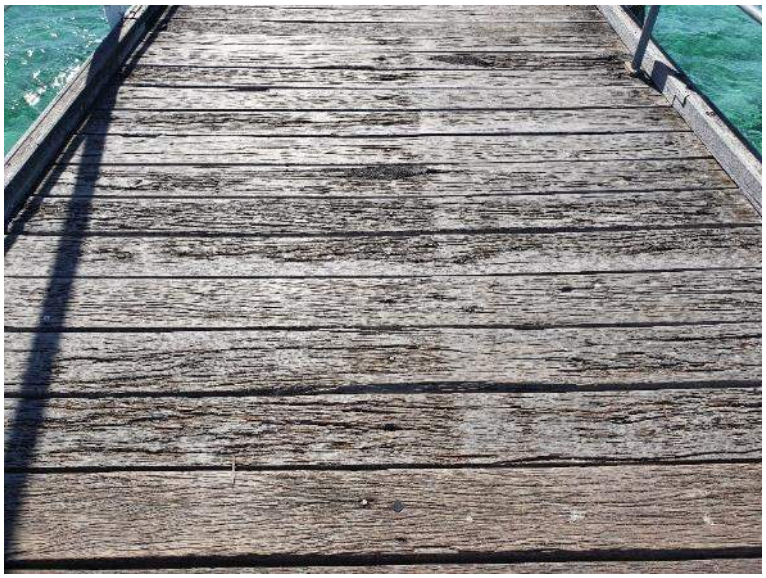

Figure 28 – Typical Condition 4/5 Decking (Defect: Splitting, Weathering & Loose Members)

3.1.11 Timber Kerbing

Table 12 details the condition rating summary for the timber kerbing. Typical kerbing defects are shown in Figure 29.

Table 12 – Condition Rating Summary for Timber kerbing

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Timber Kerbing	No. of Components (61 Lengths Total)			9	52			
				15%	85%			
	Comments	• Minor splitting and weathering observed.						
	Recommended Maintenance	• Monitor condition of timber kerbing to determine the appropriate timing of kerbing replacement. No immediate replacement works required.						

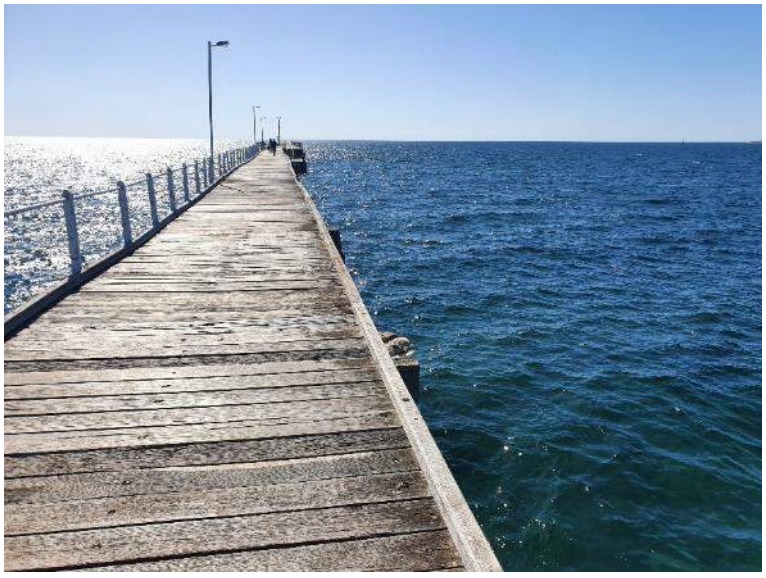

Figure 29 – Typical Condition 3 & 4 Timber Kerbing (Defect: Weathering)

3.1.12 Handrailing

Table 13 details the condition rating summary for the handrailing. Typical handrailing defects are shown in Figure 30.

Table 13 – Condition Rating Summary for Handrailing

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Handrailing	No. of Components (105 Lengths Total)			14	62	29		
				13%	59%	28%		
	Comments	• Minor surface corrosion observed on steel elements. • LHS (facing out to sea) handrail typically has timber stanchions, steel handrail and steel cable mid-rail. RHS handrail typically Monowills style system with no handrailing between bent 26 and 41. • Timber stanchions typically fixed to bearers and Monowills to decking. Loose fixings of stanchions causing large deflections, typically towards the end of the jetty. Condition rating 5 typically have loose stanchions.						
	Recommended Maintenance	• Refix loose stanchions of condition rating 5 handrailing. • Monitor condition of handrailing to determine the appropriate timing of handrailing replacement.						

Figure 30 – Typical Condition 4 Handrailing (Defect: Surface Corrosion)

3.1.13 Ancillary Items

Table 14 details the condition rating summary for the ancillary jetty items. Typical ancillary item defects are shown in Figure 31, Figure 32, Figure 33, Figure 34 and Figure 35.

Table 14 – Condition Rating Summary for Ancillary Jetty Items

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Access Ladders	No. of Components (4 Total)			3	1			
				75%	25%			
	Comments	• Aluminium ladders with minor surface corrosion around fixings (steel fixings) and large amount of marine growth at base.						
	Recommended Maintenance	• Monitor condition of ladders and fixings.						
Lights	No. of Components (9 Total)			5	4			
				56%	44%			
	Comments	• Typically, there is minor surface corrosion along column. Electrical components and amount of light emitted not inspected or included.						
	Recommended Maintenance	• Monitor condition of light steelwork.						
Shelter	No. of Components (1 Total)				1			
					100%			
	Comments	• Minor surface corrosion of steelwork and weathering of timber seats and backing panels. No corrosion occurring the shelter roof sheeting.						
	Recommended Maintenance	• Monitor condition of steelwork and timber						
Sign	No. of Components (1 Total)				1			
					100%			
	Comments	• Weathering of timber surround for lifebuoy and splitting of vertical slats.						
	Recommended Maintenance	• Monitor condition of timber surround.						

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Navigation Beacon	No. of Components (1 Total)				1			
					100%			
	Comments	• Minor surface corrosion around the baseplate and fixings of the navigation beacon.						
	Recommended Maintenance	• Monitor condition of steelwork and fixings.						

Figure 31 – Typical Condition 3 & 4 Access Ladder (Defect: Corrosion of Fixings)

Figure 32 – Typical Condition 4 Light (Defect: Surface Corrosion)

Figure 33 – Typical Condition 4 Shelter (Defect: Surface Corrosion & Weathering)

Figure 34 – Typical Condition 4 Sign (Defect: Weathering)

Figure 35 – Typical Condition 4 Navigation Beacon (Defect: Surface Corrosion

3.1.14 Access Stairs

Table 15 details the condition rating summary for each of the stair elements of the one access stair. The stairs were split into five elements, pile, beam, stringers, handrail and treads. Typical access stair defects are shown in Figure 36.

Table 15 – Condition Rating Summary for Access Stairs

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Access Stairs	No. of Elements (5 Total)			2	1	2		
				40%	20%	40%		
	Comments	• Jetty has one access stair located at bent 24/bay 23. Treads and stringers a condition rating 3, beam a condition rating 4 and handrail and pile a condition rating 5. • Handrail and pile have both surface corrosion in the tidal zone with the pile also having delamination of steel at the pile cap. • Minor defects of FRP treads and surface corrosion of the connections to the stringers.						
	Recommended Maintenance	• Replace condition 5 handrails and grit blast / repaint pile prior to excessive steel thickness loss (greater than 4.0mm). • Monitor condition 3 and 4 elements.						

Figure 36 – Typical Access Stair Defects (Defect: Corrosion)

3.1.15 Steel Landing Piles

Table 16 details the condition rating summary for steel landing piles. Typical steel pile defects are shown in Figure 37.

Table 16 – Condition Rating Summary for Steel Landing Piles

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Steel Landing Piles	No. of Components (5 Total)					8		
						100%		
	Comments	• Corrosion of steel piles is typically concentrated at the crosshead support brackets, around the weld of the pile cap and in the spray zone. • Pile caps of landing at bent 41-42 are wrapped in Denso tape with some delamination from the piles. Piles in landing 21-23 unwrapped.						
	Recommended Maintenance	• Monitor condition ra5 and grit blast / repaint prior to excessive steel thickness loss (greater than 4.0mm).						

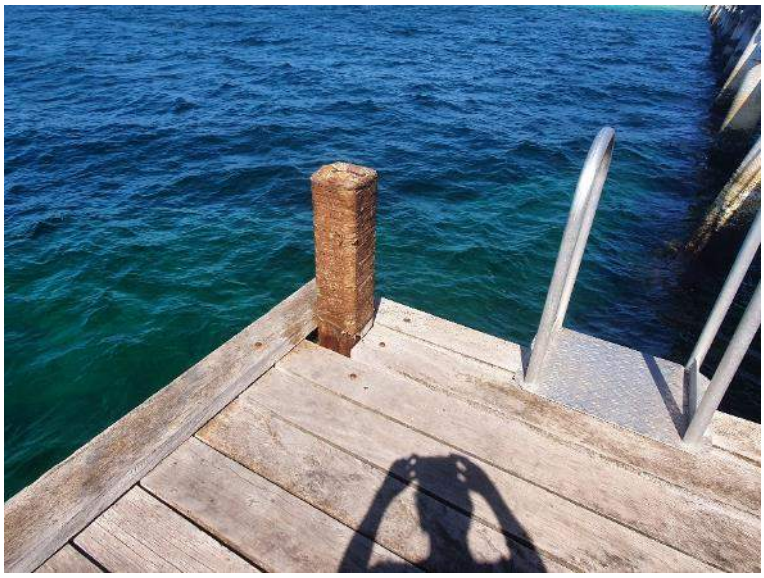

Figure 37 – Typical Condition 5 Steel Landing Pile (Defect: Surface Corrosion)

3.1.16 Landing Bearers

Table 17 details the condition rating summary for timber landing bearers. Typical landing bearer defects are shown in Figure 38.

Table 17 – Condition Rating Summary for Landing Bearers

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Landing Bearers	No. of Components (10 Total)				6	4		
					60%	40%		
	Comments	• Most common defect for bearers is weathering and minor splitting.						
	Recommended Maintenance	• Monitor condition rating 5 and below landing bearers to determine if weather and splitting defects are worsening over time.						

Figure 38 – Typical Condition 4 & 5 Landing Bearer, In Rear Ground (Defect: Splitting & Weathering)

3.1.17 Landing Fenders & Walers

Table 18 details the condition rating summary for timber fenders and walers of the landings. Due to poor access there are no photos of the typical defects for the landing fenders and walers.

Table 18 – Condition Rating Summary for Landing Fenders & Walers

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Landing Fenders & Walers	No. of Components (4 Total)				2			2
					50%			50%
	Comments	• Landing fender are typically a condition rating of 7 due to extensive rotting/decay and being detached. • Landing walers are typically a condition rating of 4 due to minor rotting/decay. • Pile caps of landing at bent 41-43 are wrapped in Denso tape with some delamination from the piles.						
	Recommended Maintenance	• Replace condition rating 7 timber. • Monitor condition rating 4 walers to determine if weather and splitting defects are worsening over time.						

3.1.18 Landing Timber Decking

Table 19 details the condition rating summary for the landing timber decking. An example of the typical landing decking observed is shown in Figure 39.

Table 19 – Condition Rating Summary for Landing Timber Decking

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Landing Timber Decking	No. of Components (4 Lengths Total)				4			
					100%			
	Comments	• Minor splitting and weathering observed.						
	Recommended Maintenance	• Monitor condition of landing timber decking to determine the appropriate timing of decking replacement. No immediate replacement works required.						

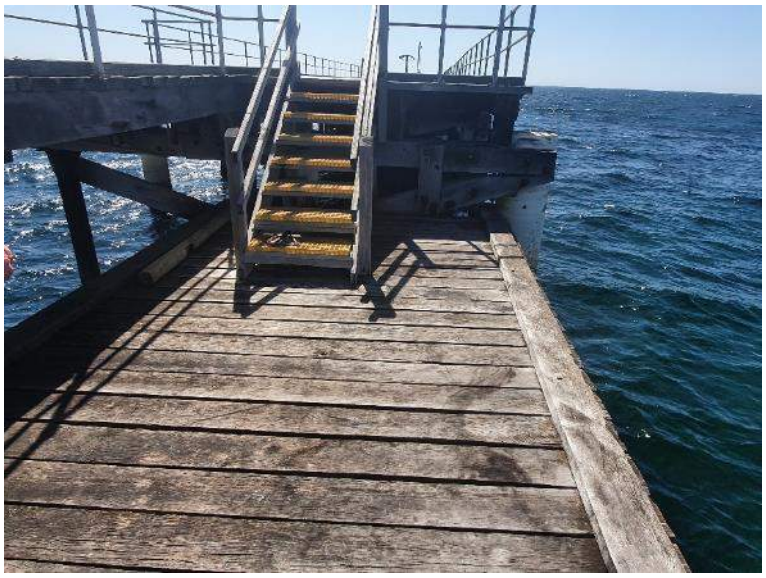

Figure 39 – Typical Condition 4 Decking (Defect: Splitting & Weathering)

3.1.19 Landing Timber Kerbing

Table 20 details the condition rating summary for the landing timber kerbing. Typical landing kerbing defects are shown in Figure 40.

Table 20 – Condition Rating Summary for Landing Timber Kerbing

Component		Worst Case Condition Rating (number of components)						
		1	2	3	4	5	6	7
Landing Timber Kerbing	No. of Components (61 Lengths Total)				2	2		
					50%	50%		
	Comments	• Minor splitting and weathering observed.						
	Recommended Maintenance	• Monitor condition of timber kerbing to determine the appropriate timing of kerbing replacement. No immediate replacement works required.						

Figure 40 – Typical Condition 4 & 5 Timber Kerbing (Defect: Splitting & Weathering)

3.1.20 Landing Stairs

Table 21 details the condition rating summary for each element of the two landing stairs. The stairs were split into three elements, stringers, handrail and treads. Typical access stair defects are shown in Figure 41.

Table 21 – Condition Rating Summary for Landing Stairs

Component		Condition Rating (number of components)						
		1	2	3	4	5	6	7
Landing Stairs	No. of Elements (5 Total)			2	4			
				33%	67%			
	Comments	• The jetty has two landing stairs, one per landing. Treads a condition rating of 3 and handrail and stringers a condition rating of 4. • Handrails and stringer are timber and typically showing signs of weathering • Minor defects of FRP treads and surface corrosion of the connections to the stringers.						
	Recommended Maintenance	• Replace condition 5 handrails and grit blast / repaint pile prior to excessive steel thickness loss (greater than 4.0mm). • Monitor condition of stairs to determine the appropriate timing of element replacement. No immediate replacement works required.						

Figure 41 – Typical Landing Stair Defects (Defect: Weathering)

3.2 GENERAL OBSERVATIONS

The overall structural condition of the Tumby Bay Jetty was generally sound with most structural components falling within the 4 – 5 WSCAM condition rating for timber, steel and concrete element. The elements of with a higher percentage of worse conditions ratings (6 - 7) were the cross bracing and corbels which do not require immediate remedial works for these condition ratings, hence not significantly reducing the overall structural condition of the jetty. Additional general defects that were observed and which are not necessarily applicable to a WSCAM rating are as follows:

- At a few locations, the corbels do not have a vertical hold-down fixing directly into the crosshead or the connection is ineffective due to splitting around fixing. Where this occurs an angle bracket with a single bolt through the side of each member is used, refer to Figure 42. This connection is susceptible to rollover and prying of the bolt when subjected to large lateral and longitudinal forces during a storm event and is not recommended. Instead the steel angle should run full height of the corbel and crosshead and have multiple bolts per member.

Figure 42 – Typical Bearer to Crosshead Connection

- Timber packing has been installed between the corbels and bearers at numerous locations along the jetty. The packing is non-uniform and causes the bearers to be supported on a small, uneven areas (refer to Figure 43). This has the potential to cause the bearers to roll during storm events and also exposes the thread of the bolts in the connection which exacerbates corrosion.

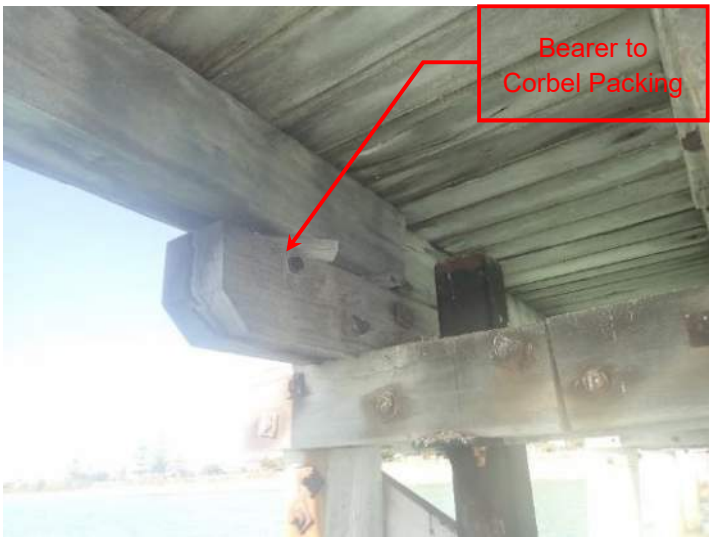

Figure 43 – Typical Bearer and Corbel Timber Packing

- Concrete piles along the RHS of the jetty within the central bents (bents 25-40) rake outwards varying amounts, refer to Figure 44. The raking piles correlate with undulating decking as well as bearers that are out of square and not parallel between bays. It appears that sections of the jetty have subsided and deflected towards the north. From the above waterline inspection, it appears that this could be caused by insufficient geotechnical capacity of the piles, lateral stability/strength or overall structural capacity in the area. Further investigation from the underwater shows that the raking has been caused by in impact, most likely by a vessel. As per the condition rating in the report a new steel pile is to be driven adjacent to concrete pile and the above bay and bent of timber members realigned.

Figure 44 – Raking of Concrete Piles

3.3 COMPONENT CONDITION SUMMARY AND RECOMMENDATIONS

A site condition assessment in accordance with the WSCAM Basic Visual Assessment was carried out as described in Section 1. The detailed “item by item” condition assessment can be found in the WSCAM Condition Rating Spreadsheet, which is also presented as a Condition Distribution Table attached in Appendix A. The condition rating “spread” for each component type with their corresponding recommendations is provided in Section 3 of this report. A condition summary of all structural and deck components for the Tumby Bay Jetty is shown in Table 22.

Table 22 – Component Condition Summary

Tumby Bay Jetty		Condition Rating							
Component Type	Total Number of Components	1	2	3	4	5	6	7	Average Condition Rating
Piles (Timber)	35				12	13	7	3	5.0
					34%	37%	20%	9%	
Piles (Steel)	99				73	25	1		4.3
					74%	25%	1%		
Piles (Concrete)	29				21	3	3	2	4.5
					72%	10%	10%	7%	
Landing Pile	8					8			5.0
						100%			
Access Stair Pile	1					1			5.0
						100%			
Crossheads (Timber)	120			22	51	39	8		4.3
				18%	43%	33%	7%		
Crossheads (Concrete)	1						1		6.0
							100%		
Bearers	259			7	117	111	24		4.6
				3%	45%	43%	9%		

Tumby Bay Jetty		Condition Rating							
Component Type	Total Number of Components	1	2	3	4	5	6	7	Average Condition Rating
Landing Bearers	10				6	4			4.4
					60%	40%			
Corbels	259			6	116	70	67		4.8
				2%	45%	27%	26%		
Cross Braces	43				1			42	6.9
					2%			98%	
Cross Beams	4				2	1		1	5.0
					50%	25%		25%	
Access Ladder	4			3	1				3.3
				75%	25%				
Light	9			5	4				3.4
				56%	44%				
Shelter	1				1				4.0
					100%				
Fish Sign	1				1				4.0
					100%				
Access Stair Beam	1				1				4.0
					100%				
Navigation Beacon	1				1				4.0
					100%				
Landing Walers	2				2				4.0
					100%				
Group assessed items (Average Bay Ratings)									
Deck (Top)	61			25	36				3.6
				41%	59%				
Landing Deck (Top)	4				4				4.0
					100%				
Kerbs	61			51	10				3.2
				84%	16%				
Landing Deck Kerbs	4			2	2				3.5
				50%	50%				
Handrailing	105			68	37				3.4
				65%	35%				
Landing Stair Handrail	2				2				4.0
					100%				
Landing Stair Stringers	2				2				4.0
					100%				
Landing Stair Treads	2			2					3.0
				100%					
Landing Fenders	2						2		6.0
							100%		
Access Stair Handrail	1					1			5.0
						100%			
Access Stair Stringers	1			1					3.0
				100%					
Access Stair Treads	1			1					3.0
				100%					
Group assessed items (Worst Case Ratings)									
Deck (Top)	61				2	59			5.0
					3%	97%			
Landing Deck (Top)	4				4				4.0
					100%				
Kerbs	61			9	52				3.9
				15%	85%				
Landing Deck Kerbs	4				2	2			4.5
					50%	50%			
Handrailing	105			14	62	29			4.1
				13%	59%	28%			
Landing Stair Handrail	2				2				4.0
					100%				
Landing Stair Stringers	2				2				4.0
					100%				
Landing Stair Treads	2			2					3.0
				100%					
Landing Fenders	2							2	7.0
								100%	
Access Stair Handrail	1						1		6.0
							100%		
Access Stair Stringers	1				1				4.0
					100%				
Access Stair Treads	1			1					3.0
				100%					

4 MAINTENANCE SCHEDULE AND PRELIMINARY COSTS

4.1 MAINTENANCE SCHEDULE

The recommend timeframe to undertake the maintenance on the Tumby Bay Jetty can be seen in Table 23. The table excludes the monitoring of the jetty which is ongoing work that should be undertaken continuously until the next WSCAM inspection in 5 years.

The maintenance works of the jetty should be scheduled to coordinate as much work as possible simultaneously to reduce costs. The Heat Map in Appendix A that shows the distribution of condition ratings along the jetty can be used to coordinate these works.

Table 23 – Maintenance Schedule

Item	Condition Rating	Recommended Maintenance	Timeframe
Cross Beam	7	Replace/Refix	2 years
Timber & Concrete Piles	7	Replace with steel 200x16 SHS piles	2 years
Cross-Braces	3 4 5 6 7	Further analysis to determine if members are required	2 years
Timber & Concrete Piles	6	Repair/Replace with steel 200x16 SHS piles	5 years
Access Stair Handrailing	6	Replace	2 years
Timber Decking	5	Refix loose & lifted members	5 years
Crosshead, Corbels, Bearers	6	Replace	5 years
Landing Fenders	7	Replace	5 years

4.2 PRELIMINARY COSTS

To assist the Council in creating budget estimates to undertake the recommended maintenance a summary of rates for the supply and install of major items are outlined in Table 24 – Preliminary Costs.

Table 24 – Preliminary Costs

Item	Supply (each)	Install (each)	Rate
Piling Barge	-	-	$9,500.00/day
200x16 SHS Steel Piles	$7,500.00	$3,500.00	-
300x150 F15 Cross Beam	$850.00	$1,600.00	
300x150 F14 Crossheads	$500.00	$1,500.00	-
300x150 F14 Corbels	$150.00	$500.00	-
300x150 F14 Bearers	$700.00	$1,200.00	-
300x150 F14 Cross-Braces	$650.00	$900.00	-

These rates are based on our experience with other similar projects and should be used as only a guide for preparing budget estimates. They do not include the demolition or disposal of the existing structure. Costs may vary depending on the availability of materials and scope of work.

APPENDIX A

CONDITION DISTRIBUTION TABLE (HEAT MAP)

Bent / Bay No.	Pile					Crossheads			Crossbraces		Corbels								Bearers							Landing Bearers			Deck Top	Landing Deck Top	Kerbing	Handrails		Light	Landing Piles		Access Ladder	Cross Beams	Shelter	Fish Sign	Navigation Beacon	Landing Fenders	Landing Waler	Landing Stair Stringers	Landing Stair Treads	Landing Stair Handrail	Access Stair Handrail	Access Stair Stringers	Access Stair Treads	Access Stair Pile	Access Stair Beam
	A	B	C	D	I	L	S	M	L	S	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	A	B	C				A	B		A	B														
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