better boating VICTORIA

Victorian Boating Facility Maintenance Guidelines

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Victorian Fisheries AUTHORITY

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We proudly acknowledge Victoria's First Nations peoples and their ongoing strength in practising the world's oldest living culture. We acknowledge the Traditional Owners' lands and waters on which we live and work, and pay our respects to their Elders past, present and emerging. We recognise the strength of Aboriginal people, Traditional Owners and their communities, and value the ongoing contribution of Aboriginal people to Victorian life, through their daily work, their application of Aboriginal knowledge and practice, and at key events; we recognise how this enriches us all. We have distinct legislative obligations to Victorian Traditional Owner groups related to cultural and natural heritage, that are paramount in our responsibilities in managing Victoria's resources in partnership with Traditional Owners.

Currency: This publication, Victorian Boating Facility Maintenance Guidelines, is published in May 2022.
Subsequent versions may be published from time to time at betterboating.vic.gov.au

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Preface

All works associated with upgrading or, providing general maintenance to boating facilities, will be underpinned by the principle of making it cheaper and easier to boat and fish.

This will apply to creating more space, improving the ease of launching and parking, and improving the boating and fishing experience of all Victorians.

Foreword

Publicly accessible boating facilities across Victoria are currently managed by a variety of entities (e.g. local government, crown land committees of management, water corporations, port management bodies etc) each of which have varied levels of experience, control and obligations in their management duties. The variety of management arrangements and the funding programs provided for recreational boating facilities in Victoria has led to inconsistent maintenance practices across facilities state-wide.

Recreational boating registrations in Victoria are increasing, leading to greater demand for and usage of boat ramps around the state. The varying conditions of recreational boating infrastructure, as a result of variable and sometimes inconsistent management and maintenance programs, can lead to frustration for recreational boating users, with the added pressure of increased usage exacerbating maintenance requirements. Furthermore, vessels size has increased and in some instances, place additional loads on ramps and holding structures.

Charting the Course: The Victorian Recreational Boating Strategy 2021–2030 identifies an objective 'to enhance the Victorian boating experience by supporting and improving the maintenance of our public facilities'. This includes developing a set of Victorian Boating Facility Maintenance Guidelines for public boat ramps.

This document provides a state-wide reference guideline to assist public boating facility managers in the maintenance of boating facilities across Victoria. It has been prepared based on a review of the existing maintenance practices for boating facilities across Australia, with consideration of international guidelines, and complemented by consultation with key representatives from Better Boating Victoria, Maritime Safety Victoria (MSV), Department of Environment, Land, Water and Planning (DEWLP) and selected public boating facility managers from coastal and inland waterways across Victoria.

The intended purpose of these guidelines is to provide complementary guidance to public boating facility managers and maintenance personnel on how to schedule and conduct maintenance, inspections and repairs to ensure their boating facilities remain functional and safe for users. However, these guidelines are not intended to replace advice provided by specialist professionals, engineers and contractors.

Glossary and Abbreviations

Abutment	Landside support of a spanning element such as a gangway
Aids to Navigation	A device, system or service, external to vessels, designed and operated to enhance safe and efficient navigation of individual vessels and/or vessel traffic
Amenity	The quality of being pleasant or attractive; a feature that adds value
Annual	Recurring, performed every year (yearly)
Approaches	The area on the periphery of the boat ramp, where queuing or low speed manoeuvring occurs
Bi-annually	Recurring, performed twice a year
Bollards	A post used define boundaries or deter vehicle or pedestrian access
Bump stop	Compressible barrier to indicate the end of a boat ramp or car space, typically of similar construction to kerbing
Capstans	A rotating vertical axled machine on which cable or rope is wound for raising anchors or other heavy items
Chevron	The pattern formed by the impression of the drainage/traction grooves
Cleats	A fitting typically located on vessel holding structures around which a rope may be made fast, usually with two projecting horns
Component	An identifiable part of the boat ramp facility which provides a particular function or group of related functions such as a boat ramp or vessel holding structure
Cover (of concrete)	Thickness of concrete protecting the reinforcement in a structure
Design Life	The period for which a structure, component or element is to be used for its intended purpose with anticipated maintenance but without major repair required

Deterioration	Worsening in condition
Durability	The ability to withstand wear and last a long time without becoming damaged
Elements	An item that performs a specific task, usually structural, such as a pile, beam or crosshead. Elements constitutes and facilitates use of a component
Public Boating Facility Manager	The local manager of a public boating facility, i.e. local council, local committee of management, state authority or agency, water authority or corporation, or individual, responsible for the management of the boat ramp facility on public land
Fenders	Energy-absorbing elements typically used on the face of a vessel holding structure to protect the ship and structure from damage due to impact between the two during berthing and mooring
Fibre Reinforced Polymer (FRP)	Is a composite material made of a polymer matrix reinforced with fibres
Flashing	Impervious material used to prevent water penetration or seepage and to direct the flow of water
Freeboard	The vertical distance between the water surface and the deck of a floating structure including pontoons and vessels.
Furniture	Movable items used to support activities such as fishing, sitting or eating such as tables
Gangway	A structure which provides access between a walkway or shore and a floating structure or vessel
High Density Polyethylene (HDPE)	High Density Polyethylene (HDPE) is a thermoplastic polymer made from petroleum which is commonly used at boating facilities on floating structures and sleeves due to its durability in a marine setting
Inspections	Inspections are conducted routinely or triggered by events, to determine asset condition and aimed to inform the need for restoration of structural integrity and/or durability. Inspections are varied in type and levels of technicality and effort and can be conducted at varied frequencies dependent on their need
Jetty	A horizontal decked walkway on piered or piled footings providing pedestrian access from the shore to the waterway and is generally aligned perpendicular to shore
Length overall (LOA)	Length overall (LOA) is the maximum length of a vessel's hull, measured parallel to the waterline.

Low Mean Water Spring (LMWS)	The height of mean low water springs is the average throughout a year of the heights of two successive low waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is greatest
Maintenance	Maintenance is preventative in principle, it should consider work undertaken on a regular basis to ensure functionality and to sustain a low rate of degradation for as long as possible. It is generally straightforward, routine and repetitive. Most importantly, maintenance is conducted independent of a structures condition.
Material	A substance (or mixture of substances) that constitutes an element, the materials that make up the majority of the structural elements
Media	Plural of medium, a gaseous, vaporous, fluid or solid material, the substance in which something is contained or acts i.e. the medium of air or water.
Member	A support that is a constituent part of any structure i.e. a structural member is a component or part which provides vertical or lateral support
Mean High Water Level	In waterway areas influenced by tides, the Mean High Water Level should be defined by the Mean High Water Springs (MHWS) tidal condition. In non-tidal areas, the Mean High Water Level may be determined from an analysis of water level records or local knowledge. It should include an allowance for predicted sea level rise over the design life of the facility that is based on projections that are widely accepted by competent scientific opinion, or as stipulated in local regulations
Pontoon	A floating platform used for access to the water or a vessel
Repairs	Repairs are considered reactive, and like inspections, can be classified into a variety of levels. The main difference between maintenance and minor repairs is that repairs are dependent on the presence of damage and their resultant condition, designed to arrest deterioration as it is observed. Although not always repeated, depending on the scope of works, repairs are likely to vary and generally more complex and costly than typical maintenance activities
Scour	Removal of material around a structure by the force of moving water
Toe	Depth of the vertically lowest point of the surface of an element
Utilities	A category of elements that provide basic amenities and fulfill specific functions, such as supply of water or lighting

Introduction

1.1: Objectives

The objective of the Victorian Boating Facility Maintenance Guidelines (2022) is to support public boating facility managers by providing guidance on:

- Planning and scheduling of regular maintenance activities
- Planning and carrying out regular condition inspections (to inform maintenance and repairs)
- Planning and execution of repair works

1.2: The Structure of this Guideline

The guideline consists of the following primary chapters:

1. This Introduction chapter, including a brief description of the Structure and Scope of these Guidelines
2. Chapter 2: Asset Management and the Maintenance Process for consideration by public boating facility managers
3. Chapter 3: Maintenance provides guidance on regular maintenance actives that should be implemented for each component of a boating facility
4. Chapter 4: Inspections provides guidance in the planning and execution of regular and event-triggered condition inspections
5. Chapter 5: Repairs provides guidance on the planning and execution of typical repairs that are commonly required in boating facilities.

In addition to the content provided in each chapter, two styles of coloured text boxes are included throughout these guidelines, to relate the technical content to common best practice and provide Victorian specific examples and information to assist in the delivery of the material. Blue boxes will indicate 'Best Practice Guidance', and Yellow Boxes will indicate 'Victorian Relevant Information and Examples'.

Best Practice Guidance and General Recommendations

Blue coloured text boxes are presented throughout these guidelines document to highlight guidance on best practice and general recommendations.

Victorian Relevant Information and Examples

Yellow coloured text boxes are presented throughout these guidelines document to provide Victorian relevant information and specific examples.

1.3: Victorian Boating Facilities and Conditions

These guidelines are intended for public facilities across Victoria, including boat ramps and boat launch and retrieval facilities along:

- Open coast regions
- Bays, marine and estuarine waterways (Figure 1.1)
- Inland waterways (e.g. lakes and rivers) (Figure 1.2)

Figure 1.1: Example of an urban ramp at Altona, Victoria

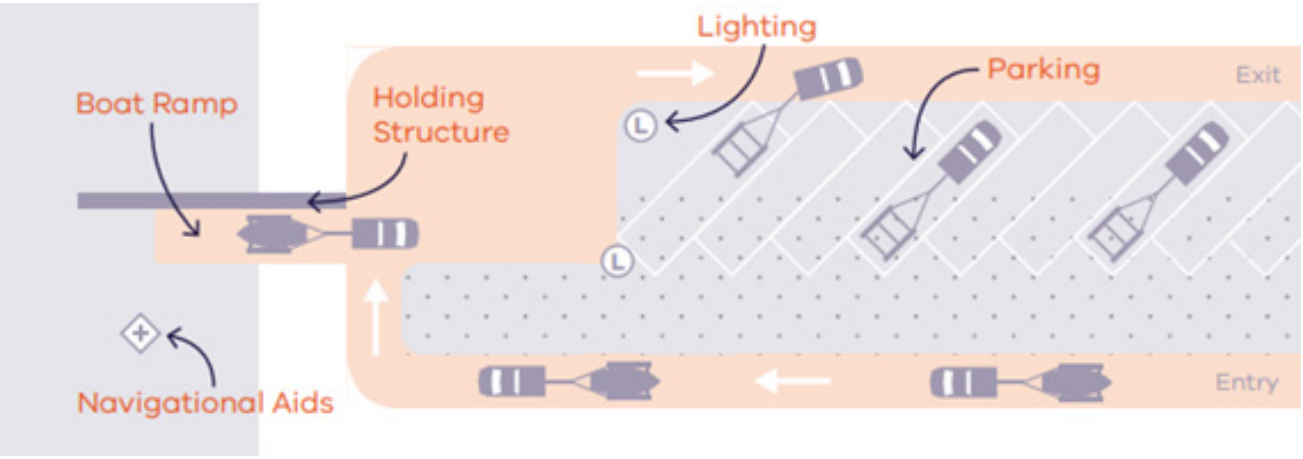
Figure 1.2: Example of a local-rural ramp at Mildura, Victoria

Although there are commonalities in the maintenance and repair needs of boating facilities across many regions, these guidelines have been prepared acknowledging the variable and specific conditions and features that take place in each facility which differ between the above listed groups.

1.4: Boating Facilities Components Covered in these guidelines

A boating facility services boaters, enabling launching and retrieval of vessels to and from waterways. Key components of these facilities include the boat ramp, approach, parking areas and vessel holding structures (jetties, gangways and pontoons), with additional ancillary components improving the amenity of the facility (e.g. lighting, toilets etc), as shown in Figure 1.3.

Figure 1.3: The main assets of a boating facility



These guidelines focus on the components at the waterline, applying to components listed in Table1.1 to Table 1.5 with each component categorised into elements as shown in Figure 1.4. Elements are further grouped by materials and into one of the following groups depending on their function:

- Structural Elements (e.g. piles, beams, corbels, crossheads, decks, pontoon frames, gangway frames, ramp approaches, etc)
- Non-Structural – Static – Elements (e.g. abutments, kerbs, bollards, railings, pontoon floats, fenders, tread plates, etc)
- Non-Structural – Dynamic – Elements (e.g. gangway hinges, pontoon joints, etc)
- Utilities, Safety and Ancillary Equipment (e.g. lighting, universal access and aids, mooring hardware, ladders, fish cleaning facilities, Boating Vic ramp and carpark camera, etc)
- Coastal Protection Structures (e.g. breakwaters, revetments, seawalls, groynes, training walls, causeways, basins, etc)

Figure 1.4: The main elements of a boat ramp and boat holding structure

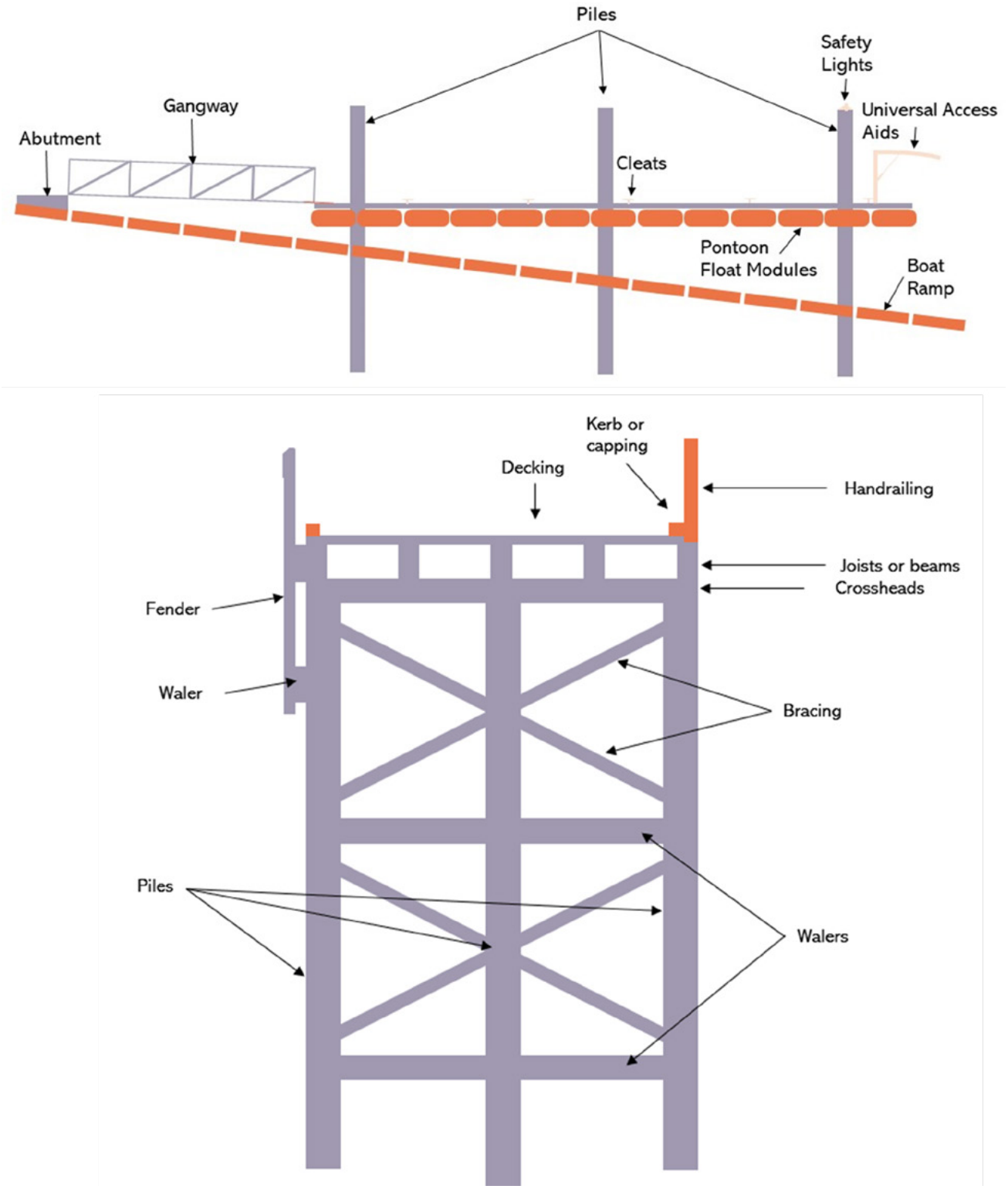


Table 1.1: Boat Ramp Components, Elements and Materials

Component	Element	Function	Material
Boat Ramps	Ramp and approach	Structural	Reinforced and Unreinforced Concrete
			Concrete blocks cast onto woven fabric or steel
			Timber
	Piles	Structural	Steel
			Reinforced Concrete
			Timber
	Beams, Corbels and Crossheads	Structural	Steel
			Reinforced Concrete
			Timber

Table 1.2: Vessel Holding Components, Elements and Materials

Component	Element	Function	Material
Vessel Holding Structures	Piles	Structural	Timber
			Steel
			Reinforced Concrete
			Fibre Reinforced Plastic
	Beams and Crossheads	Structural	Timber
			Steel
			Reinforced Concrete
			Fibre Reinforced Polymer (FRP)

Table 1.2: Vessel Holding Components, Elements and Materials (Continued)

Component	Element	Function	Material
Vessel Holding Structures	Decks	Structural	Timber
			Reinforced Concrete
			Fibre Reinforced Polymer (FRP)
			Aluminium
			Recycled Plastic
	Fenders and Walers	Non-Structural Static	Timber
			Fibre Reinforced Polymer (FRP)
			Recycled Plastic
			Rubber
	Floating Pontoon Modules	Non-Structural Static	Steel
			Reinforced Concrete
			High Density Polyethylene (HDPE)
			Composites
	Gangways and Abutments	Structural	Steel
			Aluminium
			Concrete

Table 1.3: Land-side Pavement Components, Elements and Materials

Component	Element	Function	Material
Land-side Pavements	Car and Car Trailer Unit (CTU) parking	Structural	Asphalt
			Concrete
			Gravel
			Grassed
	Pedestrian Footpaths	Structural	Asphalt
			Concrete
			Gravel

Table 1.4: Utilities, Safety and Ancillary Components, Type and Description

Component	Type	Description
Utilities, Safety and Ancillary	Electrical systems	Navigation Lights
		Lamp posts and other lighting
		Cameras
		Solar Panels
	Mooring Hardware	Cleats
		Bollards
	Universal Access Aids	Davits
		Hoists
	Traffic Aids	Kerbs and bump stops
		Bollards
		Traffic Posts
		Line Markings
Utilities, Safety and Ancillary	Boating Facility Furniture	Seating
		Pedestrian Shelters
	Ancillary Equipment	Fish Cleaning Stations
		Boat Washdown Stations
		Fishing Platforms
	Safety Equipment	Life Buoys
		Ladders
		Handrails

Table 1.5: Coastal Protection and Harbour Structures, Types and Description

Structure	Type
Coastal Protection and Harbour Structures	Breakwater
	Wave Screens
	Revetment
	Seawall
	Groyne
	Training Walls
	Causeway

1.4.1: Components excluded from these guidelines

It should be noted that these guidelines exclude maintenance of waterway access, navigational channels and general dredging. Consideration should be given to AS 3962-2020 and the Victorian Boating Facility Design Guidelines (BBV, 2022) to ensure adequate navigation is achieved at each boat ramp facility.

In the case where elements of a boating facility are excluded from these guidelines, public boating facility managers could refer to other useful resources listed in Section 1.7.

1.5: Who Should use these Guidelines?

The intended purpose of these guidelines is to provide complementary guidance to public boating facility managers and maintenance personnel on how to schedule and conduct maintenance, inspections and repairs to ensure their boating facilities remain functional and safe for users. However, these guidelines are not intended to replace advice provided by specialist professionals, engineers and contractors.

1.6: Stakeholder Needs

Public boating facility managers are encouraged to consult with stakeholders to understand the specific requirements of the users of that boat ramp and improve the overall experience for the user. The need for stakeholder consultation depends on the extent and type of maintenance or repair. For example, replacement of a deteriorated member will not typically require stakeholder consultation; however, replacement of a large trafficable surface such as a pontoon should involve some level of stakeholder engagement to determine if improvements to the facility could easily be accommodated.

For any existing boating facility, the public boating facility manager should understand the specific needs of stakeholders, such as:

- vessel types
- access requirements and constraints (e.g. is all-tide access required, or achievable)
- operational and functional criteria
- key issues associated at a facility
- demand and throughput goals (including congestion)
- the demography of vessels and car-trailer units, and likely parking demand at the site
- environmental, cultural or heritage sensitivities
- safety issues
- known uses when planning for design upgrades, and identification of conflicts with other users

Continued Feedback from Boating Facility Users for Maintenance

It is recommended that boating facility managers establish a process or mechanism that enables continued feedback from users to inform items that may require attention for maintenance and repair; noting that users would often identify some of this items at first. This can be for example: signage providing the contact details of the facility manager, a 'dropbox' for comments at the facility, a comments form via a website, QR codes, etc.

1.7: Other Useful Resources for Public Boating Facility Managers

Reference should be made to the following guidelines and standards as supplements to these guidelines:

- Australian Standards
  - AS 1379-2007 Specification and supply of concrete
  - AS 1428-2010 Design for access and mobility set
  - AS 1742-2014 Manual of uniform control traffic devices
  - AS 1743-2001 Road signs – specifications
  - AS 1744-2015 Standard alphabets for road signs
  - AS 2758-2014 Aggregates and rock for engineering purposes
  - AS 2890-2004 Parking Facilities
  - AS 3600-2018 Concrete structures
  - AS 3962-2020 Guidelines for design of marinas
  - AS 4678-2002 Earth-retaining structures
  - AS 4997-2005 Guidelines for design of maritime structure.
- VicRoads Standard Sections
  - 100 Series - General
  - 200 Series - Formation
  - 300 Series - Flexible Pavements
  - 400 Series - Asphalt and Surface Treatments
  - 500 Series - Concrete Pavements
  - 600 Series - Bridgeworks
  - 700 Series - Incidental Construction
  - Section 800 Series - Materials.
- VicRoads Technical Notes
  - TN 038 – Cracks in Concrete
  - TN 072 – Cementitious repair of concrete structures
  - TN 080 – Soil Slope Routine Maintenance
  - VicRoads Road Design Note 06-04 - Accepted Safety Barrier Products.
- VicRoads Bridge Maintenance and Repair Manual (2018)
- DEWLP Visual inspection guidelines for coastal protection structures on Crown land
- DELWP Siting and Design Guidelines for Structures on the Victorian Coast
- Ports Australia - Wharf Structures Condition Assessment Manual
- IALA Guidelines
  - No. 1035 – Availability and Reliability of Aids to Navigation
  - No. 1077 – Maintenance of Aids to Navigation.
- Asset Management Accountability Framework (AMAF).

02: Notes on Asset Management and Maintenance Process

The following notes are provided in these guidelines for consideration by public boating facility managers when preparing an asset management strategy and maintenance plan for their facilities. It is also recommended that a risk-based approach (i.e. considering likelihood and consequence of hazards and management of facilities) is applied on asset management strategy and planning.

2.1: Asset Management – "The Bigger Picture"

Components of boating facilities are vulnerable to a range of deterioration mechanisms dependant on materials, exposure, and loading.

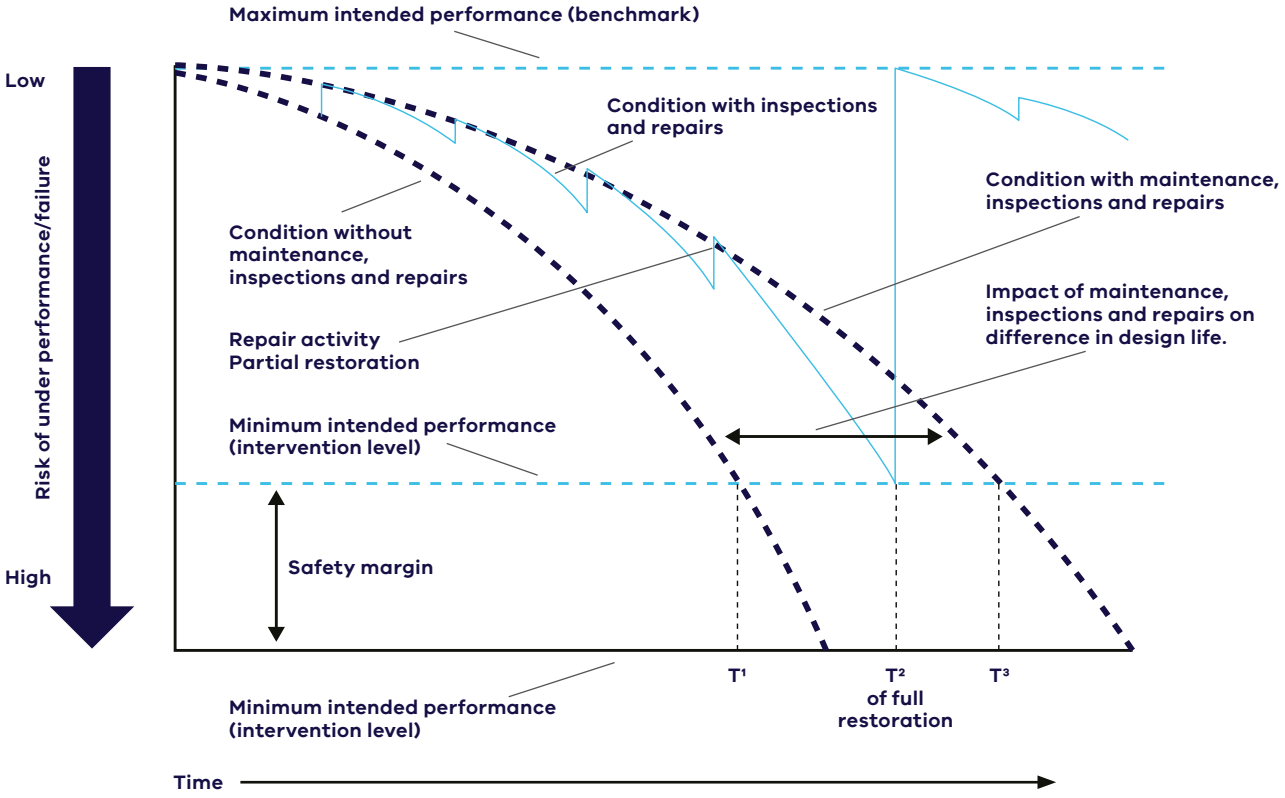
Various asset management strategies should be considered which generally align with considerations such as present and future budgets, criticality and safety, ease of access for works, and the asset condition. Strategies that can be employed in response to these may include:

- Design and planning for long life and durability with value engineering and whole of life cost decision making
- No/minimal future maintenance until demolition
- Preventative measures to limit future maintenance or extend initial design life
- Routine maintenance and repair
- Partial or full replacement
- Upgrading or reconstruction.

Because of the range of structure and material types as well as locations and exposure, it is difficult to develop a generic maintenance strategy. It is therefore useful to look to guidance in conceptualising the degradation of structures with time with a range of the above strategies as shown below. The safety margin depends on a range of factors from the "ductility" of likely failure to lowest limits of accepted levels of service as the structure degrades as well as criticality and the costs associated with any failure (see Figure 2.1).

There are asset management frameworks that have been developed by other organisations, to underpin and inform the management of assets on Crown Land and in the maritime space. Public boating facility managers are encouraged to review those frameworks, seek further advice from their parent body if required (i.e. Department of Environment, Land, Water and Planning or the Department of Transport) and adopt principles and practices that suit their needs and capacity. Refer to section 1.7 for additional resources.

Figure 2.1: Loss in asset performance with time for different maintenance scenarios adapted from CIRIA (2010)



2.1.1: The Key Role of Prevention in Asset Management

Facility managers and readers of these guidelines should understand that the most effective measure that can be implemented to increase durability occurs during the design and construction phase of a boating facilities life. Common examples include sacrificial thickness of steel, additional cover on reinforced concrete or built-in structural redundancy in the form of larger than required structural sections.

However, many boating facilities across Victoria have been designed and constructed to outdated durability requirements or have effectively aged to the point where the preventative design measures have lapsed.

The focus of these guidelines is on enhancements to these existing boating facilities that lengthen the design life of boating facility elements already in place, with the understanding that conformance to current standards and guidelines will ensure preventative measures are implemented in newly built facilities across Victoria.

2.2: Phases of Asset Management Strategy

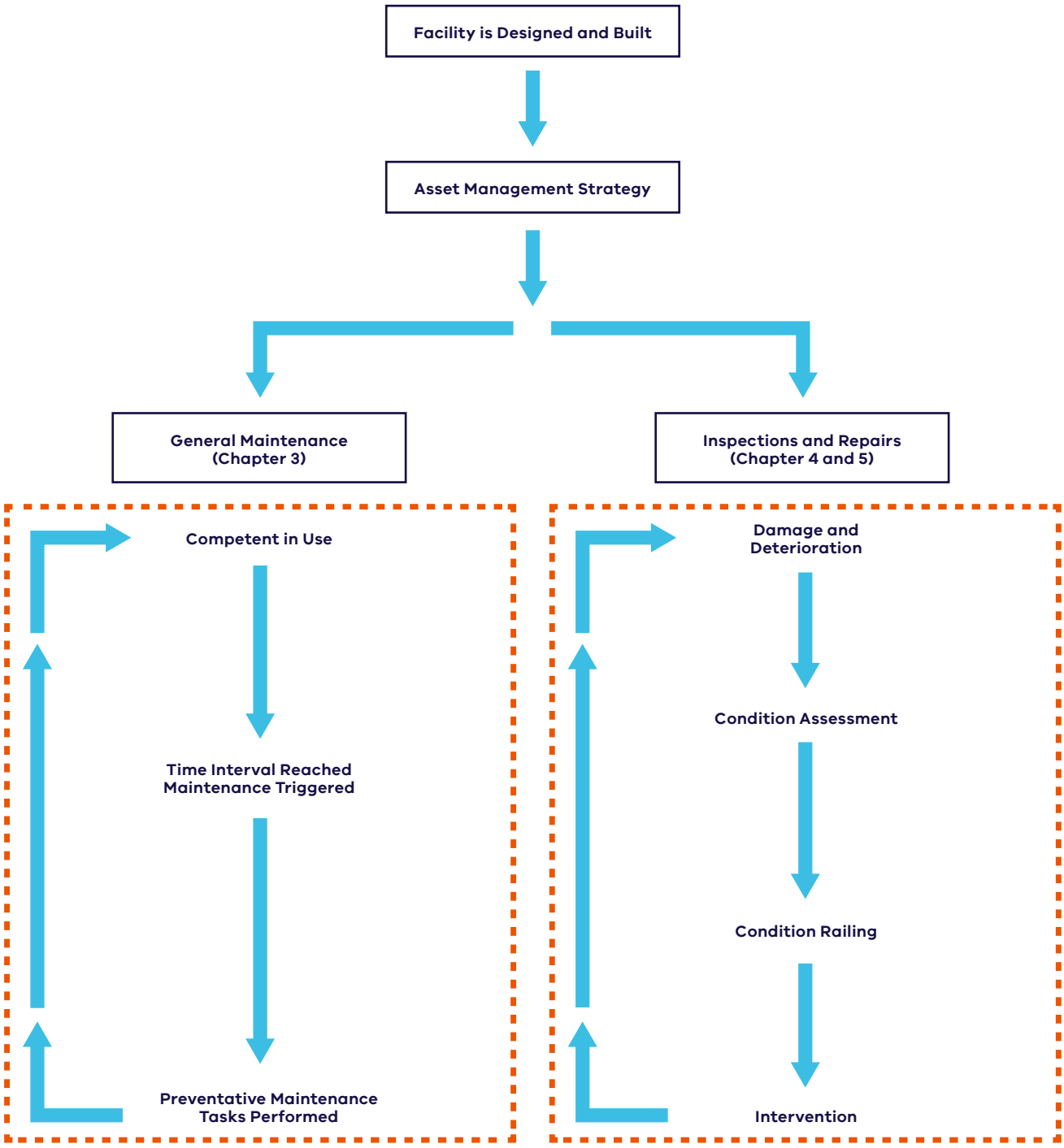
Although prevention is the most important phase of asset management, enhancements at other stages of the design life should not be the last resort. Each asset management strategy will generally involve several other aspects which assist in sustaining the functional and safe use of boating facilities.

Although the asset management strategies used by each managing entity in Victoria may vary, the following additional three phases are common, namely: Maintenance, Inspections and Repairs. Due to their interrelated nature, the following should be considered when drawing distinction between each phase:

- **Maintenance** is preventative in principle, it should consider work undertaken on a regular basis to ensure functionality and to sustain a low rate of degradation for as long as possible. It is generally straightforward, routine, and repetitive. Most importantly, maintenance is conducted independent of a structures condition.
- **Inspections** are conducted routinely or triggered by events, to determine asset condition and aimed to inform the need for restoration of structural integrity and/or durability. Inspections are varied in type and levels of technicality and effort and can be conducted at varied frequencies dependent on their need.
- **Repairs** are considered reactive, and like inspections, can be classified into a variety of levels. The main difference between maintenance and minor repairs is that repairs are dependent on the presence of damage and their resultant condition, designed to arrest deterioration as it is observed. Although not always repeated, depending on the scope of works, repairs are likely to vary and generally more complex and costly than typical maintenance activities.

Dependent on the asset strategy chosen, these phases can fit within one of the two generic sets of cycles that may occur over the lifetime of a facility, as shown in Figure 2.2.

Figure 2.2: The Asset Management and Maintenance Process of boating facilities involves a balanced approach for life use extension and cost management



2.3: Approvals considerations to undertake maintenance activities

Facility managers of public boating facilities, in both inland and coastal waters, shall have careful consideration of the statutory and non-statutory approvals and permits that may be required to conduct maintenance, repair and upgrades of their facilities. It is recommended that the public boating facility manager engages with the relevant approval agencies, as well as with traditional processes, when scoping maintenance plans and repair works. Common agencies requiring engagement are listed below:

- Local Ports Authority requirements (e.g. Works Permit in coastal, marine waters)
- Waterway Authority requirements (e.g. Works on Water Permit in inland waterways)
- Marine and Coastal Act (MaCA) Consent and all necessary background studies. For example, a background study may include an ecologist undertaking a dive investigation to determine local benthic habitats against the Victorian State CBiCS classification scheme
- Cultural Heritage Management Plan (CHMP)
- Native Title Assessment
- Land Owner Consent
- Planning Permit (if the footprint and extent of the works requires it)
- EPBC Act Referral and other Commonwealth regulations (where relevant)
- Heritage assessment

It is worth emphasising that the list above is for general guidance only, as the actual approvals and permits requirements will depend on the specific location, facility features and the nature and magnitude of the works, for both the landside and waterside.

03: General Maintenance

3.1: Introduction

A good maintenance strategy should consist of planned preventative measures which are carried out at pre-planned and pre-determined intervals. This is particularly critical because as the structure requires more repairs over time, the maintenance costs increase over time, often requiring expensive specialist works in the marine environment. The potential consequence of not undertaking the minimum preventative maintenance is that this can ultimately result in unexpected loss of facility usage, reduction in safety, and can lead to increased costs for repairs or reconstruction.

3.2: Scope of General Maintenance

The following sections provide guidance on general maintenance for components listed in Section 1.4. The objective is to provide recommendations on both maintenance tasks and their associated frequencies to assist in the shaping of maintenance plans and schedules by public boating facility managers.

3.3: Planning General Maintenance

To ensure safe and efficient use of a boat ramp facility, the public boating facility manager should prepare a maintenance schedule, with the frequency of maintenance tasks specific to the site. Concrete, timber, steel, and aluminium elements of a boat ramp typically require the most maintenance due to their susceptibility to aggressive media in the marine environment.

Table 3.1 gives recommendations for the maintenance task scheduling of these elements at a generic boat ramp in Victoria. Additional information relevant to each material can be found in the relevant sections below.

Elastomers, Synthetics and Fibre Reinforced Polymer's (FRP) have a greater resistance to deterioration in a marine environment. Therefore, general maintenance typically centres around cleaning of biological growth. Utilities, Safety and Ancillary Items are often bespoke products, with maintenance defined by the manufacturer.

Ultimately, the level of usage and demand on the facilities should be used to refine the level and frequency of maintenance required and to be performed. The scheduling of tasks should therefore include consideration of the increased need for maintenance during periods of peak usage and the seasonal effects on the boat ramp facility.

Further, following the construction of facilities, including upgrades and major repairs, the builder and/or manufacturer of components and elements may provide manuals and instructions for post-construction adjustments and maintenance (e.g. tightening of bolts after a given period, specific cleaning instructions). Public boating facility managers should follow those and consult with the provider, as required.

Planning for Maintenance

It is good practice for the maintenance plan to be established by the facility manager as a table or matrix, outlining the types of general maintenance tasks and the frequency required for each maintenance task.

An example maintenance schedule is provided in Appendix C for public boating facility managers to review and customise to their needs.

Table 3.1: Recommendations for Preventative Maintenance Task Scheduling

Material	Maintenance Task	Element		
		Structural Elements (e.g. Decks, Piles, Beams, Corbels)	**Non-structural – Static – Elements (e.g. Kerbs, Railings, Pontoon floats)**	**Non-Structural - Dynamic - Elements (e.g Pontoon joints, Gangway hinges)**
Concrete	(Re)applications of protective coatings	3-5 Years	3-5 Years	3-5 Years
	Repairs of minor cracks	As Required		-
Timber	Fastener Maintenance**	3-5 Years**	3-5 Years**	-
	Reapply end sealants in accessible areas	3-5 Years	3-5 Years	-
	Reapply preservative treatments to accessible areas	3-5 Years	3-5 Years	-
	Reseal joints in flashing and other waterproofing systems	3-5 Years	3-5 Years	-
	Replace rubbing strips	-	As Required	-
Steel	(Re)applications of protective coatings	3-5 Years*	3-5 Years	3-5 Years
	Re-placement of Cathodic protection	As Required		-
Aluminium	Greasing of Mechanical Joints and lubricating (Hinges and Rollers)	-	-	Bi-annually
	Replacing insulators	As required		
	Addition of a protective layer	As required approaching the end of element design life*		

*The level of usage and demand on the facilities should be used to inform the level and frequency of planned maintenance. Some facilities will also require greater frequency depending on the environment in which they are situated.

**Fasteners used on timber structures should be tightened between 6 to 12 months after construction to account for initial timber shrinkage.

3.3.1: Cleaning and Clearing

Due to the exposure to the marine environment, the presence biological growth at boat ramps, such as that shown in Figure 3.1, is common. This growth often results in a slippery surface for traffic using the ramp and should be cleaned off regularly. This is especially the case where no consideration was given to providing traction on ramp lane surface through alternate means in the design of the ramp (e.g. deep grooved chevrons or similar).

To ensure safe and efficient use of a boat ramp facility, the public boating facility manager should prepare a cleaning and clearing regime, with the frequency of maintenance tasks specific to the site. This includes consideration of the increased need for cleaning during periods of peak usage and the seasonal effects of the growth and build-up of marine algae. It is common for marine algae to build up over spring and summer periods, and ramps should be cleaned more frequently during these times. Table 3.2 gives recommendations for the cleaning and clearing frequency of a generic boat ramp in Victoria.

Figure 3.1: Marine growth on a concrete boat ramp requiring cleaning

Table 3.2: Recommendations for Cleaning and Clearing Scheduling by Element

Structural Elements		Non-structural elements	
Trafficable Surfaces (e.g. Decks and Ramps)	**Structural Elements (e.g. Piles and Beams)**	**Static (e.g. Kerbs)**	**Dynamic (e.g. Gangway Hinges)**
Bi-annually	When required	Yearly	Bi-annually

Appropriate frequencies for ongoing maintenance should be reviewed and revised following monitoring of the first set of cleaning cycles. The public boating facility manager should also make itself familiar with environmental conditions which cause debris or sediment build up, and ensure the ramp is also attended to directly following such events.

Manual buffing and scraping is the preferred method where feasible, as it creates debris that is more easily contained.

High Pressure Cleaning

High Pressure Cleaning of timber decking or ramps is often a useful method employed to remove biological growth and accumulated debris. However, this should generally be avoided if possible as the pressure cleaning can remove protective coatings to the timber and cause more deterioration over the long term.

Application of dilutable fungicide at low tide is recommended to remove biological growth as this will typically not affect the timbers protective coatings. Nevertheless, it is imperative to use biodegradable and environmentally friendly products to minimise any potential impacts to the local environment. If in doubt, the facility manager must consult with the state and local waterway, environment and conservation authority representatives about the suitability of products and cleaning methodology

In-land waterways

Water levels in the in-land waterways consistently fluctuate. When water levels recede to low enough levels Eucalypt, Wattle and Melaleuca seedlings become established below reservoir operating levels and on foreshore beaches. This natural regeneration process, when left unmanaged, results in reduced access to boat ramps and beaches.

Annual spraying programs should be incorporated in these maintenance plans in combination with regular inspections

Figure 3.2: Inland boat ramp following periods of no maintenance clearing

3.3.2: Concrete

In addition to incorporating preventative protection measures into the design (refer to Section 2.1.1), a well-planned maintenance strategy can also assist in prolonging a concrete elements life. The primary focus for maintaining existing concrete elements centres around surface coatings and the treatment of cracks, which prevent the ingress of aggressive media and subsequent corrosion to the reinforcing steel.

3.3.2.1: Surface Protection

Surface protections are common for boating facility structures, their main function is to reduce the permeability of concrete and prevent the ingress of aggressive media which causes corrosion. Not all concrete structures will benefit from this form of surface protection and so professional advice on the correct product to use should be first sought before developing a maintenance regime.

Waterproofing resin impregnation is the most used method for boat ramp structures as it strengthens the surface of the concrete and reduces its permeability. Hydrophobic impregnation using silanes and silicon-based products are also recommended as they impregnate the pores of the concrete and prevent ingress of water at low hydrostatic pressures.

3.3.2.2: Crack Repair

Sealing and caulking of cracks that require no cutting or extraordinary routing can and should be considered a part of preventive maintenance. The key to successfully addressing concrete cracks through maintenance requires an understanding of the causes of cracking and whether the cracks are active. If the public boating facility manager is unsure whether the cracks are active, scoping of the maintenance required is best undertaken by a technically competent professional. Regardless, it is imperative that concrete cracking be addressed as soon as feasibly possible.

Cracks greater than 0.2 mm should be considered a defect requiring repair, and as such the repair methodology should be designed by a qualified engineer, as discussed in Section 5. These cracks are typically filled or caulked with cement mortar, epoxy grout, polyurethane joint sealant, asphaltic or rubberized sealers, or other quality commercial products suitable to the application in preparation for surface coating and to keep water out of the concrete.

There are a range of commercially available products, ranging in price and quality. It is prudent to follow the manufacturers recommendations and contact the manufacturer to confirm the suitability of the product for the intended purpose.

Crack sealing of larger dormant cracks should involve enlarging or routing the hole firsts, applying a sufficiently low viscosity epoxy, cement, mortar, or polyurethane injection to ensure proper sealing. Public boating facility managers and personnel should direct attention to Section 5 for this level of intervention.

3.3.3: Timber

The treatments used to maintain timber elements are similar across most elements, typically involving a preservative or mating system which aids in preventing weathering, effects of saltwater, and biological attack from fungi, marine organisms, insects, and bacteria.

3.3.3.1: Fastener Maintenance

As recommended in Table 3 1, the condition of structural fasteners should be checked every few years. All loose fastening nuts should be tightened as tight as can be achieved with standard hand tools (i.e. snug tight). When tightening is required, nuts and threads should be coated with a petrolatum paste approved for use by the managing body to prevent corrosion.

Replacement of corroded fasteners, spikes or nails is considered a repair and is done as required.

Fastener Maintenance

Maintenance of Fasteners is best scheduled for low tides, to maximise access to each element.

Timber fasteners should be tightened between 6 to 12 months after construction to allow for initial timber shrinkage

3.3.3.2: Sealants and Preservatives

One of the primary reasons for the deterioration of timber is timber rot. Sealing the timber elements helps to prevent rot and weathering. Copper Naphthenate is a commonly used sealant, however, the public boating facility manager needs to ensure that the preservative used does not cause environmental harm, especially in cases where the boating facility is adjacent to an environmentally sensitive waterway. Application of a coating shall be done as required but is typically not required more than once every 5 years.

When appropriate, the public boating facility manager should consider replacing timber decking and elements with a more durable, low maintenance solution such as FRP mesh or Plastics. This will in turn reduce operational expenditure and the level of required maintenance through the remaining life of the structures.

3.3.3.3: Specific Considerations for Maintaining Timber Elements at Boating Facilities

3.3.3.3.1: Timber Boat Ramps

Although timber is more commonly used in the construction of vessel holding structures (e.g. jetties), there remains some instances of timber boat ramps in Victoria such as Anthony's Nose shown in Figure 3 3. Several factors attribute to the shift away from timber boat ramps, predominantly centred around the durability and strength that is better provided by other materials, such as concrete and FRP.

In the instance a timber ramp facilitates launching and retrieval access to a waterway, it is recommended the public boating facility manager consider replacement of such a ramp with alternate materials. However, in the short term where replacement of the timber ramp and approach cannot be achieved, or in instances where the timber ramp is of historical or cultural significance, the preventative measures listed in Table 3.1 are recommended in an attempt to increase the lifespan of the structure and ensure continual, functional and safe use.

Figure 3.3: Example of an existing timber boat ramp at Anthony's Nose in Port Phillip Bay

3.3.3.3.2: Timber Piles

Despite use of appropriate preventative protections measures, all timber piling in the marine environment eventually deteriorates. As a result, additional protection is often recommended. Additional layering (e.g. plastic wraps) often provides the best results (See Section 5.4.2).

However, there is little that can be done in terms of common maintenance that does not require specialist advice. Therefore, to effectively maintain timber pile elements, the frequency of inspections and adequate repairs should be considered the most important factor in maintaining timber piles.

3.3.3.3.3: Timber Beams, Corbels and Crossheads

Like timber piles, there is little general maintenance that can be done following installation. Although coatings can work towards preserving the timber, access to these substructure members makes regular preventative maintenance more difficult. Therefore, to effectively maintain timber beams and crossheads, the frequency of inspections and adequate repairs should be considered the most important factor in maintaining timber beams, crossheads and other similar substructure components.

3.3.3.3.4: Timber Fenders

Rubbing strips greatly influence the typical timber elements durability. It is therefore important to ensure these rubbing strips are regularly checked, maintained, and replaced when required. When replacing the rubbing strips, incorrect attachment to the timber fender can reduce the pile life by around half. Therefore, timber to timber contact should be avoided where possible.

Figure 3.4: Rubbing strip on a timber fender

3.3.3.3.5: Timber Kerbs

Kerbs (Bump stops) often fulfill several functions, acting as delineation to the edge of a structure, a safety measure to reduce the likelihood of a person or Car Trailer Unit (CTU) going over the edge of the structure or a structural element.

As Timber Kerbs are easily replaceable, maintenance should focus on corroded connections, chipped or split elements or areas damaged by impact. All loose fastening nuts should be tightened as tight as can be achieved with standard hand tools (i.e. snug tight) and replaced when corroded. When tightening or replacement is required, nuts and threads should be coated with a petrolatum paste approved for use by the managing body to prevent corrosion.

3.3.4: Steel

The durability of steel elements in boating facilities is primarily dependent on its resistance to corrosion. Despite preventative measures being employed during the design and construction phase of a steel structures design life, maintenance will still be required to ensure durability is maintained.

The treatments used to maintain steel elements are similar across most elements, typically involving cleaning, protective layers and cathodic protection which aids in preventing corrosion.

3.3.4.1: Protective Layers

Regular re-application of protective paint will increase the design life of the steel element if executed correctly. It is recommended that steel elements are always blast cleaned or cleaned via wire brush before being re-coated.

Additionally, any maintenance painting of an existing coated steel element will require a compatible coating, or else early coating failure will likely occur, and deterioration will be increased rather than reduced. If there is any concern about incompatibility of the new coating due to lack of accurate records, a 30cm by 30 cm in size test patch can be applied over the existing paint to check for incompatibility which should occur within a few days of application.

3.3.4.2: Specific Considerations for Maintaining Steel Elements at Boating Facilities

3.3.4.2.1: Steel Piles

The three primary preventative measures used to increase the life of steel piles are:

- Cleaning of biological growth
- Cathodic protection
- Protective layers (sleeves or paint)

Typically, the design life of protective sleeves installed during, or post construction will out-perform the steel. If undamaged, it will typically not require maintenance over its design life. Refer to Sections 5.4.6 for further information on upkeep of protective sleeves.

Steel piles are seldom painted underwater and therefore require use of post installed sleeves or cathodic protection. For sections of piles above water that require paint re-application, the general recommendations of Section 3.3.4.1 should be followed.

Design, planning and execution of these maintenance tasks should only be conducted by professionals or competent and trained staff from the managing entity.

3.3.4.2.2: Steel Beams and Crossheads

As cathodic protection can only be applied to permanently submerged steel elements, the primary preventative measure used to increase the life of steel beams and crossheads is to maintain the protective layers. However, access to these substructure members makes regular preventative maintenance less feasible for public boating facility managers. Wherever possible, (re)application of the protective layering should be combined with consistent and frequent inspections and repairs to if required.

3.3.4.2.3: Steel Pontoons

Pontoon frames are generally comprised of a variety of materials that are corrosion resistant such as aluminium or concrete. In cases where pontoons are constructed from a steel frame or have steel elements, the two primary preventative maintenance tasks that can be conducted involve cleaning of biological growth and maintaining protective layers.

Regular cleaning 'in-water' can be conducted but will not always be the most effective means to maintain the pontoons. As is the case with all pontoon elements, the focus should instead be on regular inspections and repairs where required, particularly at the joints and connections.

Maintaining Pontoons

Access to the submerged elements makes regular preventative maintenance less feasible for facility managers. To overcome this, the pontoon can be removed from the water body temporarily for maintenance. In these instances, reapplication of protective coatings can occur to the exposed steel elements after it is blast cleaned or cleaned via wire brush.

3.3.5: Aluminium

Aluminium offers advantages if designed and constructed correctly when compared with steel including higher resistance to corrosion and a higher strength to weight ratio. Marine grade aluminium is the most widely adopted due to its optimised corrosion resistance characteristics.

Due to its high resistance to corrosion, aluminium is not typically given a protective coating. However, elements made of aluminium will still be subject to corrosion, particularly when dissimilar metals are in contact, e.g. bolted joins, etc.

Typically, aluminium elements will not have a protective coating. However, corrosion still exists and it therefore may be beneficial to coat the elements with a protective coating and reduce of the rate of corrosion further. This would only be at later stages of the design life, with regular re-application required following the first application. Like steel, aluminium should be blast cleaned or cleaned via wire brush before being coated and will require a coating compatible with any existing coatings or the aluminium itself.

3.3.5.1: Specific Considerations for Maintaining Aluminium Elements at Boating Facilities

3.3.5.1.1: Aluminium Pontoons

Typically, no preventive maintenance measures need be considered regarding the aluminium frames of pontoons given its resistance to corrosion. The focus for maintenance of pontoons should be on regular inspections and repairs where required.

However, deterioration of the other materials that make up a pontoon will be likely required. Typical causes include water absorption and swelling, exposure to ultraviolet light or excessive movements at the joints and connections.

Pontoons are invariably in motion, and so attention should therefore be focused on the condition of the connections. For example, the waler bolts through the units can constantly loosen under wave action and mooring loads. Retightening is therefore necessary on a regular basis.

3.3.5.1.2: Aluminium Gangways

Gangways are transition structures providing access between land and maritime structures as they can maintain access throughout changing water levels. As they are typically made from Aluminium, their maintenance should centre around ensuring they fulfill their functional purpose.

As the gangway continually shifts position and slope, focus should be given to the gangway at its connection to land and at the connection to the floating vessel access structure. The connections at these locations will typically involve hinges and rollers, and general maintenance would ensure they mechanically perform. The connection involving a roller will also typically be incorporated with a transition plate, which can form a lip or trip hazard if damaged.

Due to the exposure to the marine environment, the presence of biological growth is common and will likely result in a slippery surface for traffic using the ramp, particularly when timber decking boards are used. This should be cleaned off regularly, with consideration given to providing traction through alternate means (course protective coating or pad). Manual buffing and scraping should be the preferred method where feasible as it creates debris that is more easily contained.

If the barriers or handrails are connected by bolts or fasteners, the condition of structural fasteners should be checked on a relatively regular basis. All loose fastening nuts should be tightened as tight as can be achieved with standard hand tools (i.e. snug tight).

3.3.6: Fibre Reinforced Polymers

Conventional fibre reinforced polymer (FRP) elements have previously been used to repair elements subject to damage in the marine environment, with the most common applications in this area being jackets on timber and steel piles. FRP elements are also increasingly being adopted as a preferred material in other applications due to their strength-to-weight ratios and resistance to deterioration in the marine environment, e.g. decks of jetties and access platforms made of FRP.

Due to its higher resistance to deterioration, FRP does not typically require maintenance other than cleaning of biological growth as a safety measure on decking elements at frequencies defined in Section 3.3.

This is particularly important for perforated FRP decking in an open coast setting. Marine growth can block the perforations , which effectively increases the uplift forces created by increasing water levels and waves, as shown in Figure 3.5.

Figure 3.5: New Gangway with perforated FRP Decking (left), Dislodged FRP decking due to marine growth in the perforations and wave loading (right)

3.3.7: Elastomers and Synthetics (Rubber, HDPE and Plastics)

Rubbers, HDPE and other elastomeric materials are commonly used in boating facilities as they are resistant to deterioration onset by the marine environment. These materials are typically utilised to fulfill a specialised purpose with the more common applications being fender systems or urethane elastomer shells encapsulating floating pontoons.

Similarly, synthetic materials are also used at boating facilities for their durability in the marine environment. The most common application is pile wraps made of flexible polyvinyl chloride (PVC) films to prevent growth of wood boring organisms and corrosion. Other typical applications include use of recycled plastic decking, kerbing, fenders or even structural beams.

As these materials have a high level of durability in the marine and aquatic environment, the maintenance strategy of a facility manger should focus on repairs which are required to ensure they serve their functional purpose (See Sections 4 and 5).

3.3.8: Utilities, Safety and Ancillary Items

Utilities, safety and ancillary items fulfill a range of unique and specialised functions at boating facilities. 'Regular' preventative maintenance should follow the frequencies listed in Table 3.3.

Table 3.3: Recommendations for Utilities, Safety and Ancillary Items Preventative Maintenance Task Scheduling

Maintenance Task	Utilities, Safety and Ancillary Items			
	Electrical Systems	Universal Access Aids	Traffic Aids	Mooring Hardware
Fastener maintenance	Bi-annually	Bi-annually	Bi-annually	Bi-annually
Item specific maintenance and testing	Bi-annually	Defined by manufacturer specifications	Bi-annually	Bi-annually
Application of surface protection layer	-	Defined by manufacturer specifications	-	As Required, Minimum of 5 years

3.3.8.1: Specific Considerations for Maintaining Utilities, Safety and Ancillary Elements at Boating Facilities

3.3.8.1.1: Electrical Systems

The nature of recreational boating means that a boating facility will often cater for users at night and early in the morning. As such, it is necessary to ensure the lighting of a facility is maintained.

Generally, the public boating facility manager should ensure that regular checks of the facility lighting is working in order, with common faults including:

- power failure
- swung lanterns
- light (poles) that have been hit by a CTU's or other vehicles

3.3.8.1.2: Universal Access Aids

Universal Access is often aided by provision of a proprietary davit or crane like product. There are a range of commercially available products, ranging in price and quality. In any case, it is prudent to follow the manufacturers recommendations and contact the manufacturer to confirm the requirements for maintenance to plan the maintenance scheduling.

3.3.8.1.3: Traffic Aids

Traffic Posts or bollards are generally used as a means of delineation, conveying information on the boat ramp lane alignment as seen in Figure 3.6.

Figure 3.6: Use of rigid bollards to prevent vehicle access onto the abutment

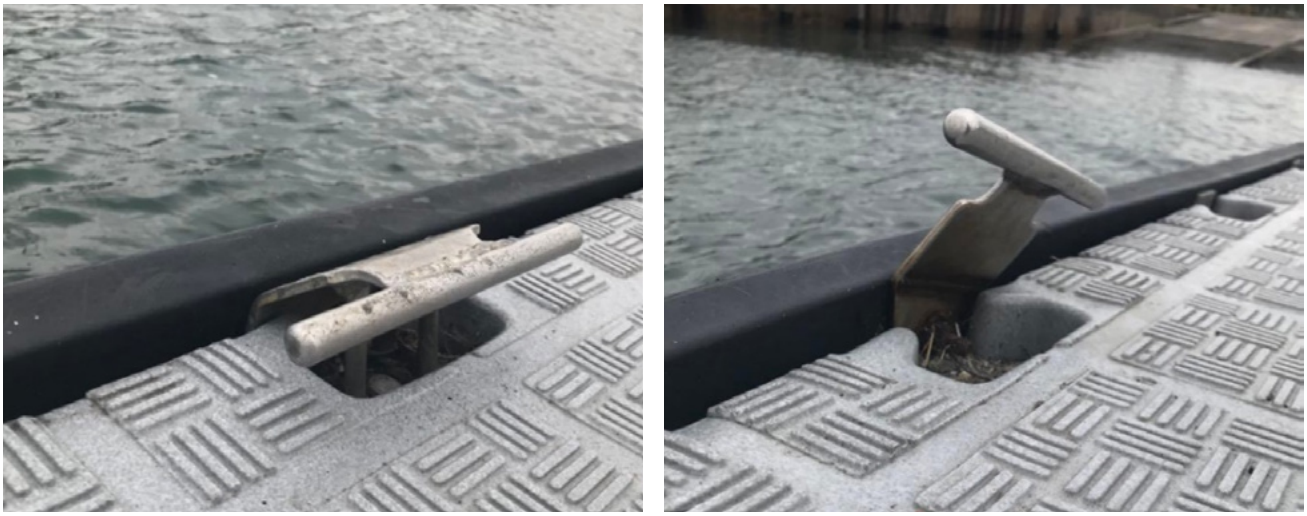
Use of flexible traffic posts is encouraged, as this type of lane delineation deflects when impacted by a CTU and returns to a vertical position, without maintenance intervention. Bent or missing flexible traffic posts should be promptly replaced. This is particularly important for multilane ramps or ramps with long approaches such as inland lakes and reservoirs. Rigid bollards are highly susceptible to damage. Bent or missing bollards should be promptly replaced with flexible traffic posts if feasible.

Reinstatement of these flexible traffic posts or rigid bollards should follow the guidance provided by VicRoads Road Design Note 06-04 - Accepted Safety Barrier Products.

3.3.8.1.4: Mooring Hardware

Mooring hardware such as bollards, cleats or capstans are important fittings on the deck of a vessel holding structure, used to secure vessels while launching and retrieving. Given the importance it is vital to understand the use and ensure that this function can be continued without issue. Common issues that may prevent the use include rough or sharp surfaces, areas of high wear, loose fittings or overloading as seen in Figure 3.7.

Figure 3.7: Damaged Mooring Hardware (cleats) on a floating pontoon



The more common materials used to make cleats are alloys such as galvanised and stainless steel and aluminium. Maintenance of any alloy component will centre around preventing and addressing corrosion and this is no different for cleats.

As recommended in Table 3.3, the condition of mooring hardware fasteners should be checked every few years. All loose fastening nuts should be tightened as tight as can be achieved with standard hand tools (i.e. snug tight). When tightening is required, nuts and threads should be coated with a petrolatum paste approved for use by the managing body to prevent corrosion.

Re-application of protective paint will increase the service life of the mooring hardware element if executed correctly, ensuring the elements are blast cleaned or cleaned via wire brush before being re-coated.

Typically, however, for the size and relative cost of mooring hardware used at boating facilities in Victoria (specifically those catering to vessels <10m LOA), it is generally more cost effective to replace the damaged or non-functioning mooring hardware element with a new one.

3.3.9: Land-Side Pavements

3.3.9.1: Car and Car Trailer Unit Parking

Guidance on maintenance, inspection and repairs of Car and Car Trailer Unit (CTU) parking areas designated specifically for boating facilities is not covered in detail in these guidelines as parking areas are typically the responsibility of the councils in Victoria. As such, councils manage their pavement assets in accordance with each of their own asset management plans.

Car parks directly abutting the edge of roads are considered as ancillary areas and are typically covered in each councils respective Road Management Plan (RMP). However, Car and CTU parking areas designated specifically for boating facilities are generally not included. In these cases, the asset management of these designated parking areas should be the same as those for the abutting roads which are covered in the RMP's. Public boating facility managers should adopt the RMP's applicable to the area in which the facility resides.

Although maintenance approaches for these areas are typically reactive, public boating facility managers should attempt to utilise preventative maintenance consisting of planned activities to extend pavement life such as surface treatments applied to seal the surface and prevent water infiltration and stabilise loose surface materials.

Figure 3:8: Car trailer unit (CTU) spaces to accommodate vehicle arrangements

3.3.9.2: Pedestrian Footpaths

Similar to parking areas, guidance on maintenance, inspection and repairs of footpaths designated specifically for boating facilities is not covered in detail in these guidelines as parking areas are typically the responsibility of the councils in Victoria. As such, councils manage their pavement assets in accordance with each of their own asset management plans.

Footpaths within road reserves should generally be covered in each council's respective RMP. However, pathways within boating facilities are generally not included. In these cases, the asset management of these footpaths should be the same as those for those within road reserves, which are covered in the RMP's.

3.3.10: Coastal Protection and Harbour Structures

The nature and size of coastal protection and harbour structures makes general maintenance less useful relative to what can be achieved through well planned inspections and repairs. Depending on the extent of deterioration or damage, most coastal protection structures will at some point require some level of maintenance.

Guidance on inspections and repairs of coastal protection and harbour structures is provided in more detail in Sections 4.4.9 and 5.4.9. Consideration can also be given to carrying out appropriate inspection and remedial measures outlined in accordance with the content listed in Chapter 10 of the Rock Manual – Monitoring, Inspection Maintenance and Repair (CIRIA , 2007)

Wave Screens are unique, performing the function of a breakwater, using structural elements more common to jetties in place of rock or concrete blocks. Wave screens generally involve use of timber or steel piles and cross bracing, with timber or concrete panels extending close to, or below the seabed. Given the similarities in elements and materials between jetties and wave screens, general guidance can be adopted with respect to inspections and repairs. However, giving the unique load paths that exist in wave screens, a specialised contractor or designer should be engaged to create an asset management plan specific to these structures.

04: Inspections

4.1: Introduction

Inspections are typically conducted to determine asset condition and are aimed to inform the need for restoration of structural integrity and/or durability.

Inspections are varied in type, which can fundamentally be characterised by either their frequency (Section 4.1.1), or their level of technicality (Section 4.1.2). These guidelines provides guidance on the recommended minimum frequencies of two technical levels of inspections, i.e. 'Basic' (or visual) and 'Advanced' (or specialised). For the 'Basic - Visual' inspection level, additional information is also provided within these guidelines on how to conduct these. For the 'Advanced / Specialised' inspection level, public boating facility managers are urged to seek advice from qualified technical personnel (e.g. Engineers, Specialist Technicians, etc) to scope and conduct those inspections.

4.1.1: Inspection Type – by Frequency

The frequency of inspections can be used to broadly classify its type. For the purpose of these guidelines, inspections should fall under one of the following three frequency categories:

- Routine Inspections
- Response or Reactive Inspections
- Special Purpose Inspection

4.1.1.1: Routine Inspections

A routine maintenance inspection is intended to be used as a screening procedure to determine whether additional measures are required.

Public boating facility managers should perform these inspections cyclically over the life of the asset(s), ensuring they record the condition of each component of a boating facility. Performing routine inspections at this level of detail will:

- identify any maintenance or repair tasks that are required urgently,
- identify if more frequent routine maintenance is required, and
- provide a basis for estimating a components residual life.

4.1.1.2: Reactive Inspections

A post event (or event-triggered) inspection is intended to be used as a means of rapid assessment following a 'significant' event (either typical or atypical) that may impact the usability, safety and/or life of a boating facility. The inspection should verify the extent of possible damage or quantify the impact to boating facility components usability. Such events that will trigger the need of reactive inspections include but are not limited to severe wind or waves events, inundation, floods, landslides, fires, earthquakes, or vessel impact.

Public and Stakeholder reporting on defective and deteriorating assets

Defects and deterioration are sometimes first detected by users, members of the public or stakeholders such as local users. It is therefore very useful for the facility managers to have a way for the public and stakeholders to report on such items, which facility managers can use as a trigger for conducting a more formal reactive inspection.

Signage with contact details to the facility manager and links to relevant web pages is often the best way of transmitting the information. Web pages should allow the user, member of the public or stakeholder to, at a minimum, record:

- the contact details of the person making the report
- the issues raised
- the outcomes sought
- any other information required to properly respond to the matter (e.g. photos)

4.1.1.3: Special Purpose Inspection

A special purpose inspection is used for a variety of reasons and are at unknown frequencies. Some of the more common types of special purpose inspections include those following new construction that are conducted following construction or upgrade to ensure proper construction quality in accordance with the design plans and specification has been achieved. Other common examples of special purpose inspection is when there is a change in management, insurance valuation, or negotiation of a lease, where it is necessary to be aware of information regarding the general condition of an existing facility, expected repairs and associated costs or other issues concerning the functionality of the facility. These types of inspections should be generally conducted by a qualified specialist or professional.

4.1.2: Inspection Type – by Level

Budget and resourcing constraints often result in reduction in maintenance and regular condition monitoring, which can have severe long-term effects on the longevity of facilities and their components. Additionally, visually inspecting all components, especially those submerged is not always practical or economically feasible. However, dividing the inspections into categories reflecting the level of effort and technical knowledge required can allow public boating facility managers more easily understand and maintain their facilities. Therefore, these guidelines has divided the inspections into two levels of detail, namely, Basic or Advanced.

4.1.2.1: Basic

Basic inspections should be considered visual only, requiring nil or minimal physical testing measures or tasks. This is done by comparing material specific descriptors to photographs, allowing less technically trained personnel to:

- Check for visible defects or hazards which might affect structural safety and the safety of users
- Compare to past condition assessments
- Identify maintenance items that require action

The guideline has provided guidance on performing this type of inspection (refer to Section 4.4).

4.1.2.2: Advanced

Conducting advanced inspections of boating facilities requires a specialised understanding of the unique features at these facilities. This level of inspection shall therefore only be carried out by professionals with the appropriate level of experience and expertise.

However, for planning and scheduling purposes, these guidelines provide guidance on the frequency of routine advance level of inspections commonly required for boating facilities. It is advisable for the public boating facility manager to consider the following work items be included when scoping advanced inspections:

- Full inspection of the boating facility including any underwater inspections required to inspect underwater elements
- Review of previous Basic and Advanced Inspections that were conducted by the managing entity
- Explanation of observed deterioration mechanisms
- Estimation of the remaining useful life of an element or component
- Risk assessment based on each governing entity's risk assessment framework
- Recommendation of any further tests or inspections
- Recommendation of any required repairs or upgrades

4.2: Scope of Basic Inspections

The inspections are intended to be, in essence, visual observations of all components of a boating facility above MLWS. To conduct the inspections, the nominated inspector(s) need to:

- Inform themselves of the most recent inspections completed
- Understand what is required to perform the inspections
- Understanding how to interpret conditions of facility elements and record the conditions on site

4.2.1: Pre-Inspection Information and Equipment

Prior to undertaking basic inspections, the most recent inspection report, either post event or routine shall be reviewed to inform the inspector(s). Following review of the most recent inspection report, the following documentation and equipment should be obtained for use in the visual inspection:

- A Safe Work Method Statement in line with the entity's requirements
- The appropriate visual assessment recording form
- A Digital Camera (Cameras with inbuilt GPS and time loggers are ideal)

4.2.2: Ratings and Residual Life

The condition rating scale shown in Table 4.1 translate the condition of the elements into numeric values from 1 to 6, with 6 representing an element of the boating facility in good condition and a rating of 1 representing an element of a boating facility that has failed.

These ratings also translate to estimations in remaining service life. It is necessary to understand that estimations of remaining service life are indicative only, used to assist public boating facility managers to better plan their management of a boating asset. More accurate estimations can be obtained through modelling based on more extensive investigations.

To execute an inspection, the Condition Rating Examples provided in Appendix B can be used to assess each observable element of a boating facility. These examples show previously identified defects and mechanisms leading to deterioration, categorised within their condition rating.

Once the service life is estimated, the remaining service life may be extended through maintenance and repairs. To confirm the appropriate time to intervene, it is always preferred that an assessment by a trained professional be carried out first.

Table 4.1: Condition Rating Scale

Condition Rating	Estimated Residual Life (% of design life)	Description
6	90-100	No visible damage or deterioration
5	60-90	Limited minor to moderate defects or deterioration
4	40-60	Localised moderate damage or deterioration
3	25-40	Advanced deterioration, damage or overstressing observed on a substantial percentage of area over the element
2	15-25	Advanced deterioration, damage or overstressing observed on most of the element
1	0-15	Failed, missing or failing element

4.2.3: Recording of Condition Assessments

4.2.3.1: Ratings and Observations

The goal of the inspections is to develop a detailed inventory of all accessible boating facility components and to track the condition of these components. To achieve this, each component should be given a condition assessment rating in line with Table 4.1.

To ensure consistency in condition assessment recordings across Victoria, an Inspection Form has been developed, located in Appendix A. This form has been partially filled to provide an example on how to record the inspection observations.

It is also prudent for inspectors to record, site conditions, deterioration mechanisms, location of deterioration and extent of damage or deterioration.

4.2.3.2: Photographs and Figures

The description of conditions should always be supplemented with photographs where feasible. This assists in identifying and locating the noteworthy observations, as they better communicate to the reader the condition of each component. Figures can in some instances convey information more effectively than photographs, as photographs do typically lack context on their own.

4.3: Frequency (Interval) of Inspections

Table 4.2 provides the reader with recommendations on how often basic and advanced routine inspections should occur based on the previously known condition of the facility. This table can be used to assist managing entities in the shaping of overall asset management plans. The frequency of basic routine inspections will ultimately need to vary dependent on the magnitude of the boating facility and waterway use, local weather conditions and their effects and the scale of the boating facility.

Table 4.2: Frequency (maximum interval [years]) of Basic and Advanced Routine Maintenance Inspections

Inspection Level		**Basic**		**Advanced**	
Facility Location		**Inland Water**	**Coastal**	**Inland Water**	**Coastal**
Previous Condition Rating	6	2.5	2	5	4
	5	2.5	2	5	4
	4	2	1.5	4	3
	3	All structural elements with a condition rating below 4 to have an advanced inspection conducted immediately to determine further action. Non-structural items which pose a safety risk should be repaired.			
	2				
	1				

1. Values depicted are in years
2. Inland water boating facilities subject to saline waters should consider the values depicted in 'Coastal'
3. Diving inspections should be completed to the same interval as Advance Inspections.

4.4: Guidance on Conducting Basic Inspections

4.4.1: Concrete

Many common durability and damage issues associated with concrete can be detected through visual observation. For Basic inspections, concrete elements should be inspected to check for any of the below listed observable types of damage or deterioration common to concrete elements in the marine environment:

- Alignment
- Rust Stains
- Cracks
- Spalling
- Exposure of reinforcement
- Staining or surface defects

Table 4.3 provides a summary of what the inspector should look for when conducting a Basic inspection of concrete elements at a boating facility. The examples provided in Appendix A provide general guidance for Basic inspections. Following observation of visual defects can then prompt more significant investigations conducted by suitably trained professionals.

Table 4.3: Basic Inspection Defects and Deterioration to expect on Concrete Elements

Element(s)	Defects and Deterioration to expect
Ramps and Approaches, Decks	- Rust Stains - Cracks - Spalling - Excessively Worn Surfaces - Exposed boat ramp toe
Piles	- Misalignment - Rust Stains - Spalling - Exposure of reinforcement - Impact Damage and loss of section - Cracking
Beams and Headstocks	- Rust Stains - Spalling - Exposure of reinforcement - Cracking

4.4.1.1: Cracking

Cracking occurs when generated tensile stresses in the concrete exceed the concrete's tensile strength. The cracking may extend through the member or not. Cracking is often characterised as being either structural or non-structural.

4.4.1.1.1: Structural Crack

"Flexural" or "shear" cracks are structural fractures created by applied loads stressing structural elements. In regions of maximal element curvature to load direction, flexural fractures typically form. It occurs in the web of a member or around a bearing point where intense load occurs. From the side, they extend diagonally to the element's mid-span.

If structural cracking is observed, the public boating facility manager should seek advice from a professional (engineer or equivalent). In cases where action is required, the facility may be directed to implement load limits through signage until the cracks can be fully addressed.

4.4.1.1.2: Non-Structural Crack

In non-structural cracking, heat gradients in large concrete sections induce temperature fractures. Marine environments with varying temperatures are prone to shrinkage cracking. Plastic shrinkage, drying shrinkage, autogenous shrinkage, thermal shrinkage, and carbonation shrinkage are among examples. Non-structural fissures are troublesome because they let water, chlorides, sulphates, and other aggressive media into the concrete matrix and in contact with the internal steel reinforcement.

4.4.1.1.3: Other types of cracks

Other types of concrete cracking can occur as a result of surface delamination, reinforcing steel corrosion, or chemical processes inside the concrete matrix. In the maritime environment, where a multitude of aggressive media can be present simultaneously, degradation cracking commonly leads to rapid deterioration.

4.4.1.2: Exposed boat ramp toes

As inland waterway levels drop and increase, the location of the boat ramp toe will sometimes be exposed above the water line. Continued use of the boat ramp in this state may result in additional damage to the boat ramp slabs and the toe protection (see Figure 4 1). In instances where the toe is exposed, the public boating facility manager should investigate whether temporary closure is warranted. If the ramp toe is left exposed for an extended period of time, the public boating facility manager should seek advice from a civil engineer, preferably specialised in boating infrastructure.

Figure 4.1: Damaged toe of Lake Bullen Merri due to overloading at the exposed toe

4.4.2: Timber

For Basic inspections, timber elements should be inspected to check for any of the below listed observable types of damage or deterioration common to timber elements in the marine environment:

- Alignment
- Section loss
- Splits and Crushing
- Rot, fungi, termite or wood borer damage
- Condition of fasteners, spikes and straps
- Areas of abrasion

Table 4.4 provides a summary of what the inspector should look for when conducting a Basic inspection of timber elements at a boating facility. The examples provided in Appendix A provide general guidance for Basic inspections.

Table 4.4: Basic Inspection Defects and Deterioration to expect on Timber Elements

Element(s)	Defects and Deterioration to expect
Ramps and Approaches	- Loose or corroded fasteners, spikes, and straps - Misalignment or missing timber planks - Presence of rot, fungi, termite, or wood borers - Excessively Worn Surfaces - Splitting
Piles	- Check for splitting or crushing - Check at low tide for necking - Check for impact damage or abrasion - Check for presence of rot, fungi, termite, or wood borers
Beams and Headstocks	- Loose or corroded fasteners, spikes, and straps - Check for splitting or crushing - Presence of rot, fungi, termite, or wood borers - Excessively Worn Surfaces
Decks	- Loose or corroded fasteners, spikes, and straps - Misalignment or missing timber planks - Presence of rot, fungi, termite, or wood borers - Excessively Worn Surfaces - Splitting
Fenders	- Excessively Worn Surfaces - Connection to rubbing strip - Presence of rot, fungi, termite, or wood borers - Misalignment - Loose or corroded fasteners - Splitting - Vessel impact damage

Calm waters and marine borers

Marine borers generally prefer calm waters, which can result in accelerated attack and degradation of timber elements. Public boating facility managers of facilities in calm, protected waters, should consider increased inspection frequencies according to their specific environment.

4.4.3: Steel

For Basic inspections, steel elements should be inspected to check for any of the 3 easily observable types of damage or deterioration in the marine environment:

- Corrosion
- Abrasion
- Loose connections (bolts, fasteners, welded joints)

Table 4.5 provides a summary of what the inspector should look for when conducting a Basic inspection of steel elements at a boating facility. The examples provided in Appendix A provide general guidance for Basic inspections.

Table 4.5: Basic Inspection Defects and Deterioration to expect on Steel Elements

Element(s)	Defects and Deterioration to expect
Piles	- Corrosion - Impact Damage - Protective Layer Damage - Scour - Misalignment - Excessive movement
Beams and Headstocks	- Corrosion - Impact Damage - Protective Layer Damage - Misalignment - Excessive movement
Fenders	- Impact Damage (deformation) - Protruding or missing connections (bolts) - Abrasion - Corrosion
Pontoons	- Instability - Misalignment and cable abrasion - Water ingress between steel and floating module - Impact Damage (deformation) - Protruding or missing connections (bolts) - Abrasion - Corrosion

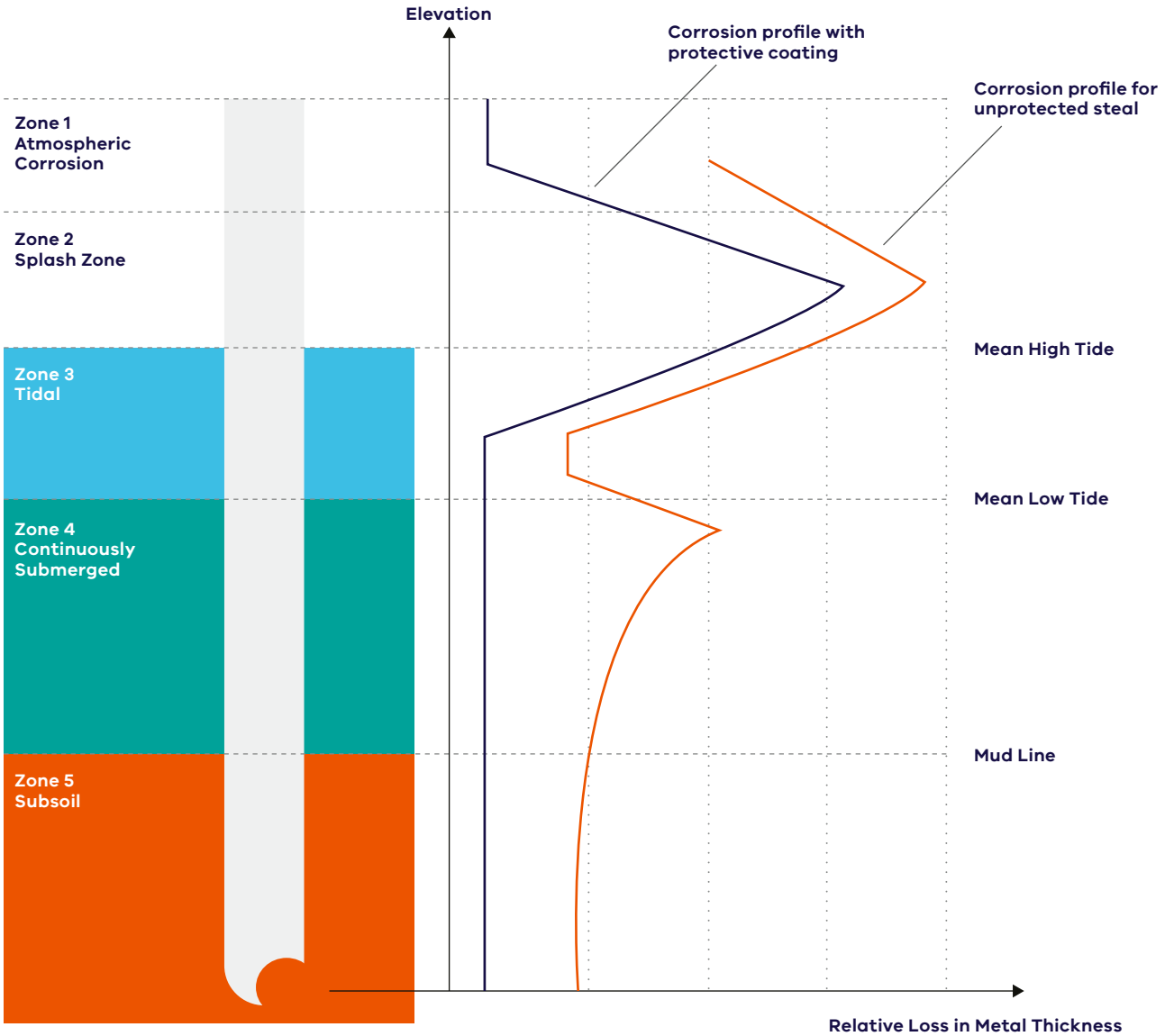
4.4.3.1: Corrosion

Corrosion of steel can be considered the deterioration of the metal due to its chemical reaction with the environment. The examples provided in Appendix A provide general guidance for Basic inspections.

When conducting an inspection, the inspector(s) should understand that due to the nature of boating facilities, steel components can be located across a variety of exposure zones of different aggressiveness and the corrosion performance of steel elements in these zones requires separate considerations.

The most severe levels of corrosion are typically in the splash zone which is located above the mean highwater level. Significant levels of corrosion also typically occur below mean low water in the frequently submerged zone. The corrosion rate profile for steel piling, generally, is shown in Figure 4.2.

Figure 4.2: Typical profiles of the thickness loss resulting from corrosion of an unprotected steel structure and a steel structure with protective coating in the marine environment



4.4.4: Aluminium

For Basic inspections, aluminium elements should be inspected to check for any of the 3 easily observable types of damage or deterioration in the marine environment:

- Weld Cracking
- Corrosion at joints to dissimilar metals
- Loose connections (bolts and fasteners)

Table 4.6 provides a summary of what the inspector should look for when conducting a Basic inspection of steel elements at a boating facility. The examples provided in Appendix A provide general guidance for Basic inspections.

Table 4.6: Basic Inspection Defects and Deterioration to expect on Aluminium Elements

Element(s)	Defects and Deterioration to expect
Piles	- Weld Cracking - Corrosion at joints to dissimilar metals - Impact Damage - Scour - Misalignment - Excessive movement
Pontoons	- Weld Cracking - Corrosion at joints to dissimilar metals - Loose or corroded fasteners and straps - Instability - Water ingress and Swelling - Impact Damage (deformation)
Gangways	- Fatigue Damage - Weld Cracking - Loose or corroded fasteners and straps - Corrosion at joints to dissimilar metals - Broken or loose members - Slippery deck surface - Broken, missing or dysfunctional wheels or hinges

Pontoon Floats

Pontoons are generally lightweight framed (aluminium) with filled or unfilled polyethylene floats. Unfilled floats must have breather holes which can accumulate water inside. Maintenance and design for unfilled floats must ensure ability to pump out through a port. Filled floats don't need pump-out, with the foam having a small % of allowable water absorption.

Gangway Slope

Gangways are transition structures providing access between land and maritime structures as they can maintain access throughout changing water levels. It is important to understand that gangway slopes change with the water level but should always slope down toward the float end. Minor issues with joints or debris build-up can prevent the gangway to fulfill its functional need, and so it is important to pay attention to these parts during an inspection.

4.4.5: Fibre Reinforced Polymer (FRP)

FRP elements utilised in boating facilities do not need intensive maintenance as they are not subject to common deterioration mechanisms such as corrosion, rot or attack by marine borers. This quality of this material results in a great low life cycle cost advantage when compared to other elements in the marine environment.

However, failure and deterioration mechanisms of FRP elements are more complex and harder to visually detect when comparted with the more common materials. This can largely be attributed to the orthotropic properties of laminates, with most failure mechanisms a result of failure of the fibre or shear / tension failure of the section.

For this reason, FRP sections should be subject to advanced inspections more often than that of its more typical counterparts, with basic inspections limited to observing already evident failure and UV light deterioration.

Table 4.7 provides a summary of what the inspector should look for when conducting a Basic inspection of FRP elements at a boating facility. The examples provided in Appendix A provide general guidance for Basic inspections.

Table 4.7: Basic Inspection Defects and Deterioration to expect on FRP Elements

Element(s)	Defects and Deterioration to expect
Piles	- Excessively Worn Surfaces - UV deterioration - Misalignment
Beams and Crossheads	- Loose or corroded of fasteners and straps - Shearing or crushing or member
Decks	- Loose or corroded of fasteners and straps - Misalignment or missing sections due to uplift - Excessively Worn Surfaces - UV deterioration
Fenders	- Excessively Worn Surfaces - Damaged or missing rubbing strip - Loose or corroded fasteners and straps - UV deterioration - Misalignment

4.4.6: Elastomers and Synthetics (Rubber, HDPE and Plastics)

For Basic inspections, Elastomeric and Synthetic elements should be inspected to check for any of the below listed observable types of damage or deterioration common to these elements in the marine environment:

- Uneven or low freeboard, misalignment, tilt
- UV Damage
- Areas of surface wearing and abrasion
- Swelling
- Loose or broken connection
- Impact Damage

Table 4.8 provides a summary of what the inspector should look for when conducting a Basic inspection of these elements at a boating facility. The examples provided in Appendix A provide general guidance for Basic inspections.

Table 4.8: Basic Inspection Defects and Deterioration to expect on Elastomeric and Synthetic Elements

Element(s)	Defects and Deterioration to expect
Fenders	- Deterioration of material due to wear - Misalignment - Missing/loose members - Loose or broken connection - UV Damage - Impact Damage
Synthetic Wraps	- Impact Damage, Tears and drops - UV Damage - Delamination - Wearing
HDPE Pontoons	- Uneven or low freeboard, misalignment, tilt - Swelling of float module - Work, uneven or slippery surface - Physical damage to shell (dents, penetrations)

Pontoon Inspections

Although not always feasible, pontoons should be inspected so that all sides of the floating module can be observed. Any damage such as cracked concrete, torn flotation modules, holes and punctures, swelling or deformations will be easily visible. Additionally, the presence of HPDE feet or skids which protect pontoons that are grounded during low water levels should be inspected, as their condition can lead to more onerous pontoon damage

Fender Damage

Fenders are made from a variety of materials, with recent focus on ultra-high molecular weight polyethylene (UHMW) and Vinyl. These plastics are particularly susceptible to damage at points of connections where they pull or rip out, and so focus should be given to these areas if access is available.

4.4.7: Land-Side Pavements

As previously detailed, guidance on inspections of land-side pavements (Parking areas and footpaths) is not covered in detail in these guidelines as they are typically covered in established asset management plans.

The frequency of routine proactive inspections (excluding reactive inspections) will vary between public boating facility managers dependent on the magnitude of facility use and the resourcing capacity of the managing body. Parking areas and footpaths should be, at a minimum, visually inspected yearly, with the recommended frequency bi-annually (twice a year) or greater.

When conducting the inspections, the inspector should check for any of the following easily observable types of damage or deterioration:

- Potholes (particularly those with a diameter of 200mm or greater which are at least 50mm deep)
- Cracking
- Tree root damage
- Missing or damaged asset pit covers
- Settlement
- Trip hazards
- Deterioration of markings (Pedestrian crossings, parking delineators etc).

4.4.8: Utilities, Safety and Ancillary Items

For Basic inspections, aluminium elements should be inspected to check for any of the 3 easily observable types of damage or deterioration in the marine environment:

- Weld Cracking
- Corrosion at joints to dissimilar metals
- Loose connections (bolts and fasteners)

Table 4.9 provides a summary of what the inspector should look for when conducting a Basic inspection of ancillary items at a boating facility. The examples provided in Appendix A provide general guidance for Basic inspections.

Table 4.9: Basic Inspection Defects and Deterioration to expect on Utilities, Safety and Ancillary Items

Element(s)	Defects and Deterioration to expect
Lighting	- Missing, broken, or structurally failed supports, corrosion - Bending or distortion - Loose hardware - Connection failure
Universal Access Aids	- Missing, broken, or structurally failed supports, corrosion - Bending or distortion - Loose hardware - Connection failure
Bollards and Traffic Posts	- Missing, broken, or structurally failed supports - Loose hardware - Connection failure
Mooring Hardware	- Coating loss - Corrosion - Abrasion - Displacement - Cracking - Corrosion and deformity of Fasteners

4.4.9: Coastal Protection and Harbour Structures

Many boating facilities include some sort of wave attenuation structure to reduce the effects of wave action and wake on moored vessels. They are commonly integrated into other components of a facility or can be stand-alone structures.

Although these structures are interrelated, it is not within the scope of these guidelines to cover maintenance of these structures. Instead, the facility manger should refer to the Visual inspection guidelines for coastal protection structures on Crown Land published by DEWLP.

05: Repair of Structures

5.1: Introduction

Repairs are actions aimed to arrest deterioration as it is observed and that are taken dependent on the presence of damage and its resultant condition. Although not always repeated, depending on the scope of works, repairs are likely to vary and are generally more complex and costly than typical maintenance activities.

5.2: Scope of Repairs Guidance

The following sections provide guidance on planning and executing repairs on boating facilities, and the triggers to do so. The objective is to provide guidance to public boating facility managers on the necessity of repairs that reflect the needs of a typical asset management strategy, which seeks a balance between extending life, usability and safety versus minimising costs, as discussed in Section 2.1.

5.3: Scoping and Executing Repairs

The first step to undertake repairs is the scoping and planning of how the repairs will be executed. This planning generally involves review of previous inspection and condition assessment reports to establish the cause of damage or deterioration and the rate of deterioration. Once these factors are established, the scope of works for repairs can be defined. Before executing the works, the public boating facility manager will also need to obtain the relevant approvals (refer to Section 2.3).

It is important for the repairs to be scoped and planned by professionals with the appropriate level of experience and expertise who have a specialised understanding of the engineering unique to these facilities. As such, it will not always be feasible for public boating facility managers entities to complete the repairs scoping in-house. If the required repair scoping is not within their in-house skillset, it should be done by an appropriately experienced specialist.

Preparing Scope of Works for Repairs

The design to repair is ultimately dependent on the asset management strategy chosen by the facility manager. Regardless, to prepare a scope of works, each of the following factors should be understood and considered:

- The functional purpose of the boating facility component
- The required life of the boating facility and the expected life with and without repairs
- Extent of damage and/or deterioration
- Permits required (see Section 2.3)
- Constraints related to mobilisation and execution of the scope of works
- Constraints related to Environmental Restrictions or laws
- Environmental Conditions at site (Wind, Waves, Tides and currents)

5.4: Triggers for Repairs

Section 4 provides guidance to public boating facility managers on inspections and how to monitor boating facility components. Once these assessments are obtained, the following sections can be used as a guide on whether repairs are required. It is only provided as guidance as the design to repair is ultimately dependent on the asset management strategy chosen by the public boating facility manager.

In the following sections the requirement for repair is related to either an observed condition or a condition rating in the form of 'triggers'.

5.4.1: Concrete

Repair of concrete components will generally fall into one of the categories listed in Table 5.1. The trigger points give guidance on what type and level of deterioration warrants each repair.

Table 5.1: Concrete Repairs

Repair	When to adopt (Trigger)	Specialised advice required?
Repair medium to large cracks	A concrete element has cracking above 0.2mm in width	Scope of works and product selected by engineer or equivalent
Major Joint repair	Construction joints are open allowing water to penetrate in or leak through the structure	Scope of works and product selected by engineer or equivalent
Concrete Patching	A concrete element has experienced deterioration of rating 3 or above and is suffering from spalling or significant cracking	Scope of works and product selected by engineer or equivalent
Concrete Encasement	Protection against further deterioration is required. Precast concrete piles have rating 3 or above along most of the pile height due to sulphate attack	Design required from Structural Engineer
Coating or wrapping of piles	Protection against further deterioration is required. A concrete pile has experienced deterioration of rating 3 or above and is suffering from spalling or significant cracking	Scope of works and product selected by engineer or equivalent in consultation with the product manufacturers
Scour repair	Serious erosion of seabed material has occurred around a concrete pile as a result of propeller wash, wave action, strong currents or a significant change in coastal processes.	Specialised advice required from civil engineer, preferably with maritime or coastal focus
Replacement of concrete element	Serious deterioration of the concrete element has occurred precluding the use of repair. Generally, condition rating 2 or less	Design required from Structural Engineer

5.4.1.1: Concrete Pontoon Decks

Concrete pontoons come in small modular and large modular and floating units connected with steel plates and timber external walers or end joined with flexible hinges and tendon strands.

Standard smaller modular concrete units currently available in the market have had a number of historic areas of maintenance generally associated with the nature of their thin shelled design around foam. Additionally, issues arise at the connections with issues relating to embedment.

The noted cracking of thin shelled fibre reinforced concrete mortar can lead to reinforcement corrosion and so it is necessary to repair. Often epoxy or crystalline fillers are used by the manufacturers to increase life and for aesthetic purposes.

Managing entities should contact the proprietary pontoon provider for advice in these instances as they are observed, and be aware of any warranty obligations, In any case, standard repair procedures related to marine concrete should be followed.

5.4.2: Timber

Repair of timber components will generally fall into one of the categories listed in Table 5.2. The trigger points give guidance on what type and level of deterioration warrants each repair.

Table 5.2: Timber Repairs

Repair	When to adopt (Trigger)	Specialised advice required?
Coating or wrapping of piles	A timber pile has experienced deterioration of rating 3 or above	Scope of works and product selected by engineer or equivalent in consultation with the product manufacturers
Concrete Encasement	Protection against further deterioration is required. A timber pile has experienced deterioration of rating 2 and above.	Design required from Structural Engineer
Scour repair	Serious erosion of seabed material has occurred around a timber pile as a result of propeller wash, wave action, strong currents or a significant change in coastal processes.	Specialised advice required from civil engineer, preferably with maritime or coastal focus
Replacement of Timber Decking or Kerbs	Serious deterioration of the timber decking element. Generally, condition rating 2 or less	Nil
Replacement of Timber Pile, Beam Crosshead, Bracing or Waler	Serious deterioration of the timber element has occurred precluding the use of repair Generally, condition rating 2 or less	Design (or review of existing design) required from Structural Engineer
Replacement of Timber Fender	Fender or supporting waler is broken or is out of alignment with Condition Rating 2 or less	Design (or review of existing design) required from Structural Engineer, preferably in maritime sector
Replacement of Fasteners	Fastener is severely corroded	Nil

Addition of Marine Tape during Timber Element replacement

In cases where the timber elements are seated on other timber members, bitumen impregnated water proofing tape (Malthoid or approved equivalent) should be utilised if feasible, covering the full bearing area.

5.4.3: Steel

Repair of steel elements will generally fall into one of the categories listed in Table 5.3. The trigger points give guidance on what type and level of deterioration warrants each repair.

Table 5.3: Repairs of Steel Structures at Boating Facilities

Repair	When to adopt (Trigger)	Specialised advice required?
Coating or wrapping	Protection against further corrosion is required. A steel element has experienced deterioration of level 4 and below to less than 15 percent of the cross-sectional area.	Scope of works and product selected by engineer or equivalent in consultation with the product manufacturers
Cathodic Protection	Protection against further corrosion is required. Anticipated rate of steel corrosion is high	Design required from Structural Engineer, preferably with a maritime focus
Concrete Encasement	Protection against further corrosion and abrasion is required. A steel element has experienced deterioration of level 3 and below to less than 35 percent of the cross-sectional area.	Design required from Structural Engineer
Scour repair	Serious erosion of seabed material has occurred around a steel structure supporting other elements (e.g. piles) as a result of propeller wash, wave action, strong currents or a significant change in coastal processes.	Specialised advice required from civil engineer, preferably with maritime or coastal focus
Patching of steel section	Small to medium holes exist in steel section. Future Corrosion is anticipated to be low. Protection against corrosion is not required.	Design required from Structural Engineer
Replacement of Steel Section	Serious deterioration of the steel element has occurred precluding the use of patches for repair	Design required from Structural Engineer
Replacement of Fasteners	Fastener is severely corroded	Nil

5.4.4: Aluminium

Fatigue problems will continue to be the focus for aluminium elements as opposed to corrosion which is the case for steel elements. Instances of fatigue suggests the 'solution' should be in the design rather than in the repair due to the ongoing issues following repair of aluminium elements.

Repair of Aluminium elements will generally fall into one of the categories listed in Table 5.4. The trigger points give guidance on what type and level of deterioration warrants each repair.

Table 5.4: Repairs of Aluminium Structures at Boating Facilities

Repair	When to adopt (Trigger)	Specialised advice required?
Scour repair	Serious erosion of seabed material has occurred around a aluminium structure supporting other elements (e.g. piles) as a result of propeller wash, wave action and/ or strong current, or a significant change in coastal processes.	Specialised advice required from civil engineer, preferably with maritime or coastal focus
Replacement of Aluminium element or connecting washer	At the occurrence of corrosion due to dissimilar metals	Design (or review of existing design) required from Structural Engineer
Replacement of Aluminium Section	An aluminium element has experienced deterioration of level 3 and below	Design required from Structural Engineer
Fastener is severely corroded	Fastener is severely corroded	Nil, ensuring dissimilar metals are segregated

5.4.5: Fibre Reinforced Polymer

Due to the nature of the failure mechanisms associated with FRP, repairs will not be commonly triggered in basic level inspections. Rather, basic level inspections will trigger advanced inspections, in which case a professionally trained specialist will recommend the appropriate remedial action.

5.4.6: Elastomers and Synthetics (Rubber, HDPE and Plastics)

Due to the nature of the failure mechanisms associated with elastomers and synthetics (most commonly a result of physical damage, exposure to the environment or aging), and the durability in the marine environment, it is more often the case to replace the element then conduct repairs.

Repairs of coatings or jackets on piling will frequently involve skilled personnel and specialised equipment, with the repairs typically accomplished by external contract.

Table 5.5: Repairs of Elastomers and Synthetics at Boating Facilities

Repair	When to adopt (Trigger)	Specialised advice required?
Elastomeric patch repair	Tears, punctures, cracks of Elastomeric (Pontoon shell etc)	Repair kits and advice provided by manufacturer
Replacement of Elastomeric or Synthetic element	Serious deterioration of the element has occurred precluding the use of elastomeric patch repairs	Proprietary design and product
Replacement of pontoon elements - wear pads	Pontoon is in contact with a hard abrasive surface such as a concrete ramp or pile grips pontoon at interface	Nil
Replacement of pontoon elements - hinges and rollers	Piano hinge or rollers non-functional, causing gangway to drag on pontoon or pile grips pontoon at interface	Nil
Replacement of protective jacket	Damage to shell rendering the jacket non-functional	Advice to be sought from product manufacturer or structural engineer

5.4.7: Land-Side Pavements

As previously detailed, guidance on repairs of land-side pavements (Parking areas and footpaths) is not covered in these guidelines as they are typically covered in established asset management plans.

In the case of damage or deterioration, facility owners should refer to the asset management plans for pavements of the respective council.

5.4.8: Utilities, Safety and Ancillary Items

Repair of utilities and furniture will generally fall into one of the categories listed in Table 5.6. The trigger points give guidance on what type and level of deterioration warrants each repair.

Table 5.6: Repairs of Utilities, Safety and Ancillary Items at Boating Facilities

Repair	When to adopt (Trigger)	Specialised advice required?
Replace lighting	Serious deterioration of the lighting element has occurred making it non-functional	Execution by suitably trained contractor
Replace bollards or traffic posts	Serious deterioration of the steel element has occurred precluding the use of patches for repair	Proprietary design and product, ensuring conformance to VicRoads specifications.
Universal Access Aids	As per recommendations of manufacturer based on condition inspection observations	Proprietary design and product
Replace mooring hardware	Serious deterioration of the mooring element has occurred to level 4 or below	Like for like replacement
Replacement of Fasteners	Fastener is severely corroded, missing or deformed	Nil

5.4.9: Coastal Protection and Harbour Structures

Repair of Coastal Protection Structures will generally fall into one of the categories listed in Table 5.7. The trigger points give guidance on what type and level of deterioration warrants each repair.

Table 5.7: Repairs of Coastal Protection and Harbour Structures at Boating Facilities

Repair	When to adopt (Trigger)	Specialised advice required?
Joint Repair	Joint leaking, of poor condition	A skilled stone mason is required or similar
Scour and Settlement repair	Settlement of rock structures, formation of voids, unstable fill	Require specialised experience and equipment. Seek advice of coastal or structural engineer.
Addition of rock to coastal structure	Sloughing of side slope in the riprap, Undercutting of the toe of the structure, Slippage of base material as the result of scour by currents, dislodgement of stones by wave action.	Require specialised experience and equipment. Seek advice of coastal or structural engineer.
Addition of backfill	Where there is evidence of erosion or loss of soil, settlement or protective coverings, such as rockfill or Armor units	Require specialised experience and equipment. Seek advice of coastal engineer or experienced contractor.
Sealing	The loss of soil from behind seawalls to prevent further loss of material prior to replacement of suitable backfill.	Require specialised experience and equipment. Seek advice of coastal or structural engineer.

06: References

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Appendix A:
Basic Inspection Example Form

Boat Facility Name	'Beautiful Launch' Boating Facility	**Facility Manager Entity**	'By The Riverbay' Council of Management
Date of Inspection	2/12/2021	**Asset Manager**	Karen Boss
Inspector Name(s)	Joe Smith		

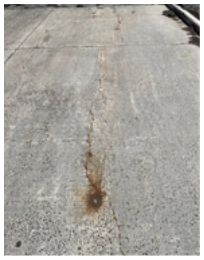
Component	Element	Material	Component ID	Photo No.	Visual Condition Rating	Comments	Safety Issues
Boat Ramp	Ramp	Concrete	BR-R-1	1-5	4	-	Sand build up on ramp
Boat Ramp	Pile	Steel	BR-P-1	6-8	4	-	
Jetty	Deck	FRP	J-D-1	9-10	6	-	Slippery marine growth
Jetty	Pile	Steel	J-P-1	10-13	3	Lots of corrosion	
Jetty	Pile	Steel	J-P-1	14-17	2	Appears to have been impacted by vessel	
Jetty	Pile	Steel	J-P-1	18-21	3	Lots of corrosion	

Comments

This jetty has had some major repair work completed in the recent weeks including new fenders, deck beams , FRP decking and new fish cleaning station. More maintenace work has been identified and needs to be carried out promptly.

Appendix B: Basic Inspection Condition Rating Examples

B.1: Concrete

Condition	Description	Example
6	- Brand new - No efflorescence - No hairline cracking	
5	- Fine Cracking - Surface staining - Minor voids - Honeycombing - Abraded surfaces - Uneven articulated blocks	   

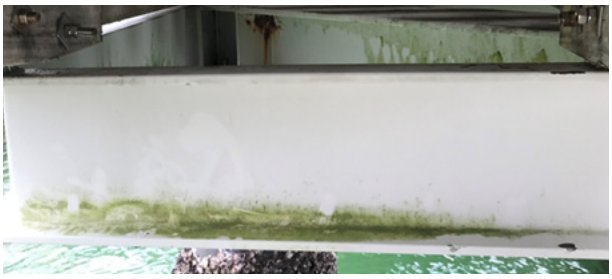
B.1: Concrete (Continued)

Condition	Description	Example
4	- Moderate cracking (up to 0.5mm) - Rust Staining - Minor Spalling in select locations - Exposed reinforcement in select locations (<5% area) - Dislodged or cracked articulated blocks - Surface deterioration	   
3	- Large Cracks in select locations - Delamination in select sections - Reinforcing exposed - Entire Rows of articulated blocks dislodged showing geotextile beneath - Displaced component	   

B.1: Concrete (Continued)

Condition	Description	Example
2	- Large Cracks over large portion of surface area (>30%) - Delamination of large sections - Reinforcing exposed in areas - Loss of section	  
1	- Failed component - Severe Spalling - Major Cracks (>2mm) - Severe delamination - Large areas of reinforcing present	

B.2: Steel

Condition	Description	Example
6	- Protective coating intact - No apparent loss of material	
5	- Protective coating mostly intact - Minor chalking - Discolouration or fading - No apparent loss of material	 
4	- Coating deterioration - Chalking - Minor to moderate corrosion	  

B.2: Steel (Continued)

Condition	Description	Example
3	- Significant (>50%) coating deterioration of visible area - Advanced chalking - Progressed corrosion across entire section - Some section loss	 
2	- Significant (>50%) coating deterioration of visible area - Chalking - Advanced (10-30%) corrosion Section loss	
1	- Failed - Significant (>50%) coating deterioration of visible area, chalking, Significant (>50%) corrosion, failed	

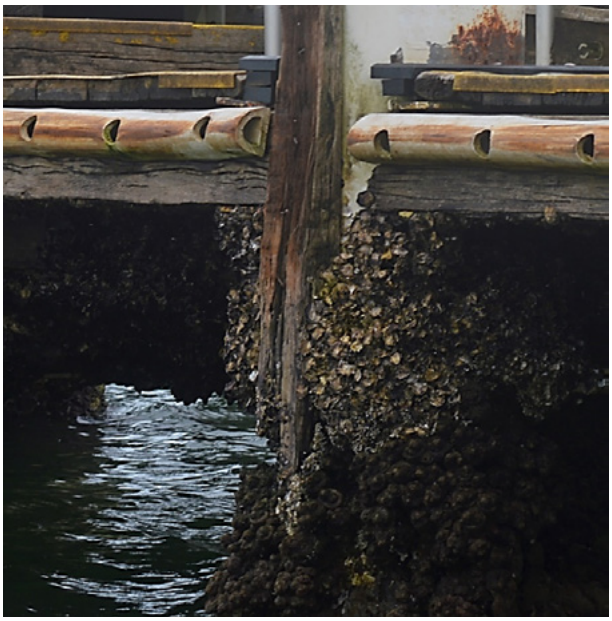
B.3: Timber

Condition	Description	Example
6	- Brand new - No/ Minor splits or section loss - No discolouration	-
5	- Minor rot, decay, necking splits - Minor Section loss (almost negligible)	 
4	- Moderate Pipe Rot, decay in locations - Presence of marine borer attack in select locations - Section loss up to ~20% of cross section - Termite activity - Moderate cracking /splits	 

B.3: Timber (Continued)

Condition	Description	Example
3	- Moderate Pipe Rot, decay to most of section - Very noticeable presence of marine borer attack - Section loss up to 20-30% of cross section - Crushing of Cross Section - Severe splitting of end spans - Large number of moderate cracking /splits	
2	- Heavy Pipe Rot, decay in locations - Very noticeable presence of marine borer attack - Section loss up to 50% of cross section - Severe necking - Crushing of Cross Section - Large number of Major cracking/splits	

B.3: Timber (Continued)

Condition	Description	Example
1	- Failed Section - Severe Pipe Rot, decay in locations - Over 50% Section loss of cross section - Severe necking - Crushing of Cross Section - Large number of Severe cracking /splits	 

B.4: Aluminium

- Weld or fatigue cracking
- Broken members

Figure B.1: Shearing of aluminium gangway weld (left), broken aluminium bracing on gangway (right)

B.5: Fibre Reinforced Polymer

- Impact Damage from boats or waves
- Shearing at bolts/connections

Figure B.2: New Gangway with perforated FRP Decking (left), Dislodged FRP decking (right)

B.6: Elastomers and Synthetics

- Misalignment
- Missing/loose members such as HDPE pile cap sleeve not welded shut
- Loose or broken connection
- UV Damage
- Impact Damage
- Tears, drops
- Uneven or low freeboard, misalignment, tilt
- Swelling of float module
- Work, uneven or slippery surface – marine growth
- Physical damage to shell (dents, penetrations).

Figure B.3: New Pontoon (left), Failed Pontoon membrane exposing floating module (right)


Figure B.4: New Protective Pile Sleeve (left), Failed Protective Pile Sleeve Capping (right)

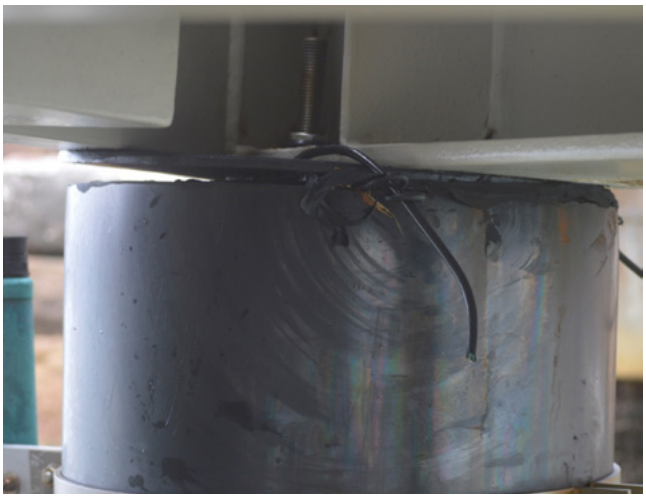



Figure B.5: New Protective Horizontal Fenders (left), Worn, Moderately Conditioned Horizontal Fenders (right)


B.7: Utilities, Safety and Ancillary Items

B.7.1: Lights, Navigation aids (on land or at end of pontoon), Universal Access Aids, Bollards and Traffic Posts, Mooring Hardware

- Missing, broken, or structurally failed supports
- Corrosion
- Corrosion and deformity of Fasteners
- Bending or distortion
- Loose hardware
- Coating loss
- Corrosion
- Abrasion
- Displacement
- Cracking.

Figure B.6: Corroded Mooring Bollard (left) Damaged cleats (centre, right)

B.8: Coastal Protection and Harbour Structures

- Failed Revetments
- Failed Retaining Walls
- Failed Breakwater Crests
- Scouring of Rock Walls or Retaining Walls.

For these components, public boating facility managers are referred to DEWLP Visual inspection guidelines for coastal protection structures on Crown land.

Appendix C: Example of a General Maintenance Schedule

Sch-A10731-1	[Insert Authority/Council Name] [Insert Location] Boat Ramp Facility Maintenance Schedule		
Revision	**A**		
Category	**Item**	**Condition**	**Activity**
Concrete Wharf			
Piles (Above Water)	All piles	-	Dive inspection including cleaning
Concrete spans	Concrete Deck - D03A	3	Passive reinforcing/dowel, patch concrete edge
	Concrete Deck - D02A	3	Injection of sealant
	Concrete panels - CB2A	2	Scrabbling of Concrete soffit, rewilding of reinforcement and sealing with epoxy
	Concrete panels - CB1A and CB2A	2	Breaking out delaminated concrete on soffit, passivating exposed reinforcement and sealing with epoxy
Concrete headstocks and capitals	All concrete headstocks and capitals	-	Repair cracks by injection of sealant
New Access Ramp			
Piles (Above Water)	All piles	-	Dive inspection including cleaning
	All piles	-	Weld existing cap to HDPE protective sleeve
Steel Headframes	All steel headframes	-	Blast and recoat, removing all corrosion present
Boat Ramp Wharf			
Piles (Above Water)	All piles	-	Dive inspection including cleaning
	All piles		Blast and recoat, removing all corrosion
	All piles		High pressure wash or dive works to remove marine growth and other surface contaminants under HAT
	Piles 7A, 7B and 8B	2,3	Replace pile cap
	Piles 7B and 9B	2,3,4	Replace pile collar
	All pile cleats	-	Blast and recoat, removing all corrosion present
Crossbeams	All crossbeams (including cleats)	-	Blast and recoat, removing all corrosion present
Bearers	All timber and FRP Bearers	-	High pressure wash or dive works to remove marine growth and other surface contaminants under HAT
	BE7A-BE13A	-	Coring investigation
	BE13A-BE13D	2,3,4,5	Replace with FRP
	BE13A	2,3,4,5	Replace missing nut and bolt to cleat
Crossbracing	All crossbracing	-	Blast and recoat, removing all corrosion
	Crossbrace 7A	2,3	Replace missing nut and bolt to cleat
Vertical timber fenders	F11A-F12A	2,3,4,5	Refix rubbing strip
	F13A	2,3,4,5	Replace fender and rubbing strip
	F14A-F18A	2,3,4,5	Replace fender and rubbing strip
Horiztonal Fender Strip	17A	-	Replace and re-fix to pile cleat
Decking	11A	2,3	Replace missing traction pad
	14A-17A	2,3,4	High pressure wash or dive works to remove marine growth and other surface contaminants
	14A-17A	2,3,4	Install new anti-slip tape

Job No.	XX	Project Programme								
Date	16.02.2021	[Insert Authority/Council Name]								
By	[Initials]	Boat Ramp Facility Maintenance Programme								
Priority	Duration	2021			2022				2023	
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
2	24 months									
3	12 months									
3	12 months									
4	6 months									
4	6 months									
3	12 months									
2	24 months									
3	12 months									
3	12 months									
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3	12 months									
2	24 months									
1	2–4 Years									
4	6 months									
4	6 months									
4	6 months									
4	6 months									
4	6 months									
3	12 months									
4	6 months									
5	Immediate									
5	Immediate									