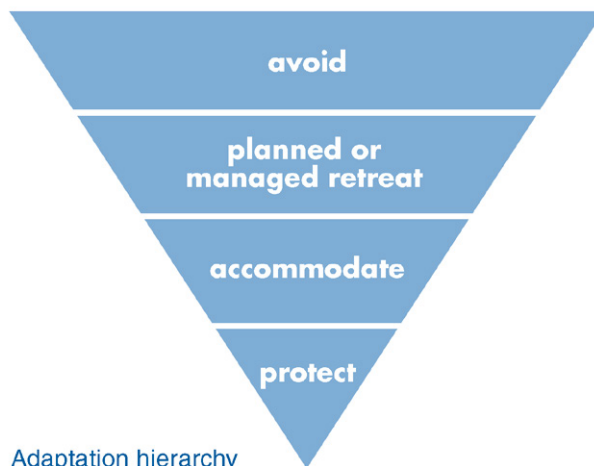


## Introduction to protection works

Coastal protection works are permanent or periodic works which aim to alter physical coastal processes or manage coastal hazards. They typically protect assets from the action of the ocean, including coastal erosion and coastal inundation.

### When to protect?

Coastal protection works are considered once other options for avoiding or adapting to coastal hazards have been explored. This is done through the completion of a CHRMAP process. The coastal hazards are assessed and adaptation options considered. Coastal protection works are considered where retreat is not possible or feasible, and the risks from coastal hazards can not be tolerated or accommodated.

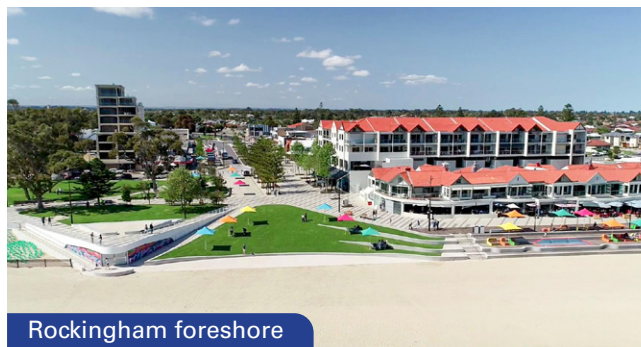


Coastal protection works need to be shown to have minimal significant impacts on the adjacent environment and be demonstrated to be for public benefit.

Funding arrangements for both the construction and maintenance works need to be considered and demonstrated.

Coastal protection works may be suitable for cases such as:

- Coastally dependent infrastructure
  - Surf life saving club
  - Boat harbour
  - Boat ramp
  - Aquaculture.
- High value coastal nodes with significant community value.
- High value infrastructure where retreat is not feasible.

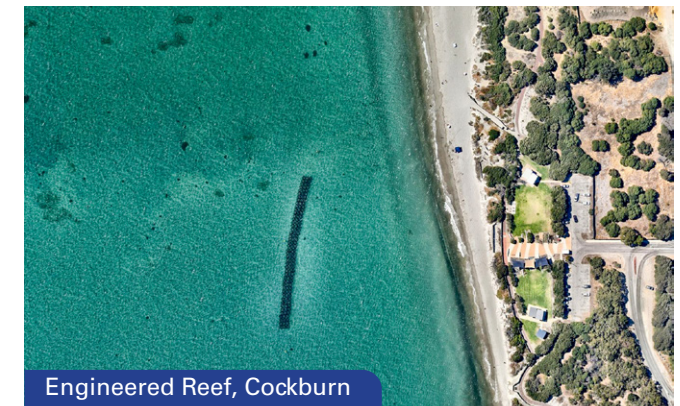


Rockingham foreshore

### Types of coastal protection works

Coastal Protection works are often referred to as “hard” or “soft” options.

Hard coastal protection options include more traditional structural options, such as groynes, seawalls and breakwaters. These take many forms and can be constructed from a range of materials.



Engineered Reef, Cockburn

Soft coastal protection options largely include nature based solutions, which aim to mimic natural ecosystems and processes to provide protection. These include works such as sand nourishment, artificial shellfish and coral reefs, revegetation, salt marshes, mangroves and seagrass.

Selection of appropriate coastal protection works needs careful consideration of the objectives of the works.

## Types of coastal protection works

There are many different forms of coastal protection works, from more traditional “hard” protection options, to “softer” and nature based solutions. The following are some more commonly used or considered coastal protection works in WA.

### Sand nourishment

Sand nourishment involves placing sand on the beach, dunes or in the nearshore area. The placed sand can re-establish the beach or dunes, provide a sediment supply and provide a buffer to coastal erosion.

Sand nourishment can be associated with other forms of coastal protection works and can be placed via various methods.



### Seawalls

Seawalls are typically linear structures constructed to retain and protect land, assets and infrastructure behind them. They can protect from both coastal erosion and inundation hazards.

Seawalls can take different forms (vertical, sloping revetment) and be constructed from a range of materials (rock, concrete, timber, sand bags).

### Groynes

Groynes are shore perpendicular structures which restrict the longshore movement of sand, providing protection to the assets behind the retained beach/ foreshore. They are primarily effective where there is longshore sand supply.

Groynes retain a useable beach, but segment the coast and can be constructed from a range of materials.

### Breakwaters

Breakwaters are shore parallel structures which block or reduce wave energy, encouraging deposition of sediment behind them. They can be shore connected or offshore and can be constructed from a range of materials.



### Artificial reefs

Artificial reefs are submerged structures constructed off the shoreline, which aim to reduce wave energy impacting the coast.

They can provide complementary benefits, with creation of habitat, or conditions for surfing.

### Other nature based solutions

Nature based solutions aim to mimic or create natural ecosystems or processes to reduce wave energy. They can include beach and dune systems, revegetation, salt marshes, mangroves, seagrass shellfish and coral reefs. While not as widespread or commonly used, their understanding and application is growing.

### Hybrid/combined works

Hybrid or combination options can incorporate nature based or bioinspired solutions into harder protection options. This can offer significant advantages in sustainability and habitat.

Examples include nature based inspirations, eg rock pools in rock structures, Living Seawall tiles on vertical walls, or combinations of nature based and hard options.

It is important to understand that all coastal protection works will alter coastal processes and dynamics. These impacts need to be understood and carefully considered when choosing an appropriate adaptation option.

## Which type of coastal protection

All coastal protection works offer advantages, disadvantages and other considerations. The appropriate form of coastal protection for a particular project needs careful consideration.

The following provide some of the items to understand and consider prior to determining an appropriate coastal protection solution.

Remember, not one solution fits all cases.

### Design objectives and criteria

The functional objectives and aims of any coastal protection works need to be understood prior to considering options. As an example, the appropriate option to protect and retain a dune from coastal erosion will be different to the appropriate option to prevent a building from inundation.

Along with the functional objectives and aims of the works, design criteria such as design life or timeframe of the protection, safety and accessibility of the works and acceptable levels of maintenance need consideration.

### Community values and sentiments

Community values and views on coastal protection works need consideration in determining an appropriate option. This is typically completed through ongoing community consultation and input through the CHRMAP and adaptation option selection process.

### Site specific conditions

The site conditions may make some coastal protection works unsuitable or inappropriate. Local conditions and processes need to be understood and considered. These may include:

- Metocean conditions (eg waves, water levels).
- Existing coastal processes.
- Site survey.
- Geotechnical or ground conditions.
- Contamination.
- Cultural and heritage considerations.

### Potential impacts

All coastal protection works will have impacts on the adjacent coastal dynamics and processes. Determining whether those impacts are acceptable is critical.

The potential impacts of coastal protection works may include downdrift or adjacent erosion, interruption or changes to sediment feed, loss or creation of habitat, amenity or aesthetic impacts and water quality.

### Costs

Direct costs of coastal protection works include both capital and maintenance costs, over the whole of the project life. Costs vary with the type of works, location, method of construction and materials and need to be considered site specifically.

Typically, harder protection options may have higher capital costs, but lower ongoing maintenance costs. Works such as sand nourishment can have higher and more frequent ongoing, or maintenance costs.

### Multi-criteria analysis

An MCA is a framework for assessing appropriate options, through considering and comparing a range of success criteria. These often include technical, environmental, social, economic and cultural criteria.

Selection of appropriate criteria to use and the scoring system is critical and can influence the outcome. Criteria can also be weighted for key criteria or considerations.

### Cost benefit analysis

A CBA process assists in refining and prioritising the range of appropriate options. It identifies the costs associated with each option along with the benefits. These include economic costs (capital or maintenance) along with social and environment costs and benefits (eg loss of foreshore or provision of beach).

The CBA is considered over the planning timeframe or the life of the project.

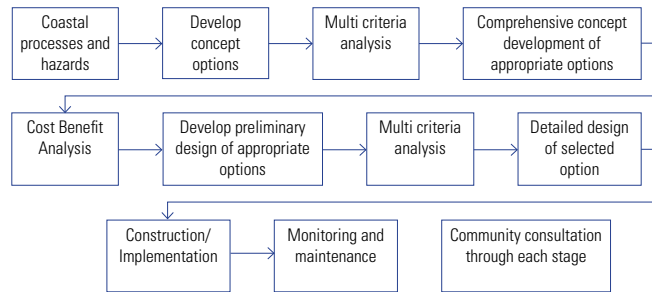


## Design, funding and approvals

An appropriate design process, consideration of funding arrangements and approval requirements are critical to the feasibility and success of coastal protection works.

### Design process

Typically, the design for coastal protection works is a staged approach, constantly refining and completing more detailed design as it progresses.



Community consultation is completed throughout the process and is an important input to design.

Changes in later stages of the design process are far costlier to implement than in the earlier stages. Determining project objectives and design criteria early are therefore often critical to project success.



### Funding arrangements

Coastal protection works in Western Australia need clear funding arrangement determined through the CHRMAP process. Funding is the responsibility of the proponent and the user / beneficiary pays principle applies.

Funding across the life of the project needs to be considered. This includes capital construction and ongoing or maintenance costs, along with other monitoring or management costs. These will vary from project to project.

There are funding opportunities throughout the project cycle, including planning, data collection, design, implementation or construction, monitoring, maintenance and asset management.

Funding opportunities are provided by State and Federal Governments and include the Coastal Management Plan Assistance Program, Coastal Adaptation and Protection grants, Disaster Ready Fund and a range of others.

### Approvals

Approval requirements will vary depending on the scale of works, location, structure and the potential for impacts. Works in environmentally or culturally sensitive locations may include a more involved approval process than those in less sensitive areas. Typical key approval authorities may include:

- Department of Planning, Lands and Heritage (planning approvals).
- DPLH (heritage approvals).
- Environmental Protection Authority (Public Environmental Review).
- Department of Transport (jetty licence).
- Department of Biodiversity, Conservation and Attractions (approvals in marine parks, Swan and Canning Estuary).
- Local government (planning and building approvals).

Along with formal approval, comment and consultation will be required with other key stakeholders, such as:

- Local community and reference groups.
- DPLH.
- DoT.
- Port Authorities.

Other approvals or advice may be required for aspects of construction, based on potential impacts.