Build. Move. Connect.

South Australian

Planning, Design and Construction of Boat Launching Facilities

2026–2035

Government of South Australia
Department for Infrastructure and Transport

Disclaimer

More information

dit.sa.gov.au

Published on June 2026

Government of South Australia
Department for Infrastructure and Transport

Build. Move. Connect.

The Department for Infrastructure and Transport acknowledges the Traditional Custodians of the Country throughout South Australia and recognises their continuing connection to land and waters.

We pay our respects to the diversity of cultures, significance of contributions and to Elders past, present and emerging.

Build. Move. Connect.

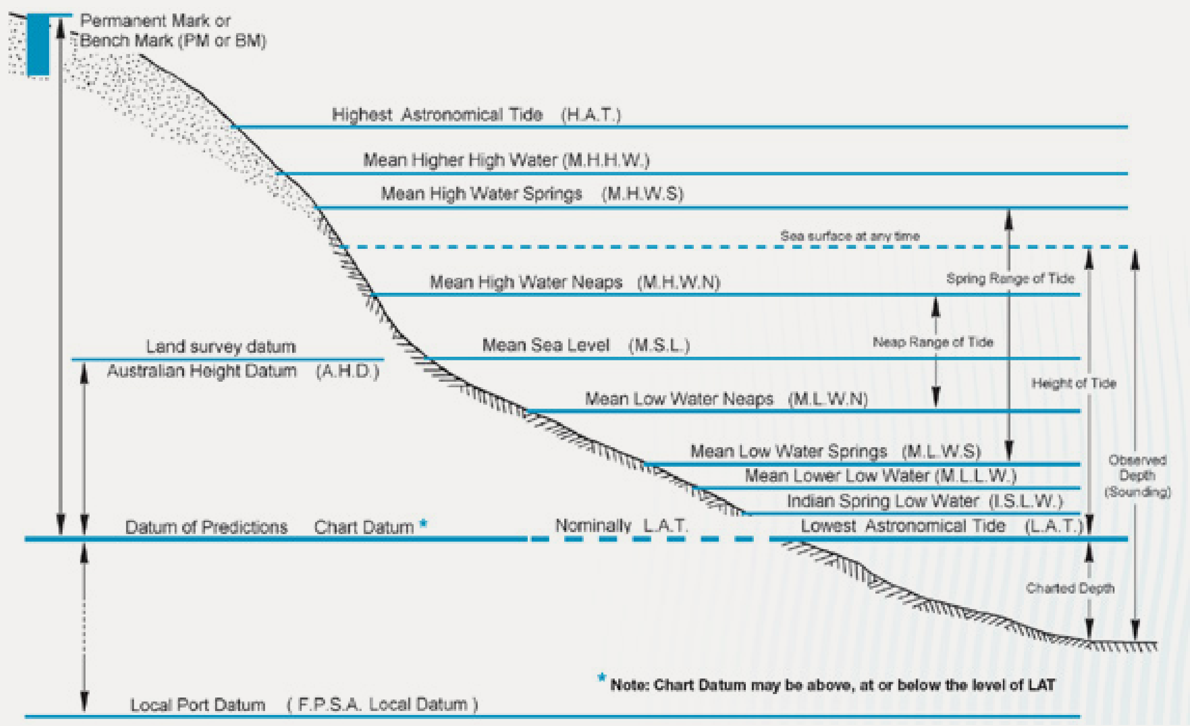
by Jaylene Ware
Wirangu, Kokatha and Antakirinja Matu-Yankunytjatjara Artist

Contents

Acronyms

AHD	Australian Height Datum
AS	Australian Standards
CD	Chart Datum
CPB	Coast Protection Board
DHW	Design High Water
DLW	Design Low Water
FRP	Composite Fibre Reinforced Plastic
GFRP	Glass Fibre Reinforced Polymer
HAT	Highest Astronomical Tide
HDPE	High Density Polyethylene
LAT	Lowest Astronomical Tide
LGA	Local Government Area
MHW	Mean High Water
WHS	Work Health and Safety

Datums and reference planes



Reference documents

AS/NZS1158	Lighting for Roads and Public Spaces
AS/NZS1170	Structural Design Actions
AS1428	Design for Access and Mobility
AS1657_2018	Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation
AS1742	Manual of Uniform Traffic Control Devices
AS1744_2015	Standard Alphabets for Road Signs
AS2159_2009	Piling - Design and Installation
AS2890	Parking Facilities – Off Street Parking
AS3600_2019	Concrete Design
AS3962_2020	Marina Design
AS3972_2010	General Purpose and Blended Cements
AS4997_2005	Guidelines for the Design of Maritime Structures
PIANC	WG 121_2014 Harbour Approach Channels – Design Guidelines
DoT, WA	Guidelines for the Design of Boat Launching Facilities in Western Australia below the 25th Parallel
TRMS, NSW	NSW Boat Ramp Facility Guidelines

Approval for the use of material from these publications is acknowledged.

Definitions

Proponent	An entity (usually a local or state government authority) that is proposing to plan, design, construct, own, operate and maintain a boat launching facility.
Designer	An entity or individual engaged by the Proponent that is suitably qualified to produce design and construction drawings of the proposed boat launching facility.
EPA	The South Australian Environmental Protection Authority.
Boat launching facility	Comprises all the features that collectively enable a boat to be launched and retrieved into and out of the water. These features could include, but not limited to, the boat ramp, pontoons, jetty, wharf, manoeuvring area, car and trailer parking, rigging area, breakwaters, navigational channel, aids to navigation, and other ancillary items.
Boat ramp	The part of the boat launching facility comprising the ramp slab and pontoons.

Foreword

Boating is an important recreational pastime that improves the health and well-being of countless South Australians. Whether it's fishing, diving, skiing, or cruising, many South Australians have an affinity for the water and boating allows people to pursue these passions.

Many of our communities, both regional and local, are centred around boat launching facilities, providing a range of recreational and economic benefits. Together with provision of aids to navigation and marine radio supported by marine safety surveillance and education programs, boat launching facilities offer an important and safe way to access our waterways.

Additionally, the boating sector also contributes to our economic prosperity, supporting commercial and recreational fishing industries, as well as tourism operators. These industries help to sustain and keep vibrant many of our coastal and riverine communities, particularly in regional areas.

Well-designed, constructed and maintained boat launching facilities allow our boaties to safely access waterways for a range of activities.

Various changes in boating activities have emerged in recent decades within South Australia. Design standards and guidance have also evolved over time and new materials and products are now available for the design and construction of boat launching facilities.

Boat registrations data as of November 2025 indicates that there are more than 47, 600 registered vessels in South Australia. To meet this demand existing boat launching facilities will need to be upgraded and new facilities constructed.

It gives me great pleasure to present the new edition of the Guidelines for Planning, Design and Construction of Boat Launching Facilities. The original South Australian guidelines were developed in 1997, which have provided guidance to the development of boat launching facilities for the last 26 years.

This new document brings together best practice guidance and past learnings to assist Councils and other Proponents to plan, design, construct and maintain boat launching facilities with a South Australia focus.

Mark Shotton
Executive Director, Road and Marine Services

1. Introduction

1.1. Objectives

The planning, functional design and layout of boat launching facilities is dependent upon many factors. These factors include location, site conditions, access to waterways, size and type of boats, expected usage as well as other engineering and environmental considerations.

The South Australian Boating Facilities Strategic Plan[1] provides the key strategic objectives in assisting Proponents to develop business cases in support of seeking funding assistance for the delivery of new or improved boating facilities.

These Guidelines assist Proponents in the planning, design, construction and maintenance of boat launching facilities.

Proponents of boat launching facilities should seek advice from experienced coastal design engineering consultants as well as planning and environmental authorities to ensure the detailed requirements and environmental impacts for a proposal are well understood and accounted for.

1.2. Approach

The initial planning and eventual detailed design of a boat launching facility must be fit for purpose and cater for the specific activities and needs of the facility. Figure 1 presents the recommended approach for the planning, design and construction of a boat launching facility.

1.3. Reference drawings

The Guidelines are supported by reference drawings to assist in specifying and designing a boat launching facility.

Reference drawings offer the designer details and design layouts consistent with these Guidelines.

The reference drawings should be used as a guide in the design of boat launching facilities recognising that every site is unique and that each design will need to be tailored to meet the specific requirements and constraints of each site.

[1] South Australian Boating Facilities Strategic Plan, Department of Planning Transport and Infrastructure, 2016

Boat launching facility - planning, design and construction approach

Strategy and planning

Undertake strategy and planning process, including:

- Clarify boating facility purpose.
- Identify usage and undertake a demand assessment.
- Identify facility service level (FSL).
- Select appropriate site, including consideration of:
  - planning controls
  - exposure to coastal processes, including waves and siltation
  - water connectivity
  - land connectivity
  - other factors, including triple bottom line.

Basis of design

Confirm basis of deign, including:

- Selection of design life.
- Identify key design constraints:
  - design vessel and trailer size
  - design water levels
  - requirement for protection and dredging.
- Specify safety and verification requirements including:
  - safety in design
  - design certification and construction verification
  - level of detail.

Facility layout and component design and construction

Design the overall facility layout (functional design) and technical components (structural design), utilising components:

- Boat ramp.
- Pontoons and jetties (holding structure).
- Parking, access and maneuvering areas.
- Supporting amenities Safety in design.

Complete independent design certification and construction verificationactivities.

Construct the boat launch facility in-line with design and planning requirements. Upgrade facility as required (start planning process again).

Maintenance

Specify, plan and implement an ongoing maintenance program to ensure the boat launch facility remains safe and reliable for users.

Figure 1: Boat launching facility planning, design and construction approach

2. Planning

Planning is the most important step in the boat launching facility development process, however, it can be easily overlooked at the commencement of a project. The best designed and well-constructed boat launching facility may never be used if there is no demand or if it has been constructed in an unsafe location, such as a site with large and exposed wave heights.

The following sections outline the recommended strategic and planning steps when commencing development of a boat launching facility.

2.1. Approach

A well-planned boat launching facility must consider multiple factors, as outlined below, and presented in the flowchart:

- Purpose – Who is going to use the boat launching facility and for what purpose?
- Strategy – Does the proposed boat launching facility align with the strategic goals and plans of local and state government?
- Needs analysis – Is a boat launching facility required and what service level should be targeted?
    - Review boat launching demand and potential usage numbers.
    - Identify facility service level (i.e. facility size).
- Site Selection – Has an appropriate site for a boat launching facility been selected?
- Consider the following factors when selecting a site:
    - Planning controls.
    - Coastal exposure and management.
    - Water connectivity.
    - Land connectivity.
    - Social, cultural and environment impacts.
- Asset Management – Is the boat launching facility going to be effectively maintained and remain safe and usable for the design life?

2.2. Purpose and usage

Boat launching facilities are important recreational and commercial facilities, however it is important to recognise that a boat launching facility is not just a destination but also part of a route.

Proponents should have the following in mind when developing boat launching facilities:

> *A launching facilities primary purpose should be to facilitate the safe and efficient launching and retrieval of vessels.*

Launching activities include:

- Prepare the boat for launching.
- Manoeuvre the boat and trailer onto the launching ramp.
- Launch the boat into an adequate depth of water.
- Secure the boat while the car and trailer are parked.
- Park and secure the car and trailer.
- Embark the crew and passengers onto the boat.
- Leave the facility safely.

Retrieval activities include:

- Enter the facility safely and find a suitable berth to hold the boat.
- Hold and moor the boat while the car and trailer is brought to the ramp.
- Disembark the crew and passengers from the boat.
- Safe access pathway for users between the ramp and the carpark.
- Manoeuvre the car and trailer onto the ramp.
- Load the boat onto the trailer.
- Leave the ramp area.
- Prepare the boat for the road journey including de-rigging, washdown, securing the boat to the trailer etc.

2.3. Strategy and strategic review

The South Australian Boating Facilities Strategic Plan outlines three specific priorities that the Proponent should address when planning and seeking funding for a new or upgraded facility:

- Activating key boating hubs — The facility is located in a key regional or tourist destination. Priority is given to facilities that experience (or are forecast to experience) high numbers of users.
- Connecting key boating routes — The facility fills a gap in the objective of connecting key boating routes. This may be due to the lack of an existing facility entirely, a facility being better located than nearby facilities and therefore needing to be developed as a matter of precedence, or where the level of service needs to be increased on an existing facility.
- Improving safety outcomes — The proposed facility addresses a safety issue.

2.4. Needs analysis

Boat launching facilities can be expensive to plan, design, construct and maintain.

It is important to ensure that they are planned and designed to meet the current and likely future demands in an area. A needs analysis is recommended to ensure there is suitable demand to warrant a new or upgraded facility and also to ensure that the facility is a suitable size outlined further in Section 2.4.3.

A needs analysis would typically involve the following step:

- Identify potential users of the facility.
- Assess boating usage and demand in the local and regional context.
- Identify a suitable facility service level.

2.4.1. Boat launching facility users

The potential users of a boat launching facility should be established at an early stage, so that specific needs or requirements are incorporated into the facilities' planning and design. Consideration should be given to mixed usage such as:

- Recreational users, including recreational fishermen.
- Personal powered watercraft.
- Yacht or sailing clubs.
- Commercial fishing operations, including aquaculture fishing operations.
- Tourism operators, including fishing charters.
- Kayaks, canoes and other unpowered marine craft.

Early identification of users helps to establish the design boat and trailer to form the basis of designing a boat launching facility, outlined further in Section 3.5.2.

2.4.2. Usage and demand assessment

The activities that currently place demand on boat use should be reviewed to estimate future boating movements and anticipated use of a new or upgraded facility.

The level of assessment will depend on the likely size and importance of the facility. For example, a large multi-lane ramp in the metropolitan Adelaide region should consider undertaking a detailed facility usage and demand study. As a minimum, assessment of the following is recommended:

- Existing facilities usage:
  - Confirm the usage and any launching or retrieving bottlenecks at existing facilities within the Local Government Area (LGA) or region.
  - Identify peak ramp user numbers through on-site surveys and traffic counting. Should surveys be cost prohibitive, traffic counters can also be used at ramp heads to count launch numbers.
- Potential future usage:
  - Confirm numbers of registered boats in an area.
  - Review registration growth rates in an area.
  - Identify potential future usage and daily launch numbers.

2.4.3. Boat launching facility service level

Levels of service define the quality, quantity, reliability, standards, physical properties, amenity and other service provisions that the boat launching facility offers the user.

The South Australian Boating Facilities Strategic Plan has classified different levels of service that a boat launching facility can provide. A summary of the boat launching facilities service level categories are shown in the table below:

Service Level 1	Beach launch and retrieval only.
Service Level 2	Sealed ramp surface only.
Service Level 3	Sealed ramp surface with a holding structure and limited manoeuvring and carparking area. Limited or no protection from coastal wave activity.
Service Level 4	Sealed ramp surface, holding structure, manoeuvring area and capability to accommodate cars and trailer. Protection provided from coastal wave activity.
Service Level 5	Sealed ramp surface, holding structure, manoeuvring area and capability to accommodate cars and trailer. Protection provided from coastal wave activity and provision of facilities to service boats such as refuelling facilities.

Table 1

For example, Service Level 1 consists of a beach launch and retrieval site, which provides minimum levels of service and only partially meets the requirements of these Guidelines. Examples of this include Farm Beach and Hardwicke Bay and are only recommended for use by experienced mariners only.

A Service Level 1 or 2 facility may be appropriate when only a handful of launches are expected each day. Figure 2 shows a Service Level 1 facility located at Hardwicke Bay, which is suitable for low-frequency launch operations.

Figure 2: Service Level 1 launch facility at Hardwicke Bay

The suitability of a particular service level will depend on the findings of the usage and demand assessment in the previous section. Section 4.2 provides broad estimates for the number of launches per day for each ramp lane.

2.5. Components of a boat launching facility

Components of a boat launching facility can be defined as those connected to the water and those connected with the land. Specific design and construction recommendations for each component are outlined in further sections.

The water-based components generally include:

- Boat launching ramp(s).
- Wharves, holding structures, including pontoons, jetties or beach landings.
- Breakwaters, groynes, revetments, and other coastal structures.
- Wave attenuators (if required).
- Access channel and aids to navigation (if required).

The land-based components generally include:

- Access ways.
- Transition spaces and manoeuvring areas, including ramp queue, rigging areas and de-rigging areas.
- Car and trailer parking areas.

Supporting Facilities Section 7 generally include:

- Services and amenities: landscaping, toilets, lighting, water supply, rubbish disposal, regulatory signage, and fish-cleaning stations.
- Supplementary facilities: recreational facilities, fuel supply, accommodation and shopping facilities.

2.6. Site selection

2.6.1. Approach

Proponents should undertake detailed investigations to ensure a chosen site is suitable for the construction of a boat launching facility. As with the demand assessment, the level of assessment will depend on the size and service level of the facility. For selecting the location of new facilities, consideration of the following aspects is recommended, as a minimum:

- Coastal processes and management, including exposure to waves, currents, siltation (i.e. sand movements) and seagrass wrack (i.e. seaweed and seagrass build up).
- Safe navigational access.
- Land availability and connections.
- Social and heritage impacts, including assessment of native title and first nations sites.
- Environmental impacts, including native vegetation.
- Planning controls and land tenure.

Potential sites could be assessed through a Multi-Criteria Assessment (MCA) approach, similar to the methodology presented in PIANC WG 185: Ports on Greenfield Sites – Guidelines for Site Selection and Masterplanning (2019).

An MCA approach is a useful evaluation tool to assist in selecting a site by using a holistic, strategic and justifiable methodology.

Further detail on the key factors for siting boat launching facilities are outlined in the following sections.

North Haven boat ramp

2.6.2. Management of coastal processes

Coastal processes influence the erosion, transportation and deposition that alter coastlines.

Coastal processes may be a naturally occurring process or altered by the presence of structures. In general terms there are several processes that can occur in the coastal environment, some of these include:

- Waves.
- Currents and water levels.
- Sediment transport.
- Sea grass wrack accumulations.
- Climate change specifically impacts of sea level rise and greater number and severity of storm events.

These processes can have a significant impact on the safety and useability of a boat launching facility and, in some cases, can render a boat launching facility unusable if the facility is sited in the wrong location.

General guidance on reducing potential coastal processes impacts on boat launching facilities is provided below:

- Waves:
  - In general, launching ramps should not be constructed in areas exposed to open sea conditions, as protection devices such as breakwaters, groynes and similar structures are costly and have on-going management requirements. Specifically, breakwaters can impact on sediment transport and is discussed in the proceeding sections.
  - Proponents should ensure that boat launching facilities are not placed in locations where wave waves heights can exceed 0.2m in height.[2] The effect of waves and boat wash, if present, should be minimised.
  - The ramp and its supporting infrastructure should be aligned with the predominant waves such that the waves impact directly on the stern of the vessel. This minimises the risk of sideways movement during launching and retrieval. Consideration should also be given to waves reflected off neighbouring solid surfaces.

[2] AS3962, Marina Design

- Currents and water levels:
  - Cross currents should be minimal in approach areas and at the ramp. The angle of the boat ramp and pontoons should account for the prevailing current direction.
  - Large water level tidal variations can make facilities difficult to use and are more expensive to construct.
  - In coastal and estuarine areas, extreme water levels can occur due to the combination of high tides, storm surge and wind setup. Potential sites should not be in low-lying areas subject to significant ocean or flood risk.
  - Design water levels are summarised further in Section 3.5.3.
- Sediment transport:
  - It is not advised to build ramps on exposed, coastal beaches where seasonal and inter-annual changes in beach levels may render the ramp unusable.
  - Breakwaters and groynes constructed on sandy shorelines can interrupt the longshore sediment transport, causing sand to build up on the updrift side and erosion on the opposite side. On-going sand management through bypassing is likely to be required to maintain the longshore transport.
  - Breakwaters and groynes can also result in a wave shadow, causing sand to settle out, leading to an increase in sand management requirements at the ramp if not sited correctly.
  - Silt deposition and thus the need for maintenance dredging of navigation channels and other navigable areas should be assessed and minimised. Any natural or man-made channels or banks adjacent to navigation areas should be stable.
- Sea grass wrack accumulations:
  - Sea grass wrack (wrack) describes detached marine macroalgae, seagrass and other marine detritus. Wrack movement dynamics are complex and are driven by a combination of winds, waves, currents and water levels.
  - Wrack material is generally either neutrally buoyant or slightly denser than seawater and tends to settle out in sheltered locations, such as harbours and next to rocky headlands. Wrack volumes tend to increase in autumn and winter.
  - Care must be taken when siting a facility in an area with large natural wrack volumes and conditions encouraging wrack accumulation should be avoided.

The potential ongoing impact of a boat launching facility on the coastal processes or inland waterways should be considered when designing and choosing a site for a new boat launching facility.

The above section has predominantly focused on siting boat launching facilities in coastal and estuarine areas. Section 9 provides further details on key factors to consider when siting facilities on rivers and inland water locations.

2.6.3. Safe navigational access

Boat launching facilities should be sited in relative proximity to popular boating destinations. This could include specific fishing grounds, dive sites or tourist destinations.

Where possible, boat launching facilities should be sited in locations with sufficient depth to accommodate the design vessel, thus avoiding the need for tidal restrictions or dredging. Further detail on the design of navigation channels is included in Section 8.4.

Navigable depths at a proposed boat launching facility should be assessed through review of recent hydrographic (i.e. bathymetric) surveys of the seabed. Where no recent hydrographic surveys are available Proponents should consider engaging a qualified hydrographic surveyor to undertake a survey to confirm the suitability of a proposed site to provide safe navigational access. The survey should cover the proposed boat launching facility location and extend over potential navigation access channels to the main waterbody.

Any height limits for vessels, for example navigation under bridges or other obstructions, should also be considered when assessing potential sites for a boat launching facility.

Potential sites should also have sufficient water space for boat queuing, launching and retrieving, Section 5. Additionally, sufficient water space should be allowed for any coastal protection structures such as breakwaters and groynes to minimise the risk of boats impacting on these structures.

2.6.4. Land availability and connections

The land-based components of a boat launching facility require a sizeable land area. The size of the facility and number of boat ramps is often limited by the number of boat trailer parking bays. Where possible, the boat launching facility should be designed to allow for future demand and peak-usage overflow areas such that is has the ability to be expanded.

Land availability can be constrained by multiple other factors listed in this section, including planning controls, other land uses, such as urban areas and locations of significant environmental or heritage value. Land ownership is also an important constraint and should be confirmed as part of the site selection review. Developments on private land will require the land holder's approval.

A boat launching facility should be sited with all-weather road access and to and from main roads. Depending on the facility service level, the proximity to existing utilities, such as power, mains water and sewerage may be important and should also be considered when selecting a site, as these can be expensive to connect.

The following factors are also important factors when siting landside facilities:

- Geotechnical — A stable foundation material is needed to enable the boat launching facility to be constructed economically.
- Topography and slope stability – Where possible, sites with a cut to fill balance for any earthworks should be selected to minimise costs.
- Acid Sulfate Soils and Contamination – Some coastal, estuarine and riverine areas may have acid sulfate soils present. Where possible this should be identified, and high-risk areas avoided to reduce expensive treatment requirements.
- Utilities Assessment – Accurate location and assessment of existing utilities should be considered. Where possible, overhead powerlines may be a safety risk for tall vessels, such as yachts. Similarly, low-lying land may complicate connection to existing wastewater sections.

2.6.5. Social and heritage

The Proponent should consider the following social and heritage impacts when reviewing potential sites for a new boat launching facility or improving an existing facility:

- Community support or opposition regarding the development. Community engagement can be used to gauge a local community's preference for different sites under consideration.
- European heritage sites, including heritage building and shipwrecks, that may be disturbed by the proposed development.
- First nations sites that may be disturbed by the proposed development. A search of the Register of Aboriginal Sites and Objects Taa wika[3] can identify any known sites in the proposed development area. Engagement with first nations representatives from the local area is also recommended to identify any local sites not within the register.

[3] Taa wika — Cultural Heritage Database and Register — https://taawika.sa.gov.au/public/home

2.6.6. Environment

In general, boat launching facilities should not be located where the ramp activities will have an adverse effect on the existing amenity of the area.

Areas of significant environmental value should be identified and avoided when considering potential sites. The natural vegetation of the foreshore area should be protected and preserved wherever possible.

Development within or close to coastal dune areas should also consider the potential risk of creating wind-blown sand issues due to their disturbance. Examples of sand dunes in North Haven.

North Haven sand dune

Figure 3: Example of sand dunes in North Haven

2.6.7. Planning controls

Proponents should identify if there are any planning controls in place that might preclude the development. For example, land tenure and ownership should be identified early and included within the development application, Section 2.7.

Proponents should also investigate local council development plans and other planning objectives and principles pertaining to the land use as part of the site investigations.

2.7. Approvals

2.7.1. Development approval

Boat launching facility projects may require development approval under the Planning, Development and Infrastructure Act 2016 through the relevant planning authority. Depending on land ownership and the size of the development, development approval may need to be sought from the local council or the State Commission Assessment Panel (SCAP).

The SCAP will then refer such application to the relevant council, state government authorities and any other authority for assessment prior to finalising development assessment.

2.7.2. Other approvals and assessments for consideration

The development approval process will likely require evidence that the impacts of the proposed project have been appropriately considered and assessed, and there is an appropriate plan in place to manage the impacts. Potential considerations include:

- Aboriginal and Cultural Heritage Impact Assessment – The investigation and assessment of Aboriginal cultural heritage may be undertaken to:
  - Identify whether Aboriginal cultural values and objects are present.
  - Assess the nature and extent of present Aboriginal cultural values and objects.
  - Assess the harm a proposed activity may cause to Aboriginal objects and declared Aboriginal Places.
  - Outline the proposed management approach if an Aboriginal site or object is identified through the construction phase.
  - This process provides a way to clearly identify the harm that activities will cause, what is avoidable and what is not.
- Social Impact Assessment – This assessment may be undertaken to analyse, monitor and manage the intended and unintended social consequences that a proposed development will have on the local community and amenity.
- Traffic Impact Assessment – This may consider the potential impact of the facility on the traffic and residents in the local area, including traffic safety, access routes, entrance and exit from the facility and parking.
- Environmental Impact Assessment – This may consider how the air quality, noise (on land and under water), site contamination, waste, wastewater, water quality and native vegetation clearing impacts are addressed within the proposed development.
  The environmental impact assessment should include activities that occur during construction and whilst operating and maintaining the boat launching facility.

3. Basis of design

The following section outlines the high-level basis of design aspects that should be identified at the start of the boat launching facility design process. This includes design standards, design life, design constraints, safety and verification.

Design guidance for specific facility components is included in Sections 4 to 8.

3.1. Design standards

The design of a boat launching facility includes multiple components with different materials and design requirements. Several design guidelines and standards exist that outline design criteria, formula and specifications.

Reference has been made to a number of Australian Standards and publications in the preparation of these Guidelines, as previously outlined in the preface.

Proponents should ensure a qualified engineer experienced in the planning and design of boat launching facilities supported with knowledge of coastal engineering undertakes the design.

3.2. Design life

The AS 4997 (Guidelines for the Design of Maritime Structures) describes design life as:

> The period for which a structure or structural element remains fit for its intended purpose with appropriate maintenance.

The design life for the facility should be determined at the start of a project that matches the intended purpose of the facility, the facility service level, and the whole of life costs, Section 3.3.

AS 4997 (Guidelines for the Design of Maritime Structures) recommends the following selection of design life for different facility classes:

- 5-year design life for temporary works.
- 25-year design life for a small craft facility.
- 50-year design life for a normal commercial structure.

AS 3962 (Marina Design) recommends a minimum design life of 25 years for marina structures including boat launching facilities. Other consumable elements such as pile guides, fenders and similar items will have a much lower design life as specified by the product specifications.

It is possible that different components are likely to have different design lives depending on the selected materials and anticipated maintenance regime.

The design life chosen will then influence how much consideration is required for the following design inputs.

3.2.1. Design wave and water level events

The longer a structure's design life, the higher the likelihood that it will be exposed to extreme wave and water level conditions.

- The design of maritime structures should be designed to allow for the highest wave likely to occur over the structures chosen design life.

Table 2, sourced from AS 4997 (Guidelines for the Design of Maritime Structures), recommends the annual exceedance probability based on functional category and chosen design life from which to calculate a design wave height. This can be interpreted as the chance of a wave exceeding the design wave height. For example, a 1/200 annual exceedance probability means that there is a 0.5% chance of a wave exceeding the design parameters of the boat launching facility in any one year.

Function Category	Category Description	Design Working Life (years)			
		5 or less (temporary works)	25 (small craft facilities)	50 (normal maritime structures)	100 (Special structures/ residential development
1	Structures presenting a low degree of hazard to life or property	1/20	1/50	1/200	1/500
2	Normal structures	1/50	1/200	1/500	1/1000
3	High property value or high risk to people	1/100	1/500	1/1000	1/2000

Table 2: Annual Exceedance Probability of Design Wave Events[4]

3.2.2. Sea level rise

A marine structure shall be designed to address coastal storm surge and ensure it can adapt to climate change, specifically for anticipated sea level rise over its design life.

The South Australian Coast Protection Board (CPB) provides planning advice on coastal protection and development in South Australia, including protection from the impacts of sea level rise. The CPB is also a prescribed referral agency with respect to development applications for coastal boat launching facilities.

The CPB policy and the Planning and Design Code adopts the following allowances[5] for sea level rise relative for sea level to 1990 mean water levels:

- 0.3m sea level rise to 2050, or
- 1.0m sea level rise to 2100.

[4] AS4997, Guidelines for the design of maritime structures
[5] DEWNR, November 2013, Coastal Planning Information Package

Proponents and designers should incorporate these potential sea level rise values within the design in consideration over the proposed structure's design life.

Climate change predictions can change over time as climate modelling is updated. Designers should be aware of such changes and constantly review and update design parameters used in design.

3.3. Whole of life costs

The whole of life cost is the total cost of owning an asset over its entire lifetime, including construction, inspections, maintenance, operation and disposal. Proponents should consider the whole of life costs when selecting materials when designing a boat launching facility, import factors include:

- Maintenance regime:
  - Proponents should identify the proposed maintenance and inspection regime at the start of the design process.
  - This may be done in conjunction with material manufacturers based on their experience with durability of their products in the corrosive marine environment.
  - This assessment allows decisions to be made on the total whole of life cost for different materials and products.
  - Refer to Section 10 for more details on the maintenance aspects.
- Alternative products:
  - Alternative and innovative products, such as composite fibre reinforced plastic (FRP), should be considered. These may offer a superior design life and maintenance regime compared to traditional steel, timber or concrete elements that are susceptible to premature corrosion and degradation in a marine environment.
- Vandalism:
  - Boat launching facilities are public spaces and may be subject to vandalism and theft.
  - Proponents should ensure they include adequate measures to prevent or minimise theft and vandalism to avoid on-going costs and unnecessary maintenance.
  - For example, this could include using vandal-proof hex screws on panels or structural elements or the use of security cameras, as necessary.

3.4. Safety and verification

3.4.1. Safety in design

The *Work Health and Safety Act 2012* and associated legislation and publications requires engineers and designers to consider the hazards presented throughout the entire life of a facility. This is to ensure, so far as is reasonably practicable, that the design is safe to build, install, operate, maintain and demolish.

Proponents should consider carrying out a Safety in Design risk assessment for the proposed boat launching facility by the engineer or designer. Early engagement of the construction and maintenance representatives is recommended.

3.4.2. Design certification and construction verification

The planning, design and construction of a boat launching facility within a constantly changing coastal environment is a complex task to achieve optimal results over the long term.

Proponents should make a considered risk assessment approach to evaluate the need to include a level of independent design certification and construction verification to ensure (and test) that the completed facility is built to an optimal outcome.

3.5. Design constraints

Design constraints are critical design elements that dictate the geometry, functional and structural design of a boat launching facility. It is recommended that these design constraints are identified up-front at the start of a project, so that they can be carried through the facility design process.

The following sections summarise some of the common design constraints for boat launching facilities.

3.5.1. Existing facility upgrades

Many projects will involve the upgrade or redevelopment of an existing boat launching facility. For example, an existing ramp surface may be upgraded by overlaying a new concrete slab or an additional boat ramp lane may be added to one side of an existing ramp.

The existing structures that are to be retained or upgraded represent potential design constraints, as the design of the new components must account for the existing structures.

It is recommended that the following are undertaken at the commencement of an upgrade project:

- A feature survey of the existing facility to identify the levels, slopes and dimensions of the existing structures and to guide the upgrade design.
- A condition inspection of the existing structures to identify the remaining service life and potential costs to repair or upgrade the components.

The design of a facility upgrade should be determined on a case-by-case basis by the Proponent in accordance with the recommendations within these Guidelines where possible.

Key considerations when upgrading existing facilities, should include:

- Consideration for the remaining service life of facility components that are to be retained and incorporated into the upgraded design.

- New ramps should not be founded on an existing ramp that may be unstable or of questionable integrity. Where possible, the placement of a new ramp slab over an existing ramp should aim to achieve the design guidance set out in Section 4. Of particular importance is providing a continual slope over the length of the ramp surface without introducing sharp changes in grade when the new ramp is overlaid on the old ramp.
- When adding new ramp lanes or holding structures, suitable space should be maintained for boat queuing and manoeuvring.

Port Davis boat ramp

Figure 4: Port Davis boat ramp

3.5.2. Design boat and trailer size

The design boat and trailer size chosen is a key design parameter and will impact on the following components of the design:

- The combined weight of car, vessel and trailer may have an impact on the ramp slab design, particularly in areas of poor foundation material.
- The weight or displacement of a boat impacts the potential loads on jetties and piles.
- The combined length of car, boat and trailer sets the geometry of the landside parking, manoeuvring and approach areas, as well as ramp slope transitions between the top of ramp and manoeuvring areas.
- The boat drafts may have an impact on the channel depths and toe depths.

As noted in Section 2.4.1, Proponents should identify the potential ramp users during the planning phase. From these users, Proponents should identify the critical vessel and trailer dimensions and weight combinations.

It is possible that there are two design boat types. For example, one type of boat could set the weight limit and another boat type could set the draft limit.

Proponents should determine their own design car and boat combinations based on the specific users at the proposed boat launching facility.

A typical boat launching facility without any special users, a car and trailer unit with a total length of 12.9m, consisting of a vehicle 5.8m in length coupled to a trailer 7.1m long (carrying a 6.5m long boat) may be used for design.

3.5.3. Design levels

Boat launching facilities must be designed to accommodate a range of water levels. For example, in the Upper Spencer Gulf, tides can range up to 3.5m, with storm surges and floods potentially increasing peak levels.

Design levels are based on the water levels specific to each location and influence the geometry of several facility components. These design levels are summarised below and shown diagrammatically in Appendix A.

- Datum:
  - All levels and soundings should be reduced to Chart Datum (CD), which is nominally Lowest Astronomical Tide (LAT) and referenced to the Australian Height Datum (AHD), which is the standard vertical datum.
  - Where CD or LAT is not known, an investigation should be carried out to determine this level. This investigation should be done by a licensed surveyor.
- Design Low Water (DLW):
  - The water level chosen as the lowest water level for design purposes is the DLW level.
  - In most cases, for all tide (i.e. unrestricted) access, CD or LAT will be chosen as the DLW level. Where the use of this datum is unsuitable, the reason for choosing DLW should be given.
- Design High Water (DHW):
  - The water level chosen as the highest water level for design purposes is the DHW.
  - The level chosen as DHW should be one which is rarely exceeded and is often set at Highest Astronomical Tide (HAT) for tide access.
- Mean High Water (MHW):
  - MHW level is the average high-water level recorded in tidal areas, usually recorded as MHW spring tide.
- 1 in 100 year Average Recurrence Interval water level (ARI):
  - An annual average recurrence interval is sometimes also known as 'return period'. It is the average number of years that it is predicted will pass before an event of a given magnitude occurs. For example, a 1 in 100 year ARI event would on average happen once every 100 years.
  - The 1 in 100 year ARI water level would need to be determined from long term water level records.
  - A 1 in 100 year ARI event is a statistical estimate and may not be exact.
  - A 1 in a 100 year ARI event could occur on more than one occasion in 100 years. Alternatively, it may be thought of as the annual exceedance probability or 1% chance of occurrence in 1 year.

The relationship between the design levels above must be shown on the boat launching facility drawings.

Special consideration must be given to water levels at boat launching facilities in riverine environments.

3.5.4. Universal and disabled access

A boat launching facility must comply with the Disability Inclusion Act 2018 and be designed in consideration and full inclusion of the community of people with disability and to ensure they achieve their full potential as equal citizens. Proponents should determine the universal access provisions based on the needs and users of the facility.

Design for universal and disabled access may include consideration of:

- Suitable grades and slopes, to allow ease of access onto pontoons or jetties. Cross-grades should be minimised while allowing for drainage if required.
- Suitable jetty and pontoon widths to allow safe access by persons in wheelchairs and other mobility aids. Kerbing or edge protection could be included to reduce potential for falls. Seen in Figure 5.
- Surface materials should be slip-resistant and firm under all weather conditions. Avoid excessive surface texture that may create rolling friction that interferes with wheelchair mobility.
- Pontoons should be stable under typical weather conditions and pedestrian loads.
- Where appropriate, specialist lifting equipment, including wheelchair lifter, may be installed to allow safe embarkation and disembarkation onto boats for persons in wheelchairs.
- Provision should be made for individuals with physical disabilities in parking areas. This should include a minimum of one disabled parking bay with a width of 3.5 m.
- Cut outs or ramps to cross kerbs or other obstructions, and appropriate signposting or pavement marking shall also be provided where appropriate.
- These facilities should be located as close as practicable to the boat ramp. For larger and more popular facilities, 2% of car only parking spaces should be allocated for disabled access.[6]

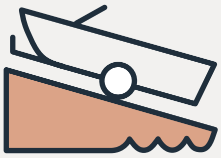
Guidance on universal access for people with disabilities should be referenced to AS 1428 (Design for Access and Mobility) and all other relevant guidelines and publications.

St. Kilda Boat Ramp

Figure 5: St. Kilda boat ramp

[6] Building Code of Australia, BCA, National Construction Codes.

4. Boat ramp



4.1. Objective

The boat ramp provides a transition between the land and water and is used by boat owners to:

- Safely launch the boat into an adequate depth of water.
- Safely retrieve the boat by loading onto the trailer.
- Achieve both objectives without flooding the car passenger area or engine bay.

Where no holding structures are present, crew and passengers also embark and disembark on the ramp.

4.2. Number of lanes

The number of lanes required should match the boat launching facility service level and should be guided by the number of anticipated launchings and retrievals per day.

The following general numbers can be used to guide the number of ramp lanes. Each lane of a ramp can accommodate the following launches and retrievals per day:

- 30 to 40 without any holding structures.
- 40 to 50 if boat holding structures are provided.
- 50 to 60 if separate rigging/de-rigging areas are provided (in addition to holding structures).

However, the number of boat ramp lanes is most commonly dictated by the area available for car and trailer parking, particularly in space-constrained areas Section 6.

Consideration should also be given to the demand constraints, such as tidal limitations and boat type, which may result in high usage levels at certain times of the day.

4.3. Layout and geometry

The boat ramp should meet the following criteria, as set out in AS 3962 (Marina Design) and as shown on the Reference Drawings Appendix A.

4.3.1. Gradient

The ramp gradient shall be within the range of 1V in 7H to 1V in 9H with a preferred gradient of 1V in 8H.[7]

The chosen gradient should be constant over the length of the ramp, as abrupt changes in vertical curves or grade changes can affect lines of sight to the rear of the trailer, making reversing difficult and causing potential trailer hitches to impact the ramp.

Where local needs and conditions require a grade outside this range, the variation and its associated use limitations shall be clearly shown on a sign adjacent to the head of the ramp.

A suitable vertical curve grading could be used to allow a smooth transition and satisfactory vehicle clearance to the manoeuvring area.[7] This transition can be determined using vehicle swept path analysis software that can check appropriate horizontal and vertical clearances.

[7] AS 3962, Marina Design where 1V in 8H refers to a slope having 1 vertical length unit and 8 horizontal length units

4.3.2. Dimensions and levels

- Length:
  - The ramp length will depend on local tidal conditions and coastal topography.
  - It is desirable for both the towing vehicle and boat trailer to be on the ramp itself while the boat is being launched, therefore a length of approximately 10m of ramp should be exposed at MHW.[8]
- Widths:
  - A ramp lane width should be a minimum of 4.5m.
  - Lane widths may be increased to account for larger commercial boats.
- Levels:
  - Where ramp use is considered to be all tide (i.e. unrestricted), the design water level range should extend from LAT to HAT.[9]
  - Where ramp use is restricted, this shall be clearly shown on a sign adjacent to the head of the ramp.
  - The crest level should be a minimum of 0.5m above the DHW.[9]
  - For normal trailered boats, the toe level should be at a minimum depth of 1m below DLW. [9]
  - Toe scour protection should extend 2m past the end of the ramp and be continued at the same gradient as the ramp to a minimum depth of 1.25m below DLW, as shown in Figure 6.
  - The toe depth should be extended a further 1.2 m below DLW for fixed-keel trailered sailing yachts or as required to accommodate the design boat draft.[9]

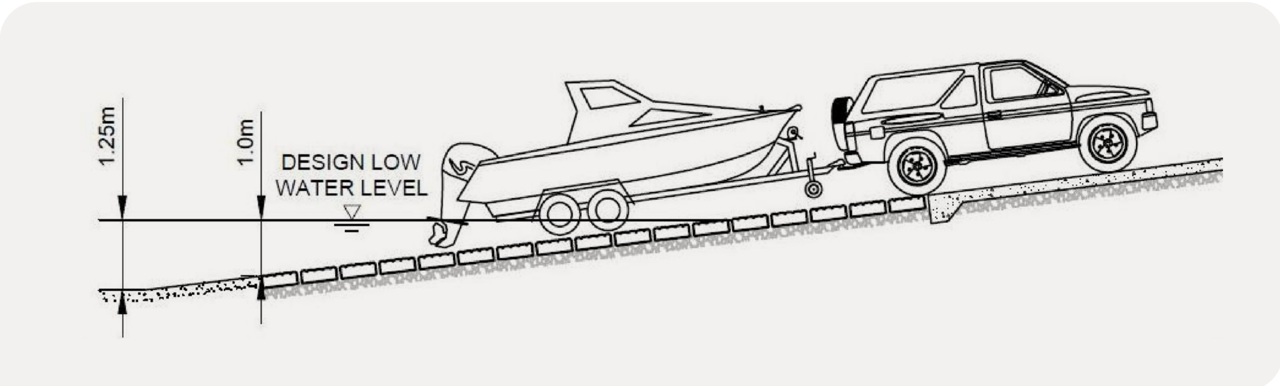


Figure 6: Ramp Toe Geometry

[8] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015
[9] AS3962, Marina Design

4.4. Structural design and construction

4.4.1. Foundation

The boat ramp foundation design is critical in preventing settlement and to provide a stable base to construct or place the concrete ramp slab.

The recommended boat ramp foundation design is shown in the reference drawings in Appendix A and includes the following components:

- Geotextile — Use of an appropriately designed geotextile filter fabric is recommended over the sub-grade (i.e. natural surface) material. This separates the sub-grade from the base layer to minimise consolidation and locally strengthen the base material.
- Base layer – A base layer of 50-100 mm sized rock should be placed on top of the geotextile in a layer of 200mm minimum thickness. It is essential that the base layer be well-formed and compacted to ensure the long-term structural integrity of the ramp. Igneous rock is recommended given its strength and durability properties.[10]

In areas of poor sub-grade condition, a geogrid can be placed between the geotextile and base layer to improve bearing capacity.

4.4.2. Erosion protection

The ramp must be protected from erosion due to tidal influences, current movements, waves and propeller wash. The areas of the ramp requiring protection are the toe of the ramp and the sides within tidal or current influences. Figure 7 below shows a boat ramp at Avoca Dell Reserve where bank reclamation and erosion control works were implemented.

Figure 7: Boat ramp at Avoca Dell Reserve that underwent bank reclamation and erosion control works

Erosion from propeller wash and boat ramp users 'power hauling' onto trailers is of particular concern, as the toe of the ramp may be undermined, leading to collapse of the ramp structure. Therefore, it is recommended that toe protection be provided as far as practicable beyond the berthing area. This toe protection should extend a minimum of 2m beyond the end of the ramp.

Suitable protection options include:

- Rock revetment, including rock armour and rock filter material, placed on top of a geotextile material. Limestone or sandstone rock is preferable to hard rocks such as dolomite or granite to minimise boat damage should contact be made with these rocks.
- Rock filled wire mattresses placed on top of a geotextile material is another option if large armour rock is not available in an area. Designers should consider the potential durability of wire mattresses in the corrosive marine environment, including the requirements for galvanising and polymer coatings.
- Grout filled mattresses are another alternative but are not suitable in locations where the ramp is exposed to large wave conditions.

[10] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015

Designers should consider the durability and whole of life costs of the different protection options in the corrosive marine environment when selecting options.

Where necessary, exposed areas between the ramps and adjacent erosion protection may be protected with stone pitching (i.e. rocks set in mortar). These should be finished with a rough-broomed finish.

Randomly tipped rock and rough concrete at the sides of ramps should not be used that may create risk of injury to boat ramp users or boat damage.

Consideration should be given to signage and education of users to discourage power hauling retrievals. Where power hauling is common practise (e.g. commercial fishing punts or river based ramps) toe protection should be given extra consideration.

4.4.3. Concrete slab design

Boat ramp slabs are typically constructed of concrete. The design of a concrete slabs is complex and involves several elements and material types. For boat launching facilities or ramps with difficult geotechnical conditions, ramp slab design should be undertaken by a structural engineer experienced in the design of marine structures.

Ramp slabs should be designed to satisfy strength, stability and service requirements for the potential loads that would apply the most severe design actions to the ramp. This includes:

- Dead loads from the self-weight of the ramp.
- Live loads that may be applied to the ramp from vehicles and pedestrians, including uniformly distributed loads from the design car-and-trailer combination, as set out in AS 4997 (Guidelines for the Design of Maritime Structures).
- Environmental loads, such as waves, currents and buoyancy, as set out in AS 1170 (Structural Design Actions).

The thickness of the concrete slab shall not be less than 200 mm.

The concrete slab may need to be thicker to account for poorer quality subgrades and potential construction, maintenance and operational traffic loads.

4.4.4. Concrete mix and reinforcement

Boat launching ramps should be designed for long-term durability when subjected to on-site exposure conditions and should be compatible with the intended method of construction.

All concrete design shall be in accordance with AS 4997 (Guidelines for the Design of Maritime Structures), AS 3600 (Concrete Design) and AS 3972 (General Purpose and Blended Cements). The following general recommendations are made for concrete used in the boat ramp:

- Use Special Class 50 (50 MPa) mix for above water and underwater placement.
- Use exposure classification C2 as outlined in AS 3600 (Concrete Design) and AS 4997 (Guidelines for the Design of Maritime Structures) for design.
- Use of approved plastic fibres in concrete to improve durability.
- Where possible, all concrete should be cured using a water-based hydrocarbon resin curing compound applied in accordance with manufacturer’s specifications. Curing compound should achieve at least 14 days curing time under ambient conditions and be designed to breakdown after 14 days. Care should be taken not to overdose the application of the curing compound as this may result in an initial slippery surface.

In areas of poor sub-grade condition or high loads, the ramp slabs may need to be constructed with reinforcement to provide additional strength.

It is preferable wherever possible to consider using glass fibre reinforced polymer reinforcement (or approved equivalent) as a substitute for steel.

Reinforced concrete using steel reinforcement should be designed in accordance with AS 3600 (Concrete Design) and AS 4997 (Guidelines for the Design of Maritime Structures) for strength, serviceability and durability, including provision for the following key considerations:

- Cover to steel reinforcement shall be 65 mm or greater for galvanised or carbon steel reinforcing bars.
- Galvanised reinforcement shall be specified in combination with stainless steel or galvanised tie wire.

Glass fibre reinforced polymer reinforcement can also be considered in lieu of steel reinforcement in order to achieve higher durability outcomes.

4.4.5. Ramp surface

The ramp surface is a critical aspect and must provide traction for the towing vehicle at all tide levels, as well as a sound footing for boat users guiding their boats on and off trailers. AS 3962 (Marina Design) provides guidance on the recommended ramp surface for concrete ramps.

The ramp surface must comprise the following two key components:

- Textured Surface finish:
  - The concrete ramp surface shall be finished with a coarse-grained finish, such as a raked rough-broomed finish, to improve grip and reduce the risk of slippages.
  - A steel trowelled finish either performed by hand or mechanical machine is not permitted.
- Grooves:
  - The concrete ramp surface shall have deep grooving to support towing vehicles.
  - The preferred option is an angled groove pattern moulded into the surface at an angle to the ramp contours to drain excess water and debris and allow self-cleansing.
  - The grooves shall be 25 mm deep and 25 mm wide, square-shouldered at an angle of 45-degrees to the ramp contours and at 75 mm centres. A recommended groove pattern is shown on the Reference Drawings in Appendix A.
  - All grooves must terminate into a gutter at the low end of each sloping panel such that water drains into the next panel further down the slope, thereby preventing grooves from holding water. The below Boat Ramp at Largs North shows a textured surface finish with deep grooves to support boat launch and retrieva, Figure 8.

Largs North boat ramp

Figure 8: Boat ramp at Largs North

Other concrete surfaces that pedestrians may step onto or access, such as concrete abutments or stone pitching between ramps, should also be finished with a coarse-grained finish, such as a raked or rough-broomed finish.

4.4.6. Ramp placement method

The ramp construction method is a fundamental consideration when designing boat ramps. There are two methods to construct a concrete ramp; in-situ concrete (poured concrete to a form) or precast concrete panels. The precast concrete panel method is generally used to form a concrete ramp below the water level and in-situ concrete above the water level (in the dry).

It is preferred, wherever possible, to form the concrete ramp by using in-situ concrete and minimising the use of precast concrete panels. Maximising the use of in-situ concrete to form a concrete ramp provides greater quality control in the assessment and preparation of the base layer and creates a monolithic concrete ramp that can outperform precast panels.

Installation of precast panels requires a well prepared and even base layer from which the precast panels can be supported upon to achieve an overall continuous uniform slope. This can be a challenge when performing this task below water.

In-situ concrete placement:

- Concrete ramp slabs are formed, poured, vibrated and cured in place. This is the most common method of ramp construction above mid-tide level, as the placement can be undertaken around tidal levels.
- Using the in-situ placement method below mid-tide level requires more complex construction techniques, including:
  - Construction of a cofferdam around the perimeter of the ramp and dewatering, allowing the ramp to be fully constructed in dry conditions. This allows for a high-quality finish but is more expensive than alternative methods. Sheet pile walled cofferdams are typically favoured over rocks to prevent loss of rocks into navigable areas.
  - Pumped placement of concrete on the prepared base in still water conditions. This method is economical for multiple lane ramps but the use of divers is generally essential for this form of construction underwater. Careful consideration should be given to the placement of screeding rails to enable accurate underwater forming of the surface.

Precast concrete panels:

- Ramp precast concrete panels are formed, poured, vibrated and finished in a factory.
- Once cured, the precast panels are transported and lifted into place on the prepared foundation and connected to the adjacent panel using corrosion resistant connection straps and bolts.
- Any panels damaged during transportation shall be repaired using an approved method by a qualified engineer prior to installation.
- Each precast concrete panel requires appropriately designed lifting hooks and longitudinal steel reinforcement to sustain handling loads. Provision should be made during the casting of the elements for their interconnection.
- This precasting method can provide higher stringent quality control of the concrete mix, curing and reinforcement, particularly if made at a pre-cast concrete yard.
- For the construction of the ramp below mid-tide level, the use of precast panels offers cost advantages over the use of poured concrete or the use of cofferdams and the dewatering of the ramp area.

Given limitations of the two methods, it is not uncommon for ramps to be constructed using a combination of the two methods, with precast panels placed below mid-tide and in-situ placement above mid-tide. The first pre-cast panel is connected to the cast ramp, and adjacent slab elements being connected to each other down the ramp.

The following general recommendations are made for the construction of a ramp slab:

- In-situ method:
  - Construction of expansion joints, with recommended longitudinal and transverse directions at not greater than 10 m spacings. Contraction joints are not required as the grooves in the surface of the ramp control the propagation of cracks.
  - The best method of forming the angled grooves in the ramp surface, Section 4.4.5 is by saw cutting and chiselling out the concrete to the design shape to form the final groove. This should be done about 24 hours after the concrete is poured.
- Pre-cast panel method:
  - All precast concrete panel systems must be configured to allow individual slab panels to be replaced without affecting the neighbouring slab panels.
  - Corrosion resistant materials such as marine grade stainless steel or glass fibre reinforced polymer reinforcement bars should be used for all connections between neighbouring panels. All spaces between panels and around connections are to be filled with an approved grout.
  - The groove patterns in the ramp surface, Section 4.4.5 can be incorporated into the precast panel forms.
  - The precast riding surface shall be finished with a coarse-grained finish. This can be achieved by casting the precast panels upside down and forming the appropriate surface texture from the base of the panel forms.

West Beach boat ramp

5. Boat holding structures

5.1. General

A boat launching facility may require boat holding structures such as floating pontoons, jetties and other associated structures to enable the safe launching and retrieval of boats. It may also be appropriate to provide no boat holding structures and only retain a beach landing ramp.

Boat holding structures should be considered in urban and regional launching facilities, with a Service Level 3 or higher, as they increase the efficiency of launching and retrieval activities and provide a safer embarkation point.

Design of the boat queue and embarkation facility should consider the following general aspects:

- There is always a delay between the launching of a boat and its departure from the ramp due to the need to collect the driver of the car and trailer.
- Since the driver of the car and trailer is often the boat operator, the boat is unlikely to be moved from the ramp, the boat queue or the embarkation facility until the car driver is back on the boat.
- The boat queue and embarkation facility may be a beach or holding area adjacent to the ramp, or a fixed (jetty) or floating (pontoon) landing or a combination of several of these.
- For facilities without a holding structure or beach, the boat ramp can serve as the boat queuing and embarkation facility. However, the effective capacity of the ramp will be reduced if it is necessary to use the launching ramp in this way.
- The provision of a lay-by berth adjacent to a boat ramp can provide additional overflow capacity for peak periods. These should be considered if space allows.
- Where appropriate, provision of life saving equipment, such as lifesaving rings, and ladders should be considered on holding structures.

Wharves are also a common feature at riverine boat launching facilities, as outlined further in Section 9.

5.2. Purpose and usage

The purpose and usage of a boat holding structures are used by boat owners to:

- Launch:
  - Boat queuing – Hold the boat while the car and trailer are parked.
  - Embarkation – Embark the crew and passengers onto the boat.
- Retrieve:
  - Disembarkation – Disembark the crew and passengers from the boat.
  - Boat queuing – Hold and moor the boat while the car and trailer is brought to the ramp.

5.3. Selecting between a pontoon, jetty or beach landing

Selection between a holding structure or a beach landing will depend on a number of factors, including tidal range, wave exposure, available space, and anticipated maintenance regime.

The following outlines key aspects when considering the different options:

- Pontoons:
  - Pontoons are flexible interlocked structures that float on the surface of the water and hence follow the rise and fall of the water level.
  - Pontoons are often favoured by users for their easy access to and from boats and are preferred over jetties where possible.
  - Pontoons are suited to locations with large water level variations, a distinct advantage over jetties. They can also accommodate future sea level rise.
  - Pontoons can be single pontoons attached with a gangway or an on-ramp pontoon, which lays over the ramp surface.
  - On-ramp pontoons are generally more common and provide greater useability for most situations. Seen in Figure 9
  - Pontoons require edge treatment, including provision of rubbing strips and fenders to prevent damage to the boat and/or pontoon.
  - Unless specifically designed to accommodate large waves, pontoons are typically not suitable for areas exposed to wave heights greater than approximately 0.3m. Careful review of design wave conditions is recommended prior to selecting a pontoon for a site.

Axel Stenross boat ramp

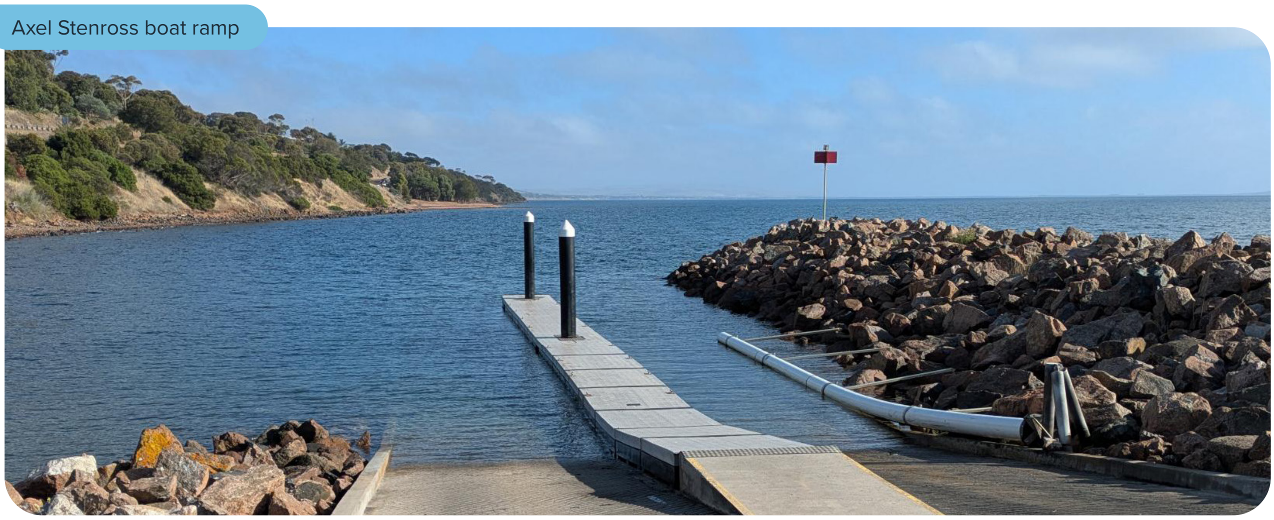


Figure 9: Axel Stenross boat ramp

- Jetties:
  - Jetties are rigid structures fixed to the seabed with piles and a flat deck sitting above the water level.
  - Jetties are usually more resilient than pontoons and can be designed to withstand significant wave action.
  - Jetties can go on either side of the boat ramp and should be placed on the downdrift side of the ramp (i.e. the side where the predominant wind, current and waves will hold the boat against the jetty).
  - Jetties are not suitable for locations with a large tidal range.
  - Stepped or terraced landings can be used to provide a set of landings over a tidal range.

- Beach Landing:
  - Some locations are built next to a small beach, which can be used to hold boats for queuing and for embarkation and disembarkation.
  - Beaches are not suitable for disabled passengers or those restricted in mobility. They are also not suitable in large wave environments, as a moving boat is dangerous for embarkation or disembarkation of passengers.
  - Beach landings take up more space along the coast, as they run parallel to the boat ramp. This is not suitable in space constrained locations, such as facilities requiring breakwater protection.
  - A beach provides a soft landing point for boat and the length of the boat queue is limited only by the length of the beach.

5.4. Configuration of boat holding structures

The number of holding structures should be based on the intended number of boats at any tidal stage that the facility is designed for.

The most economical and widely used boat ramp arrangement is a single pontoon or jetty placed centrally that can serve a lane either side of the holding structure (ie two lane ramp).

On sites where there is limited wave protection, a jetty should be located on the side that the prevailing wind and swell holds the boat against the structure.

A jetty may also be designed to provide some form of limited wave protection (wave attenuators) whilst boats are being launched or retrieved.

Pontoons should not be used where there is limited wave protection.

5.5. Layout and geometry

5.5.1. Lengths

The following general recommendations are made for the lengths of pontoons and jetties:

- For small facilities, the usable berth length should be 1.5 times the design boat length, Section 3.5.2 at the DLW leve, Figure 10.[11]
- For large facilities, the usable berth length should be at least 3 times the design boat length.[11]

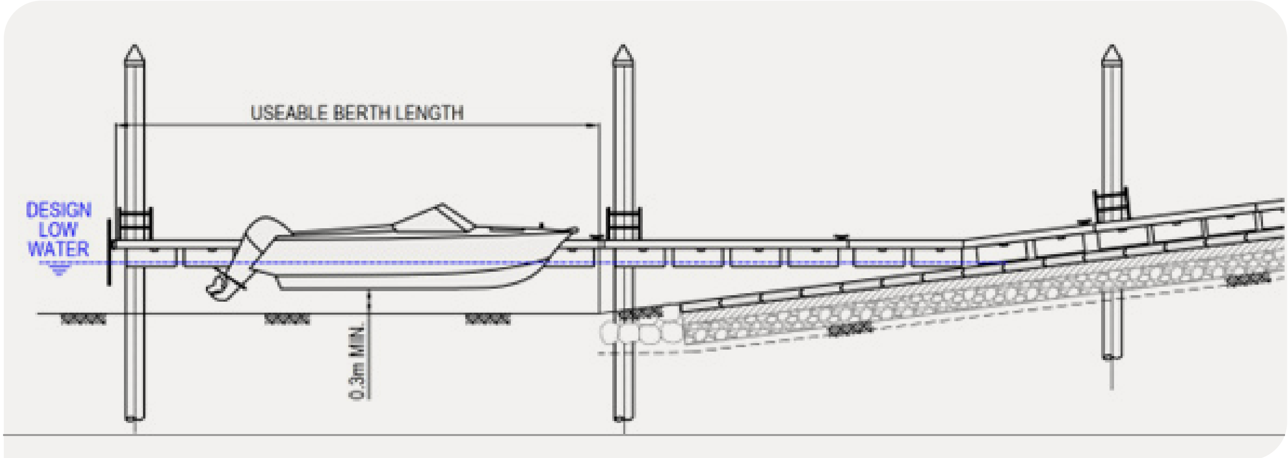


Figure 10: Usable berth length at design low water (on-ramp pontoon example)

[11] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015

5.5.2. Floating pontoons

The following general recommendations are made for floating pontoon dimensions:

- Have a deck width of at least 1.5m.[11]
- A desirable deck width of 2.0m is preferred that enables boats to be managed simultaneously from both sides and allow passage of facility users.
- Pontoons should be designed to float level with decks 350mm to 450mm above the water (i.e. freeboard).[11]
- Piles shall be high enough so that the pontoon does not float off the top of the piles under extreme conditions. For example, the specified maximum flood or surge level combined with the wave action.[12] This should also include consideration of sea level rise, Section 3.2.2.
- Where pontoons are accessed by non-powered craft and/or personal watercrafts, consideration should be given to providing a lower freeboard for sections of the pontoon or vertical fendering to accommodate the low height of these craft. An example of these recommended design features can be seen in Figure 11 below.

Dickson Reserve floating pontoon

Figure 11: Fixed floating pontoon at Dickson Reserve

[12] AS3962, Marina Design

5.5.3. Jetties

The following general recommendations are made for jetty dimensions:

- A desirable deck width of 2.0m is preferred, but not less than 1.5m, clear between kerbs and handrails.
- A deck level shall be as low as practicable and no higher than the boat ramp crest level.[11]

Designers are also encouraged to consider the following safety aspects related to jetties:

- In areas of fall height greater than 1.5m onto hard ground or the seabed, consider provision of a handrail/guardrail in accordance with AS 1567 (Fixed platforms, walkways, stairways and ladders — design, construction and installation).
- In areas where persons who fall from the jetty or pontoon into water and would not be able to easily regain the shore, consider provision of ladders. The bottom rung or tread of the ladder shall extend, where practicable, from 1 metre below LAT to deck level.

5.5.4. Beach landings

A beach landing may exist naturally adjacent to a boat launching facility. However, it is rare to find a naturally stable beach which slopes at between 1V in 8H and 1V in 10H, to match the preferred slope of the ramp, and which extends from DHW to DLW.

In many cases, however, it may be possible to construct an artificial beach using rounded gravel to provide an adequate boat queue and embarkation facility. Care should be taken to ensure material from the beach landing is not washed or moved into the navigation areas, such as the toe of the ramp or entrance channel.

5.6. Structural design and construction

5.6.1. Piles

Jetties are connected to the sea or riverbed using piles, which provide lateral restraint for vessel berthing, uplift restraint for waves and bearing capacity for pedestrian loads. Pontoons also require appropriately spaced piles to provide sufficient lateral restraint and to prevent them from drifting beyond their intended straight alignment, especially in adverse conditions.

Piles can be constructed of different materials, including steel, concrete, timber and composite fibre reinforced plastics or equivalent. The pile type and installation method should be determined by assessment of the existing ground conditions, availability of sea-based plant and materials, and durability considerations. Most piles in new jetty and pontoon structures are typically circular or rectangular hollow steel sections fitted with a high-density polyethylene (HDPE) or equivalent sleeve.

Marine pile design should be undertaken by a qualified structural engineer experienced in the design and construction of marine structures. Design guidance for pile design in the marine environment is provided from AS 2159 (Piling — Design and Installation) and AS 4997 (Guidelines for the Design of Maritime Structures). This includes design actions and loads, as well as durability considerations.

Steel piles are subject to significant corrosion rates in the marine environment. The service life of a steel pile can be extended by painting and wrapping the pile. Steel structures can also be protected against corrosion using cathodic protective methods; however, these are less common due to the higher design and maintenance costs.

Piles are typically moved into position using a piling rig installed on a barge (for marine areas) or from a crane accessible from land. Piles can be driven using a pile driving hammer or with a vibratory head.

Key aspects to verify during the installation of steel piles are outlined below:

- Inspection of any damage or scratching to painted areas and wrapping areas that should be repaired.
- Contractors should keep accurate pile records for all piles, including:
  - The number of blows per sets for a given length of pile driven for a hammer pile driver.
  - The amount of time for a given length of pile and frequency for a vibratory pile driver.
  - For a facility with many piles, pile testing should be undertaken to confirm sufficient penetration has been achieved to provide the lateral and uplift restraint. Testing should be undertaken on the pile showing the lowest set count or duration in the records.
- The piling method should consider the impact on marine mammals from underwater noise caused by piling. Methods for piling should include:
  - Spotters used to sight marine mammals within a shutdown zone where piling works cease until such a time as they have vacated the zone.
  - Any marine mammals detected within an observation zone should be monitored such that if they approach the shutdown zone piling works can be halted quickly.
  - At the beginning of each piling run a series of low energy blows be used to scare away any marine mammals before full energy blows commence.

5.6.2. Floating pontoons

A pontoon holding structure is usually constructed of multiple interconnected pontoon units, which are held in place by piles. The pontoon units typically float up and down on rollers or sliders placed over the pile.

Pontoon units are required to be detachable to allow individual units to be removed for repair or replaced without any effect on the neighbouring units or piles, and without the need to elevate the units above the water. This may require pontoons to have detachable perimeter rails that can provide temporary restraint to the remaining units.

Pontoons may be constructed of several different materials, including:

- High density polyethylene (HDPE) – HDPE pontoons are durable, UV tolerant and relatively lightweight, making them easy to place and maintain. However, given their lighter weight they may not be stable under certain wave climate conditions. Careful consideration should be taken when choosing to use HDPE pontoons such that they remain serviceable over their design life.
- Concrete – Concrete pontoons generally provide superior wave attenuation and are more stable than HDPE pontoons. However, the section of the concrete pontoons that land on the concrete ramp during the lower tide cycle can be susceptible to cracking due to slamming on the boat ramp from wave action.
- Steel – steel is susceptible to corrosion and less favoured.

Pontoon units may also be a composite of a HDPE shell and a concrete deck. There are several proprietary pontoon products available on the market. Individual manufacturers can provide guidance on:

- Design life and durability.
- Design wave conditions.
- Construction and installation methodology.
- Maintenance requirements.

Given pontoons are floating, they must be designed to ensure they are stable and do not cause excessive movement under wave loads or during berthing. Pontoon structural design should be undertaken by a structural engineer experienced in the design of marine structures.

The design loads and stability criteria for the design of pontoons are provided in AS 3962 (Marina Design).

Fenders, cleats (preferably in-built) and rubbing strips should be provided on pontoons. Pole type mooring bollards may also be provided on pontoons for special circumstances. Bolted fixings are preferred where possible.

The cleats and mooring bollards on the pontoons must display their intended safe working load rating.

5.6.3. Jetties

A jetty may be best suited as a boat landing over a floating pontoon system if the site is within an exposed location and subjected to higher wave heights.

A jetty is made of multiple structural elements, including piles, crossheads, deck, and fenders. Jetty elements can be constructed of a range of materials, including steel, concrete, timber and composite fibre reinforced plastic products. Material selection is ultimately dependent on several factors, including the anticipated loads, availability of materials, design life, maintenance regime and cost.

A jetty may need to be designed with multiple stepped decks to match the full anticipated tidal range. This arrangement enables boat users in all tide conditions to select the safest deck to berth alongside to enable passengers to embark or disembark with the greatest comfort and safety.

Jetty structural design should be undertaken by a structural engineer experienced in the design of marine structures.

The design loads and durability criteria for the design of jetties are provided in AS 4997 (Guidelines for the Design of Maritime Structures).

Several key elements to consider in jetty structural design are outlined below:

- To reduce corrosion, steel elements should be painted with a marine grade coating system and hollow steel members should be sealed and should not allow standing water.
- Wrapping of steel members to reduce corrosion using an approved product and method approved by a suitably qualified engineer is permissible.
- Composite fibre reinforced plastic (or equivalent) decks are cost effective options that are durable in the marine environment. Proprietary composite fibre reinforced plastic deck products with slip free decks are common and should be installed to the manufacturer's recommendations.
- An appropriate number and type of fenders shall be provided along jetties to enable safe launching and berthing. All fenders shall be designed by a qualified engineer and take into consideration the current and future berthing loads, including adverse berthing, over the structure's design life.

6. Parking, access and maneuvering areas

6.1. Purpose and usage

The parking, access and manoeuvring areas serve several purposes and are used by boat owners to launch and retrieve their boat, these processes involved the following activities:

- Launch:
  - Prepare the boat for launching.
  - Manoeuvre the boat and trailer onto the launching ramp.
  - Launch and secure (tie up) the boat.
  - Park and secure the car and trailer.
  - Board the boat and depart the facility.
- Retrieve:
  - Manoeuvre and secure the boat onto the ramp.
  - Manoeuvre the car and trailer onto the ramp.
  - Drive the boat onto the trailer.
  - Leave the ramp with boat and move to a secure area.
  - Prepare the boat for the road including de-rigging, washdown, securing the boat to the trailer etc as seen in Figure 12.

Securing the boat to trailer

Figure 12: An example of safely securing a boat to depart a facility

[11] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015

6.2. Car and trailer parking numbers

6.2.1. Car and trailer parking

The availability of car-and-trailer spaces can often be a limiting factor in the capacity of a boat launching facility, particularly in large urban and rural locations with high demand and limited available space.

Boat launching facilities should provide enough car-and-trailer parking spaces to meet normal weekend demand during the boating season. Additional overflow parking, which does not need to be sealed or marked, should be provided for peak boating seasons.

Car-and-trailer parking can be influenced by several factors, including:

- The number of boat ramp lanes, Section 4.2.
- The available parking area.
- The level of parking demand based on the existing facility usage and proximity to alternate boat launching facilities.

Table 3 is reproduced from AS 3962 (Marina Design) and provides car-and-trailer parking provision for urban and rural facilities. Care should be taken when applying these general parking provisions as individual site needs may override this table.

Area classification	Design Working Life (years)		
	Ramp only	With vessel holding structures	With separate rigging and derigging areas)
Urban	20-30	30-40	40-50
Rural	10-20	20-30	30-40

Table 3: Parking at public boat ramps[13]

6.2.2. Car parking

Separate parking areas for cars without trailers should be provided at the rate of 1 car space per 5 car and trailer spaces as shown in the example below, Figure 13. Failure to provide separate parking may result in cars using the car-and-trailer spaces.

The design of the parking area and access lanes should ensure that the ramp manoeuvring area is not used as a circulation space or access pathway.

Port MacDonnell car park

Figure 13: Seperate parking areas at Port MacDonnell

13 AS3962, Marina Design

6.3. Layout and geometry

6.3.1. General

The efficiency of a boat launching facility depends on the layout of the accessways and parking areas.

A well-designed traffic control layout aids considerably in safely and efficiently controlling vehicle movements and alleviating traffic constrictions.

Wherever possible, the parking and manoeuvring area associated with a boat launching facility should form a single integrated zone, within which the user can expect to safely carry out all the activities normally associated with the use of a boat launching facility.

Designers should refer to AS 2890 (Parking Facilities) and AS 1428 (Design for Access and Mobility) for specific traffic design, traffic lane and parking bay guidance. The designer should refer to the relevant authorities for additional requirements for traffic access and car parking guidelines.

The following provides specific design guidance related to boat launching facility parking, access and manoeuvring areas.

6.3.2. Turning circle

The designer should refer to Austroads and Australian Standards for car and trailer movements, utilising templates developed in the selection of turning clearances, turning radii within parking and manoeuvring areas associated with boat launching facilities.

The total width of turning areas is to be at least 20m.

The manoeuvring path for a car-and-trailer unit is shown in Figure 14 and is included in AS 3962 (Marina Design). As a minimum, reference should be made to this template when designing parking and manoeuvring areas.

The design should be specifically analysed with vehicle swept path analysis software to ensure the design is suitable for the movement of all design vehicles.

6.3.3. Access roads, traffic flow and entrance queue

Access roads to the boat launching facility should be wide enough to provide unimpeded movements of cars and trailers, especially at changes of direction, and be sealed and drained as necessary. It is recommended that accessways be sealed only where high levels of use are anticipated but should be marked and/or signposted to indicate traffic flow directions.

Ideally there should be a single entrance/exit to the boat launching facility to reduce the number of intersections with the access road.

Traffic design should utilise one-way traffic flow for the primary outer lanes. Clockwise circulation is preferred as it is consistent with driving on the left side of the road and generally makes reversing easier.

There must be sufficient length of roadway between the entrance and the rigging area to minimise the possibility that queues will extend into the public access road.

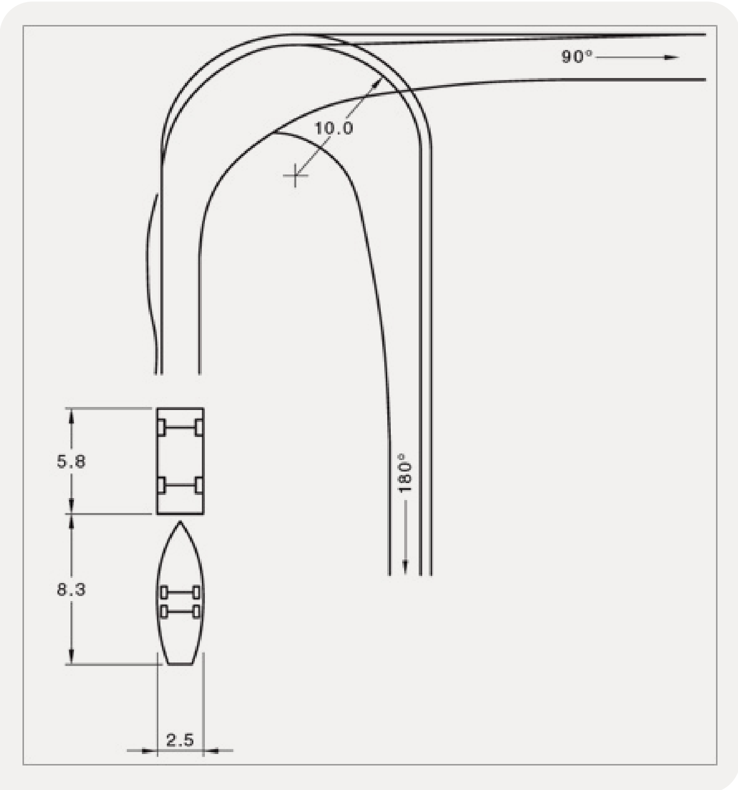


Figure 14: Car, Vessel and Trailer Turning Path[14]

14 Diagram extracted from AS 3962, Marina design, Figure 7.1

6.3.4. Rigging area

A rigging area is required to enable a boat owner to prepare their boat and trailer for launching. This improves the efficiency of a boat launching facility by reducing the time that vehicles occupy the manoeuvring area and boat ramp.

The entrance should lead to a rigging area which provides between 1.5 to 2 bays per lane of boat ramp for the purposes of rigging and generally preparing the boat for launching. Rigging areas should be 3.5m wide.

Although there is no need for arriving cars and trailers to pass through the rigging area, in most cases it is more convenient to direct traffic past this area. The route should be direct, resulting in a single queue being formed at the head of the ramp.

6.3.5. Ramp manoeuvring area

A manoeuvring area should be provided at the crest of the boat ramp to allow for cars and trailers to turn and reverse on to the ramp. The ramp manoeuvring area should:

- Extend at least 30m landward beyond the crest of the ramp.
- Be as wide as the boat ramp.[15]
- Where possible be orientated to permit straight line backing down the ramp.
- Have a longitudinal grade of 1V in 100H (1%) to 1V in 20H (5%) towards the boat ramp and zero to 1V in 50H (2%) crossfall (zero crossfall is preferred).[15]
- Be free of obstructions including overhead power lines and lane dividing barriers.

The ramp manoeuvring area may be used as the rigging and securing area. It is preferred, however, that separate manoeuvring areas be provided as such activities significantly reduce the capacity of the facility, as seen in Figure 15 below.

In areas with limited space or visibility, line marking should be considered to aid the driver when reversing their car and trailer onto the boat ramp.

Example of a ramp manoeuving area

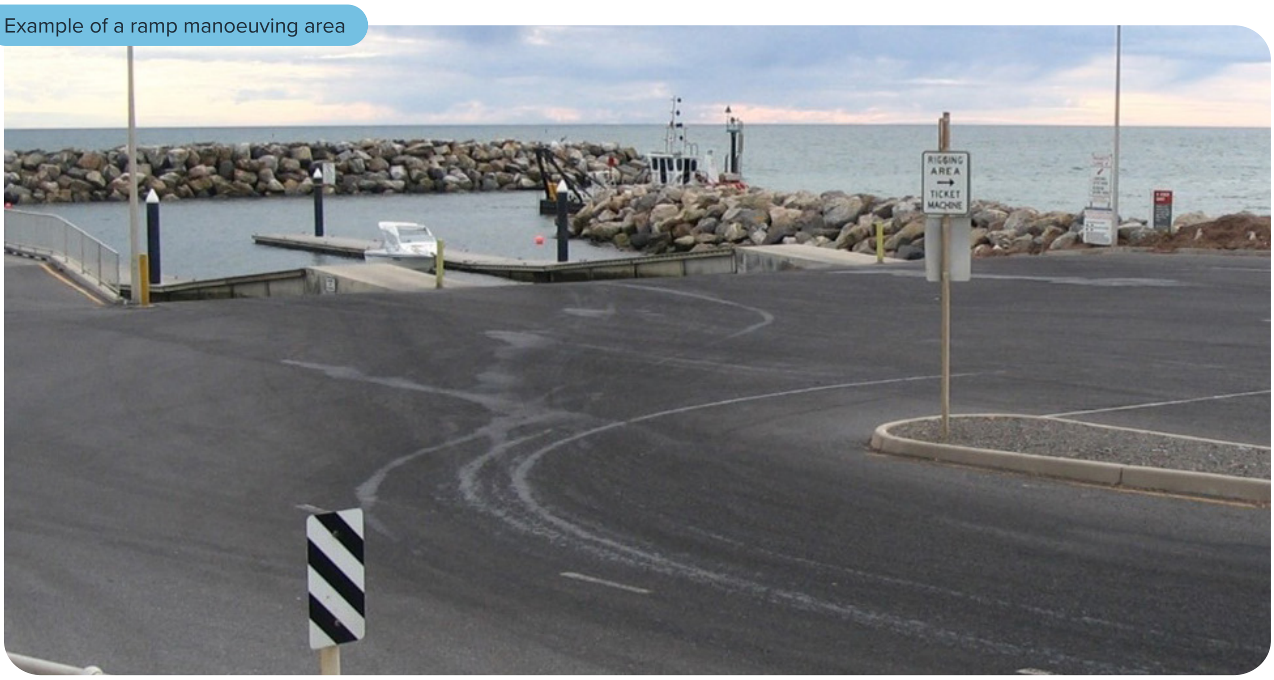


Figure 15: A manoeuvring area for safe vehicle and trailer movement

[15] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015

6.3.6. Car and trailer parking areas

To optimise space, parking spaces should be angled to permit reverse parking (refer to Reference Drawings in Appendix A for a typical parking area design). A parking space angle of 45-degrees is preferred with 60-degree and 90-degree parking also possible.[15] Parking bays should be clearly defined to minimise un-controlled parking.

Gravel, grassed or mulched overflow areas can also be designated as parking areas to minimise the area of bitumen and potential drainage flows.

The selected dimensions of car-and-trailer parking spaces will depend on the size and type of boats expected to use the boat launching facility. For typical situations, car and trailer spaces should be a minimum of 3.0 metres wide and 12.5 metres long to accommodate typical car and trailer combinations.[15]

Elongated parking bays for oversized vehicles and trailers should also be considered, particularly in regional locations or areas with larger commercial fishing vessels (eg oyster punts) are used.

6.3.7. De-rigging and washdown area

The de-rigging and washdown area allow boat owners to washdown their boat and to prepare their boat and trailer for road travel, Figure 16. The exit from the boat ramp should lead directly to the de-rigging and washdown area, such that users are encouraged to vacate the ramp area as soon as the boat is retrieved.

The size of the securing area should be similar to that provided for rigging.

Boat washdown points and rubbish receptacles should be provided in the de-rigging and washdown area. A washdown area should be provided to enable the capture of all contaminated water. The washdown area shall include a sump fitted with an oil separation pump-out pit to maintain water quality.

Drainage of un-treated washdown bay water directly to adjacent waterways is not permitted.

Example of working de-rigging / washdown area

Figure 16: Example of a de-rigging / washdown area

[15] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015

6.4. Other considerations

6.4.1. Drainage and flooding

Wherever feasible, water runoff from paved areas should be encouraged to drain to adjacent site landscaping and grassed areas, rather than piped away from the site.[15] Designers should also consider including an intercepting drain across the ramp crest to divert drainage from the approach pavements into a gross pollutants trap or infiltration basin.[16]

Proponents should also ensure that the boat launching facility does not create an ingress point for coastal inundation (i.e. storm surge) to flow to adjacent low-lying areas. The facility should be sited at a suitable level above coastal inundation levels dependent on the local conditions. Alternatively, the construction of levees, including raised portions of access road, may be required to prevent coastal inundation to adjacent areas.

6.4.2. Line marking and signage

Sealed boat launching facilities should include traffic control devices such as line marking, speed signs and other associated signage to ensure there is clear delineation for vehicles travelling along laneways and manoeuvring areas.

The design of traffic control devices associated with a boat launching facility should be in accordance with AS 1742 (Manual of Uniform Traffic Control Devices) and AS 1744 (Standard Alphabet for Road Signs)

[15] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015

[16] Guidelines for the design of boat launching facilities in Western Australia below the 25th Parallel, The Government of Western Australia, Department of Transport, 2009.

7. Supporting facilities

7.1. Objective

A boat launching facility's basic function is to transit safely and efficiently boats into and out of the water.

These facilities can be greatly enhanced by providing complimentary support facilities thereby realising a greater purpose that is valued by the community.

The supporting facilities may be general in nature for most boat launching facilities, Section 7.2 ranging to specialised supporting facilities for regional boating hubs or large commercial facilities, Section 7.3.

7.2. General facilities

General services and amenities may include:

- Information and regulatory signage.
- Rubbish collection facilities.
- Toilets.
- Fish-cleaning stations.
- Lighting.
- Water supply.
- Pay Stations.
- Landscaping.
- Seating

Figure 17 shows a boat launching facility at O'Sullivans Beach, featuring general support amenities that provide added value to the community.

O'Sullivans Beach

Figure 17: a boat launching facility at O'Sullivans Beach

7.2.1. Signage

The Proponent shall install appropriate signage at the head of the boat ramp to advise users on the safe and efficient use of the facility. Depending on the site, these signs may include:

- Specific information related to use and management of the launching facility, including:
  - Ramp design levels, slopes and tidal restrictions (if applicable).
  - Ramp size and weight limits (if applicable).
- Local waterway map and local boating information, including:
  - Speed limits at the ramp and adjacent waterways.
  - Safe boating information.
  - Emergency contact details.
  - Fishing seasons and limits.

The selection, design, placement and number of signs should be assessed to ensure they are effective and do not adversely impact on the visual amenity of the area.

7.2.2. Rubbish collection facilities

Refuse bins are essential and should be provided in and about the parking areas in addition to the de-rigging area or fish cleaning station (if provided). It is important that these refuse bins are emptied regularly and kept in good and clean order.

7.2.3. Toilet facilities

Proponents should consider providing toilet and shower facilities, including disabled facilities, at larger more popular boat launching facilities. The toilet facilities should be placed in an appropriate location, including consideration of the necessary services e.g. water supply, sewerage and electricity supply.

7.2.4. Fish-cleaning stations

Fish-cleaning stations may be included in larger facilities and areas of high fishing activity or close to fishing grounds, Figure 18. Consideration should be given to the provision of running water to allow users to clean the station after use.

Regular cleaning of fish-cleaning stations as well as rubbish collection and disposal services is critical to ensure the overall amenity of the area is not compromised.

Example of fish-cleaning stations

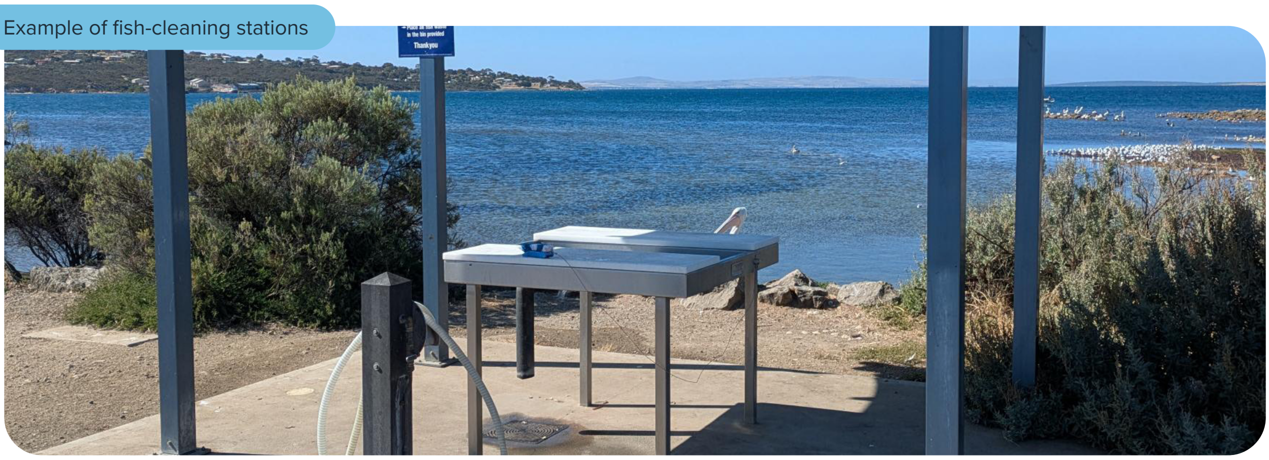


Figure 18: shows a fish-cleaning station

7.2.5. Lighting

Proponents should consider including lighting at the ramp and manoeuvring areas for night and early morning use. Consideration should also be given to the lighting of car and trailer parking areas.

Lighting is to be designed in accordance with AS 1158 (Lighting for Roads and Public Spaces), and in all cases the designer should ensure that the design of lighting is consistent with the requirements of navigation safety.

7.2.6. Water supply

A potable water supply whilst not essential, significantly enhances the amenity of a boat launching facility and is considered by most users as a necessity.

Water is required at the facility to provide for drinking, washing, showering (if such facilities are provided), service fish cleaning station and washing down boats.

7.2.7. Landscaping

The acceptance of a boat launching facility in a community can be greatly enhanced with well designed, constructed and maintained landscaping. Landscaping can improve the visual appearance and attractiveness of a facility, but where possible, should be designed as part of an integrated master plan approach for the greater coastal or riverbank precinct.

The use of infiltration swales and detention basins to handle surface water runoff should be designed as an integral part of the landscape design.

7.3. Specialised facilities

For larger facilities or boating hubs, Proponents may also wish to include the following specialised services and amenities:

- Repair, maintenance and fitting out facilities.
- Dry storage areas and other marina type facilities.
- Fuel supply, accommodation and shopping facilities.
- Rescue facilities.
- Land-based outdoor recreational facilities such as playgrounds and barbecue areas.
- Club-type services and activities.

While the above are not essential, they assist in making the facility more attractive to users or may support a specific commercial activity.

8. Other components

Proponents should be aware of the following components that may be required to ensure safe use of boat launching facilities:

- Breakwaters, revetments and protective structures.
- Wave attenuators.
- Navigation channels and harbours.
- Moorings.
- Aids to navigation.

8.1. Breakwaters, revetments and protective structures

A breakwater or other protective structure, such as a groyne, may be required to provide a sheltered location for boat launching and retrieval activities, Figure 19.

These structures can be expensive to construct and maintain and they may also adversely impact on adjacent coastal processes, potentially leading to siltation and coastal erosion. As such, they should only be considered for large boat launching facilities where there are few options.

Whilst not an exhaustive list, proponents and designers should consider the following aspects when a breakwater or protective structure is required:

- Coastal processes:
  - Proponents are recommended to undertake a metocean instrument deployment and analysis to assist in the design of breakwater structures. This deployment should measure waves, water levels and currents over a summer and winter period to understand the ambient and extreme weather conditions. Should the site be in a remote area away from established Bureau of Meteorology weather stations, the deployment should include wind measurements.
  - The metocean measurements above should be combined with wave, hydrodynamic and sediment transport modelling (where necessary), to calculate ambient and design wave, water level and current conditions for the breakwater design.
  - Breakwaters should not be designed in active coastal areas with significant sediment transport, as they can trap sediment on one side and create erosion on the opposite side. Breakwaters can also result in sand to accumulate inside or adjacent to the breakwaters. Expensive, on-going sand bypassing or dredging would be required to maintain the natural sediment transport and prevent the breakwater entrance from becoming silted up.
  - Breakwaters can also trap sea wrack within the boat ramp area or on adjacent beaches. In areas of high sea wrack deposition this can greatly compromise amenity, navigation and the environment. The tidal current and flow dynamics are critically important and in areas of high wrack availability, breakwaters should be modelled to assess the potential impact on wrack accumulations.
  - Where breakwaters are contemplated as part of the boat launching facility, potential impacts on sediment transport and wrack should be assessed by a suitable qualified coastal engineer.
  - Proponents should determine the cost and frequency of the coastal processes management and ensure suitable funding mechanisms are in place for this on-going management to be carried out.

- Layout:
  - A hydrographic survey of the proposed breakwater location is essential to optimise the breakwater layout and confirm water depths for design.
  - Sufficient space should be provided between the breakwaters and/or revetment to the holding structures to allow for boat queuing and manoeuvring without blocking adjacent fairways and channels.
  - The design location of the boat ramp in relation to a breakwater and/or a revetment must be carefully considered to allow sufficient space such that boats are not at risk of striking such structures during adverse weather conditions.
  - Suitable breakwater overlap (for multiple breakwater layouts) or extension should be provided to prevent wave penetration into the ramp area. The breakwater entrance should also be carefully oriented to prevent the formation of a dangerous following wave.
  - Waves can penetrate through a wide breakwater entrance, negatively impacting on the boat ramp activities. To reduce potential for wave penetration, AS 3962 (Marina Design) notes the width of the entrance channel may be narrowed over a short length at protecting breakwaters. The minimum width of this narrow section shall be the greater of:
    - 15 m or
    - 3 times the beam (width) of the broadest design vessel.
  - Where the breakwater creates an enclosed basin or are exposed to swell conditions, care should be taken to prevent the formation of surging (or harbour seiching).[17]
  - The breakwater layout design, including wave penetration assessment and entrance orientation, should be undertaken by a suitable qualified coastal engineer.
- Structural design:
  - Breakwaters and protective structures are constructed of multiple layers of rocks or other materials, such as concrete armour units, Figure 19.
  - A suitable armour size and durability is required to prevent excessive damage and failure in the design event.
  - The core of a breakwater or revetment must be lined with a suitably designed geotextile to prevent core material from washing through the rock armour. Failure to place a suitably designed geotextile will greatly reduce the design life of the breakwater or revetment.
  - The toe should be founded at a suitable depth and with sufficient toe rock protection to prevent scour from waves and currents in the design event and from propeller wash during everyday use.
  - Breakwater crest levels and widths should be designed to protect against wave overtopping forces.
  - The breakwater structural design should be undertaken by a suitable qualified coastal engineer.

Example of breakwater

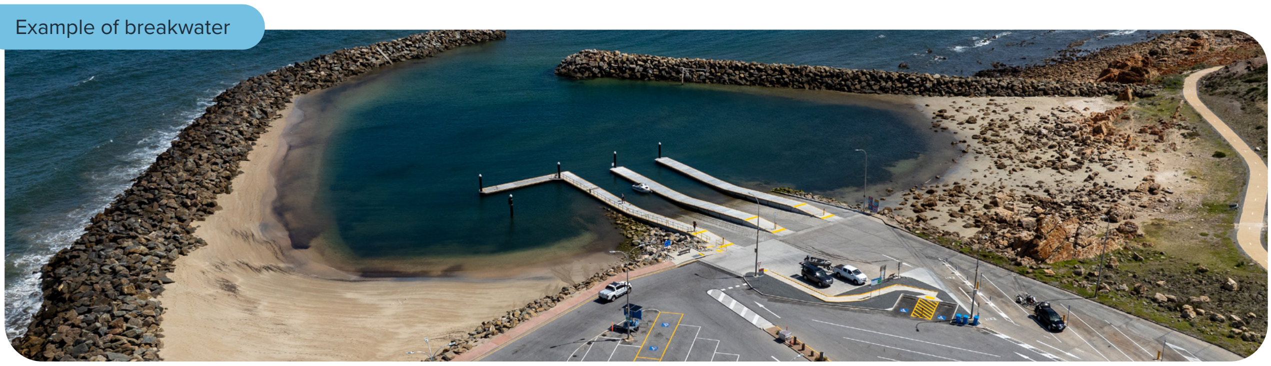


Figure 19: O'Sullivans Beach breakwater

[17] Seiching is a standing wave in an enclosed or partially enclosed body of water that oscillates causing water levels to rise quickly.

8.2. Wave attenuators

In the situation where a breakwater is not a feasible solution to offering wave protection for a boat launching facility a well-designed wave attenuator can help to reduce the energy and impact from incoming waves to acceptable levels.

Proponents and designers should evaluate the acceptable wave climate conditions required within the boat launching facility first before evaluating and choosing the most cost-effective wave attenuation system.

Wave attenuators can be of different types ranging from proprietary floating systems to a bespoke designed fixed structure, both types are designed to reduce the energy of an incoming wave.

Fixed wave attenuation structures can comprise of vertical solid elements spaced at appropriately designed intervals supported by horizontal walers usually installed on the outside face of a landing jetty or as a separate discrete structure, Figure 20. The design wave height, approach angle and period are critical inputs when determining the configuration of the fixed wave attenuator as well as its proximity to the launching area.

Wave attenuator systems should be designed by a qualified engineer experienced in the planning and design of marine structures supported with knowledge of coastal engineering.

Emu Bay boat ramp

Figure 20: Examples of a fixed or floating attenuator

8.3. Moorings

A mooring is a point of fixity in the water where a boat can be attached to secure its position.

A mooring can either be a swing mooring or a fixed structure.

A swing mooring consists of a single anchor on the seabed attached to a chain or rope that is tethered to a floating buoy on the water surface. The floating buoy allows a boat operator to locate the swing mooring and connect their boat to the anchor. There are various proprietary swing mooring products available that are designed to cater for individual applications.

A boat attached to a swing mooring will circle with the direction of wind and tidal changes.

A fixed mooring is a permanent structure that provides fixity to a boat. A fixed mooring can be a pontoon, jetty, wharf, or pile. Within a boat launching facility, it may be appropriate to provide a separate lay-by berth for boats to tie up for longer periods of time.

The Proponent shall consider the provision of moorings either within a boat launching facility or in other locations as deemed appropriate to meet user needs.

The design and installation of any mooring should be undertaken by a structural engineer experienced in the design of marine structures.

Moorings are not permitted in any channels or harbors without prior approval from the Department for Infrastructure and Transport. The installation of swing moorings will require obtaining an assessment of the location to ensure it does not impact safety of navigation by the Department for Infrastructure and Transport.

Emu Bay boat ramp

8.4. Navigation channels

A navigation channel may be required to provide a safe pathway from the boat launching facility to the ocean or adjacent waterway. The navigation channel may be a naturally occurring deep channel or it may need to be constructed and maintained through dredging.

Key considerations related to navigation channels are outlined below:

- Coastal processes:
  - Navigation channels should not be sited or constructed in areas of significant sediment transport, as the channel may change or become silted over time.
  - Care should also be taken when siting navigation channels in locations with strong currents and/or large wave conditions.
- Dredging:
  - Dredging involves the removal of sediment from within navigation areas, including channels and boat ramp areas. Dredged material is often transported and placed in another location.
  - Capital dredging occurs when the channel is dredged for the first time and may involve dredging of harder substrate, such as bedrock. Dredging of rock is often undertaken with a large cutter suction dredge or a backhoe dredge depending on the material strength and fracture properties. Dredging can also be undertaken using land-based equipment from bunds, Figure 21.
  - Maintenance dredging is undertaken to remove material that has built up within the channel, boat ramp and navigation areas, which is often sand or silt. Maintenance dredging can be undertaken by smaller cutter suction dredges, backhoe dredges or trailing suction hopper dredges.
  - Dredging requires development approval and can take considerable time and effort in planning activities including developing an environmental impact assessment and consultation with the relevant planning and environmental authorities.
  - Dredging can be very expensive, as sea based plant used is highly specialised and involves careful management to prevent adverse environmental impacts.
  - Given the planning challenges and high costs of dredging, it is preferable to construct navigation channels and boat launching facilities in areas that do not require capital or on-going dredging.

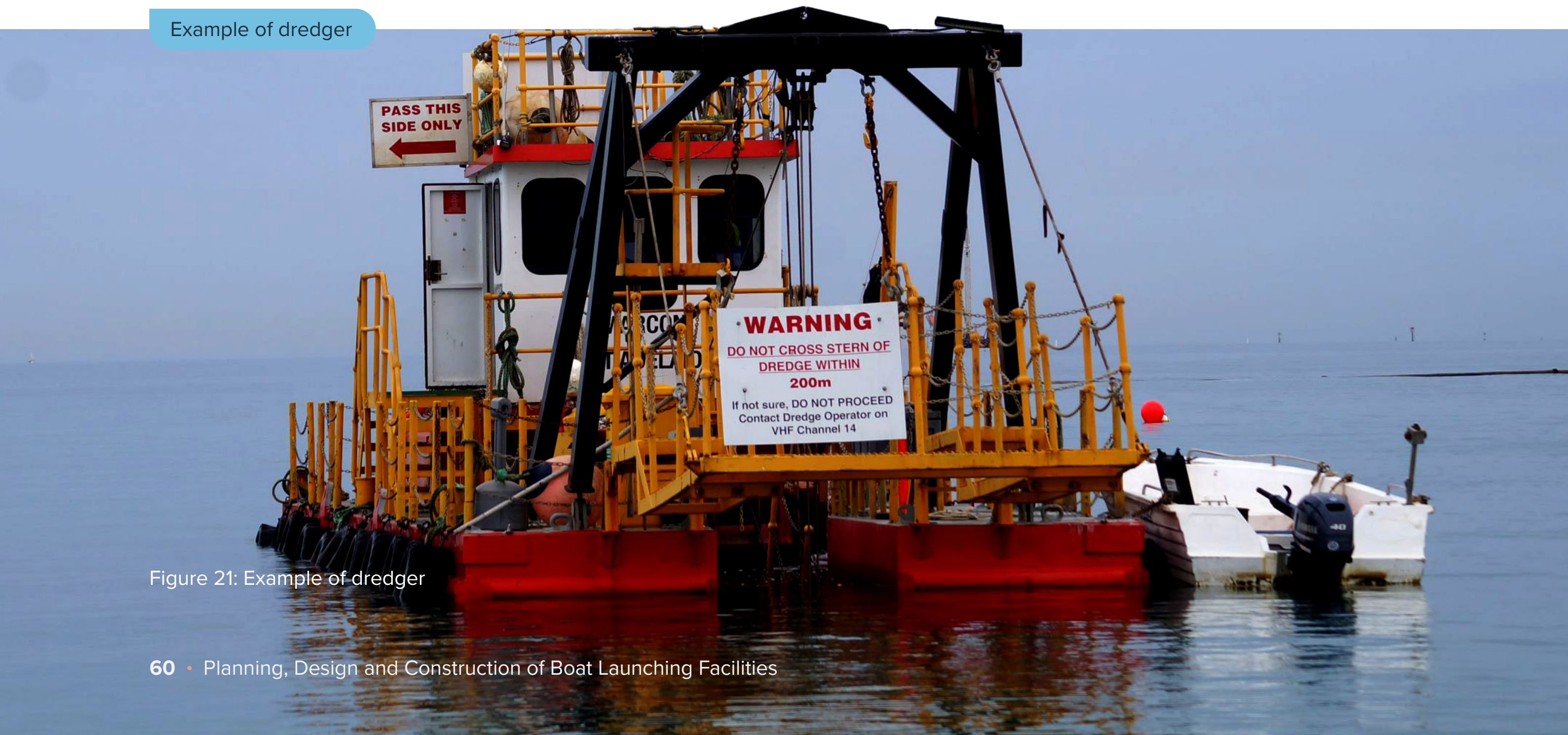


Figure 21: Example of dredger

- Geometry:
  - The access channel depth should be determined on a case by case basis depending on the tidal restrictions and design vessel draft.
  - For a typical all tide access, the navigation channel depth should be at least 1.0m below DLW. AS 3962 (Marina Design) provides further details on recommended channel depths for vessels of different length and draft.
  - AS 3962 (Marina Design) and PIANC WG 121_2014 (Harbour Approach Channels — Design Guidelines) provide recommended approaches to calculating channel widths and boat turning circles.
  - The navigation channel design should be undertaken by a suitable qualified coastal engineer.
  - All channel depth and height restrictions impeding access to boating destinations should be carefully examined and considered.

8.5. Aids to navigation

Aids to navigation may be required to mark the navigation channel into and out of the boat launching facility and to locate the facility at night. The location and type of the aids to navigation shall be subject to approval by the Department for Infrastructure and Transport.

A hydrographic survey of the approach channel may be required to determine the location of the proposed aids to navigation.

The aids to navigation at the boat launching facility or along the approach channel may require a solar navigation light to ensure safe navigation at night. Although the boat launching facility may be lit, the downward lights will likely be difficult to see from a distance at sea, hence it is recommended that a navigation light be installed at the boat launching facility so that it can be located from a long distance.

Aids to navigation shall conform to standard drawingsfound at: dit.sa.gov.au/standards/standards-guidelines

Example of navigation aid

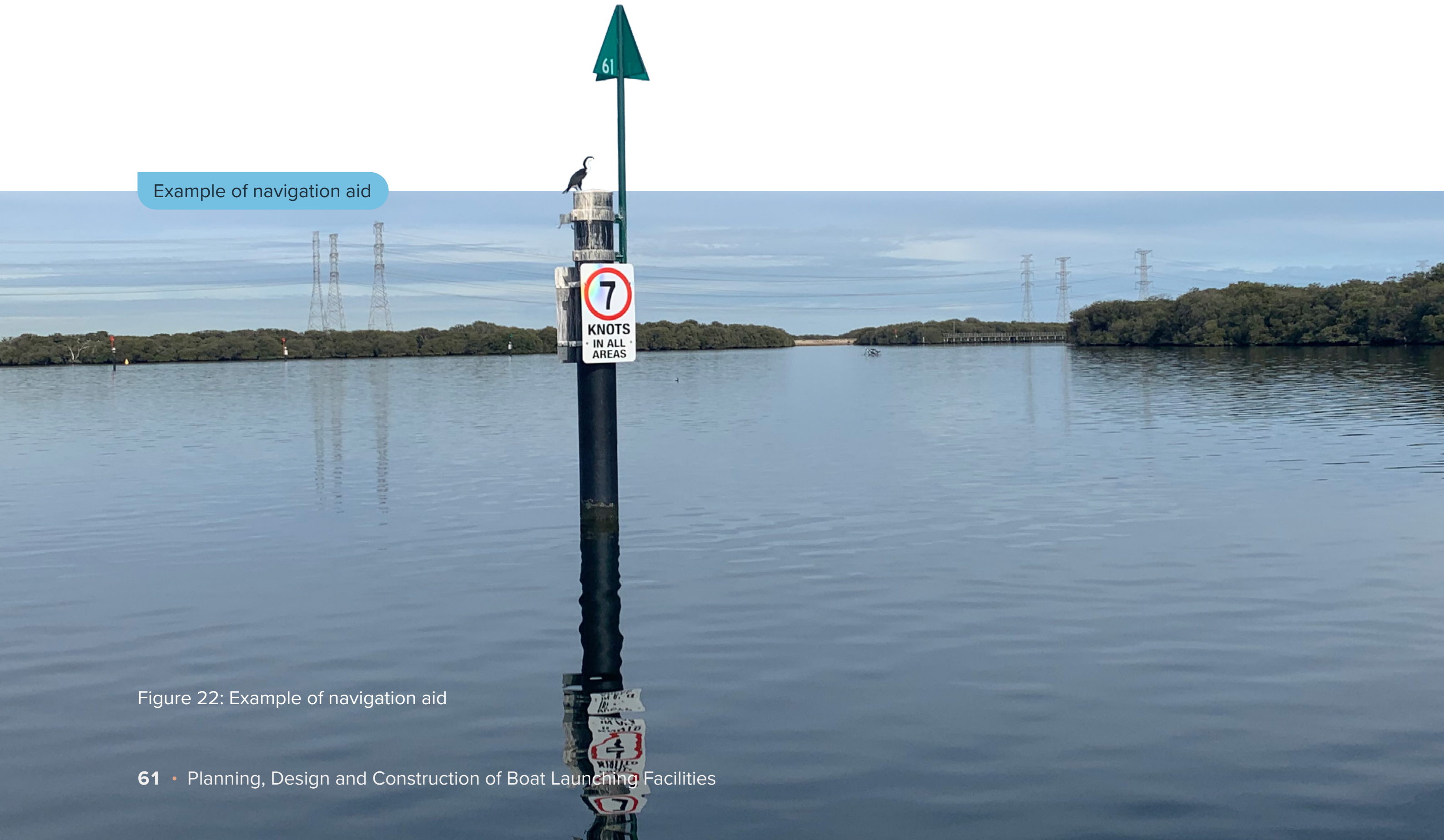


Figure 22: Example of navigation aid

9. River boat ramps

The Murray River is a popular boating location within South Australia and is accessed from a number of existing boat launching facilities along the river.

Much of the preceding Guidelines has focused on boat launching facilities in ocean or estuarine environments. Riverine boat launching facility design, whilst similar in many respects, is different in respect to the dominant processes and design conditions.

Proponents and designers should consider the following aspects when developing a riverine boat launching facility:

- Flood levels:
  - The crest of the ramp should be sited 500 mm above the 1 year ARI water level as determined by analysis of water level records.
  - Proponents and designers should consider the potential river flood levels when designing manoeuvring and parking areas. The selected level should depend on the proposed design life and intended use and purpose of the boat launching facility.
- River currents:
  - Facilities should be sited in locations with reduced current speeds and turbulence. Suitable locations should be identified through consultation with locals who understand the river dynamics.
- Layout:
  - Design features that may assist with launching and retrieval activities in river environments include:
    - Angling of the boat ramp in a downstream direction, from 0-degrees to 15-degrees (up to 30-degrees maximum) from shore-normal to suit the flow line in rivers.[18]
    - Holding structures such as jetties or pontoons should be placed on the upstream side.[18]
    - At smaller ramps, vessel holding may be achieved with a pile installed on the downstream side of the ramp.[18]
    - Wharves are also common holding structures at river facilities, allowing safe passenger embarkation and disembarkation.
    - Construction of rock mound structures on the upstream side of the ramp to reduce exposure to currents.
    - Provision of guide poles in the ramp approach area in high flow regions.
    - Creation of a sheltered basin behind the bank of the river.[18]
  - Sufficient space should be provided between the boat ramp and any bank stabilisation or wharves in the area.

[18] NSW Boat Ramp Facility Guidelines, NSW Government Roads and Maritime Services, 2015

- Structural design
  - Riverine areas are more likely to have clay or silty ground conditions, providing a poor foundation for the boat ramp panels. Designers should include allowance to compact and/or treat foundation areas. Increased ramp thickness and additional reinforcement within the ramp panels may also be required to allow for panels to span potential potholes that form with differential settlement.
  - Holding structures should be designed for flood current loads and may be subject to debris actions, which are detailed in AS 4997 (Guidelines for the Design of Maritime Structures).
  - The freshwater environment is less corrosive than marine areas but consideration may need to be given to corrosion from potential acid sulfate soils.
  - Bank stabilisation may be required on adjacent sections of river bank to prevent end scour effects.

10. Maintenance and asset management

Regular maintenance is required throughout the design life of a boat launching facility to extend its life and reduce the likelihood of major repairs.

Proponents should specify, plan, and implement an inspection, cleaning and maintenance regime to ensure continued safe and reliable use of the facility.

10.1. Inspections

The requirement for maintenance should be identified through a routine inspection program.

The frequency of the inspections will depend on the facility service level and usage rates, as well as the specific component or maintenance issue being inspected. For example, inspection of sea grass wrack or slime accumulations may need to be undertaken daily during winter, while underwater inspection of piles or ramp toe scour using divers may be undertaken every 3 to 5 years.

Inspections should be carried out by a suitably qualified person with at least 5 years of experience in the design and inspection of marine structures and include assessment of the following aspects for the different facility components:

Boat ramp:

- Sea grass wrack or sand accumulations on the ramp surface or at the toe of the ramp.
- Marine growth on the ramp surface or loss of traction in high-use areas.
- Displacement or undermining of scour protection along the edges and toe of the ramp.
- Scour at the toe of the ramp, including formation of a ‘drop-off’ or hole.
- Damage to kerbs, manoeuvring areas and ramp crests, including and any trip hazards or wheel hazards.
- Loss of foundation material below ramp.
- Evidence of reinforcement corrosion within concrete elements, such as cracking, spalling, and rust stains.
- Movement or settling of the ramp deck and separation at joints and connections.

Jetties and pontoons:

- Damaged, loose or missing fenders, chaffers or rubbing strips.
- Damaged, loose or missing cleats or bollards.
- Damaged decking resulting in trip hazards.
- Loss or wear of non-slip surfaces.
- Evidence of reinforcement corrosion within concrete elements.
- Evidence of corrosion or loss of paint on steel elements and deterioration of timber elements.
- Inspection and testing of sacrificial anodes (if used).
- Damage to pontoons, including:
  - Instability or tilting of pontoon units.
  - Damaged hinges or missing or corroded elements, such as pins.
  - Marine growth.
  - Damage to on-ramp pontoons caused by impact on the boat ramp from wave action.
- Damage to piles, including:
  - Marine borer or termite attack for timber piles.
  - Damage or scratches on steel pile paint coatings.
  - Changes in alignment or movement of piles.
  - Wear, corrosion or fracture of pile guides and fastenings.

Manoeuvring and parking areas:

- Reduced visibility of line marking.
- Damage to signage, including from vandalism.
- Scour around drainage elements.
- Evidence of blocked drainage or flooding following rain events.

Breakwaters and protective structures:

- Movement or slumping of armour rocks.
- Evidence of overtopping damage, including scour of any access roads or crest rocks.
- Evidence of toe scour.

Navigation channels:

- On-going hydrographic surveys of the navigation channel may be required to monitor navigable depths and whether maintenance dredging is required. The survey frequency depends on a number of factors, including:
  - Historical rate of siltation.
  - Level of usage.
  - Under keel clearance of design vessel.
  - Channel widths.
  - Seabed material type.

Any specific inspection recommendations from the manufacturer of proprietary products, such as pontoons, should be included in the inspection regime, as should any supplementary facilities constructed at a boat launching facility.

10.2. Cleaning

Marine growth on boat ramps and the resultant slippage can be a significant safety issue on boat ramps.

Asset owners of boat launching facilities shall make allowances for the regular cleaning / removal of marine growth from boat ramp slabs.

Marine growth is recommended to be removed with a high-pressure water blaster or through mechanical scrubbing. More abrasive cleaning methods and harsh chemicals are not recommended to remove marine growth.

Asset owners must consult with the EPA to ensure all approvals and necessary environmental controls are in place for the method of cleaning before works commence.

The frequency of the ramp cleaning will depend on the local site conditions and may change seasonally. The requirement for cleaning and frequency of cleaning can usually be identified through on-going inspections and user feedback. The Proponent should prepare a cleaning regime and allow an appropriate budget for this periodic cleaning.

If constructed, fish-cleaning stations, rubbish collection points, washdown bay oil separation pits and toilets will also require regular inspection and cleaning.

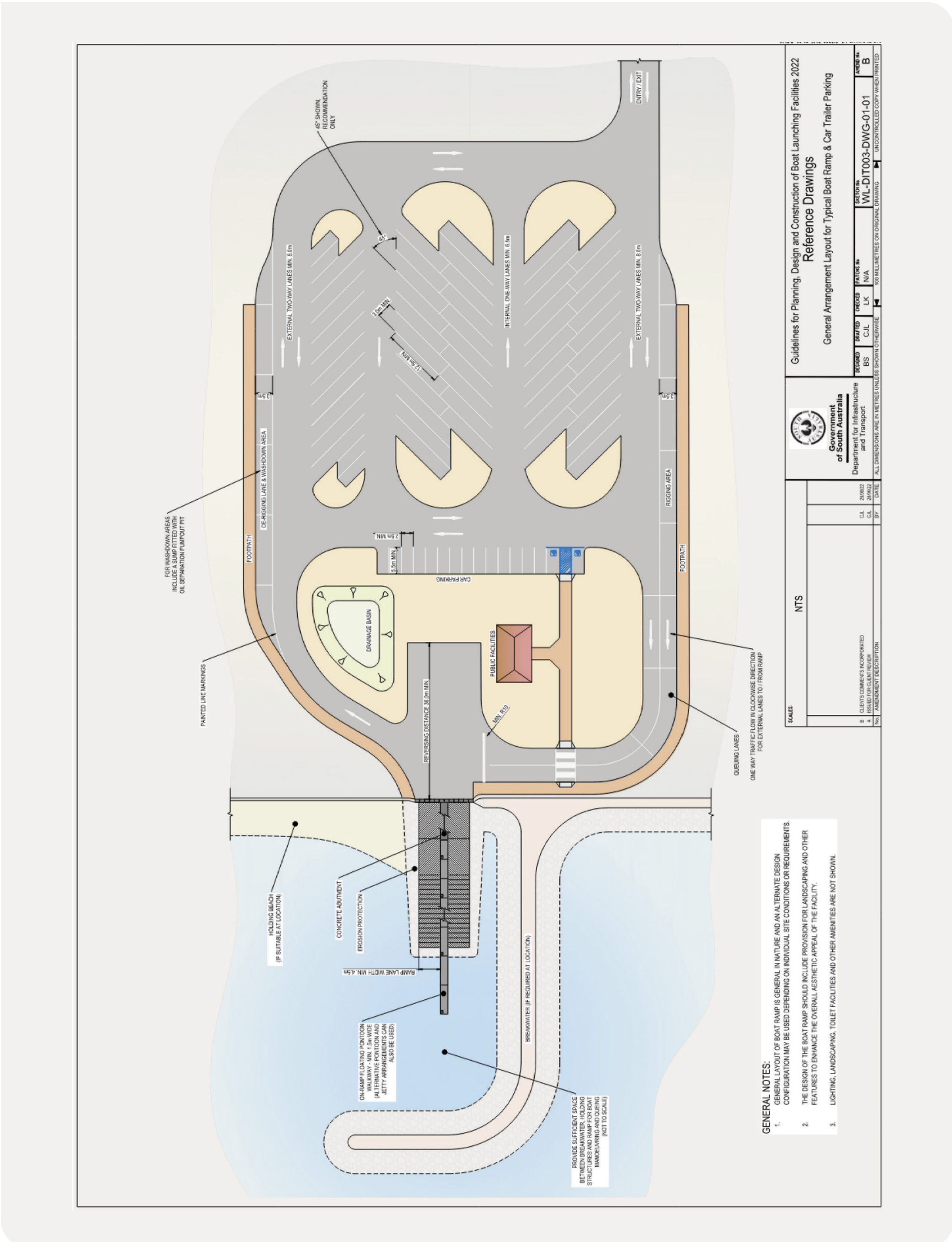
10.3. Maintenance plan

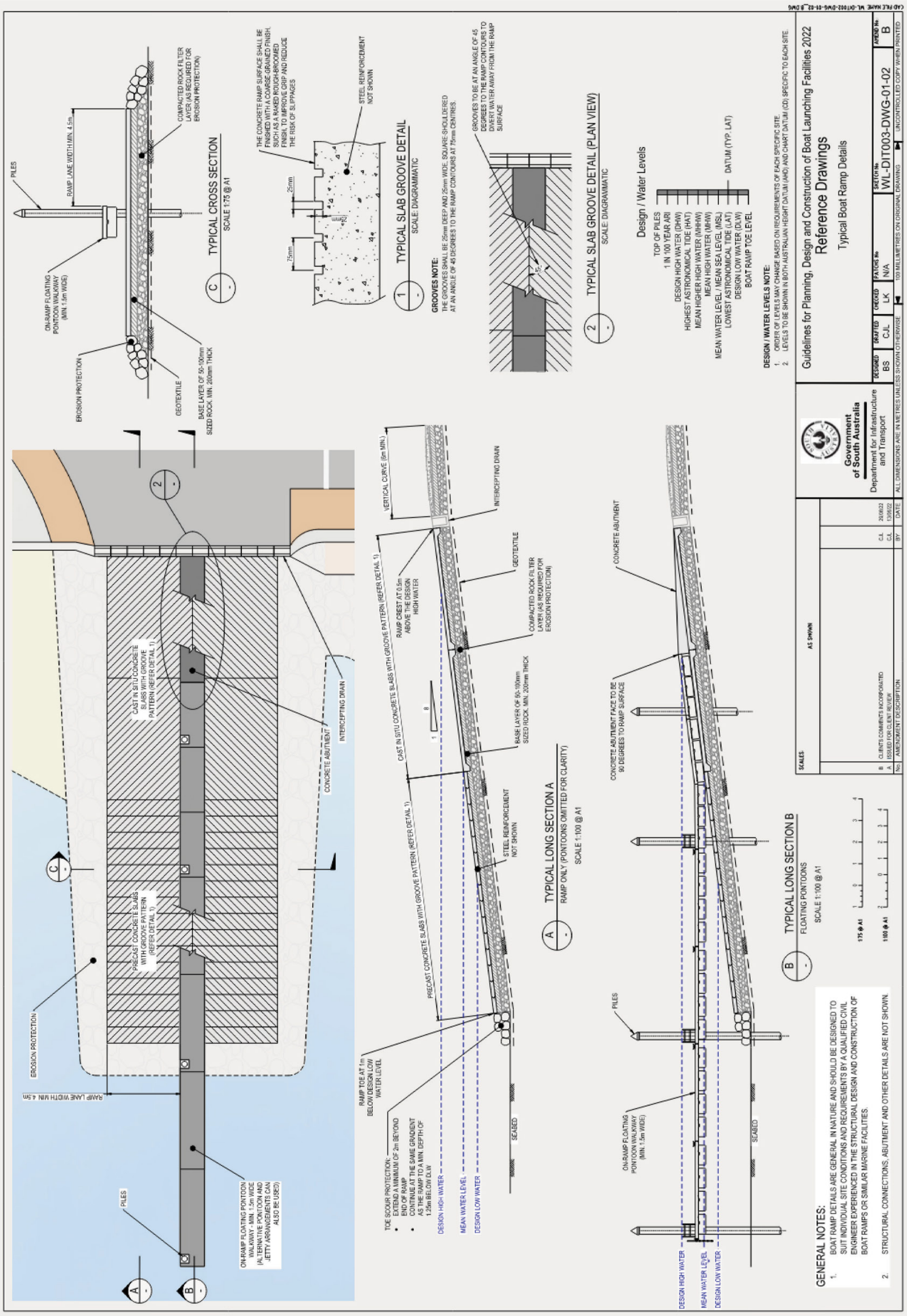
The frequency and type of maintenance would depend on the local waterway and weather conditions, as well as the boat launching facility service level and usage rates. The requirement for maintenance of a specific element or component can be confirmed through regular inspection outlined in Section 10.1.

Maintenance of small, damaged elements, such as cleats and fenders, should be undertaken as they are identified in inspections to prevent damage to structures and vessels. Removal of sand and sea grass wrack accumulations should also be undertaken as required to make the ramp useable.

Larger maintenance tasks such as removal and re-application of protective coatings, replacement of sacrificial anodes, replacement of protective armour and ramp panels may also be required over the life of the facility and should be undertaken as required. Any specific maintenance recommendations from the manufacturer of proprietary products, such as pontoons, should be included in the maintenance regime.

Appendix A – Boat launching facility reference drawings





Guidelines for Planning, Design and Construction of Boat Launching Facilities 2022
Reference Drawings
Typical Boat Ramp Details
WL-DIT003-DWG-01-02
Government of South Australia
Department for Infrastructure and Transport
GENERAL NOTES:
1. BOAT RAMP DETAILS ARE GENERAL IN NATURE AND SHOULD BE DESIGNED TO SUIT INDIVIDUAL SITE CONDITIONS AND REQUIREMENTS BY A QUALIFIED CIVIL ENGINEER EXPERIENCED IN THE STRUCTURAL DESIGN AND CONSTRUCTION OF BOAT RAMPS OR SIMILAR MARINE FACILITIES.
2. STRUCTURAL CONNECTIONS, ABUTMENT AND OTHER DETAILS ARE NOT SHOWN.
TYPICAL CROSS SECTION
SCALE 1:75 @ A1
TYPICAL SLAB GROOVE DETAIL
SCALE: DIAGRAMMATIC
TYPICAL SLAB GROOVE DETAIL (PLAN VIEW)
SCALE: DIAGRAMMATIC
TYPICAL LONG SECTION A
RAMP ONLY (PONTOONS OMITTED FOR CLARITY)
SCALE 1:100 @ A1
TYPICAL LONG SECTION B
FLOATING PONTOONS
SCALE 1:100 @ A1
Design / Water Levels
TOP OF PILES
1 IN 100 YEAR ARI
DESIGN HIGH WATER (DHW)
HIGHEST ASTRONOMICAL TIDE (HAT)
MEAN HIGHER HIGH WATER (MHHW)
MEAN HIGH WATER (MHW)
MEAN WATER LEVEL / MEAN SEA LEVEL (MSL)
LOWEST ASTRONOMICAL TIDE (LAT)
DESIGN LOW WATER (DLW)
BOAT RAMP TOE LEVEL
DATUM (TYP. LAT)
DESIGN HIGH WATER
MEAN WATER LEVEL
DESIGN LOW WATER
EROSION PROTECTION
PILES
SEABED
CONCRETE ABUTMENT
INTERCEPTING DRAIN
GEOTEXTILE