



## 10. Coastal Management Considerations

### 10.1 Introduction

While consideration of options for coastal management works is beyond the scope of Phase One of this investigation, the following review of legislative and regulatory requirements has been undertaken to frame the context in which all management options should be considered. The scope of the management options in this context has also been provided.

### 10.2 Regulatory requirements

The selection of the most appropriate coastal management tool at any particular location must include consideration of any relevant legislation and planning requirements. As the entire study area is located in a region renowned for its biological diversity, the environmental protection requirements for the Pumicestone Passage shoreline are more complex than for many coastal locations.

#### 10.2.1 *Sustainable Planning Act 2009*

Within Queensland, the approval of most development is regulated by the *Sustainable Planning Act 2009* (SPA). This Act establishes an integrated development assessment system (IDAS) and approval timeframes for all stages of development. To streamline the approvals process, most other development related approvals are regulated through the IDAS. In addition, the SPA also establishes statutory plans to sustainably manage regional growth. The South East Queensland Regional Plan 2009–2031 (SEQ Regional Plan) is the relevant plan for the study area. The key documents to be considered when selecting coastal management options resulting in development are discussed below.

#### 10.2.2 *Coastal Protection and Management Act 1995*

The *Coastal Protection and Management Act 1995* (Coastal Act) establishes criteria to allow the protection, conservation, rehabilitation and management of the Queensland coast. These criteria are also supported by State and Regional Coastal Management Plans, which set out specific requirements for particular types of development in selected locations and have the effect of State Planning Policies. The primary issues to be considered are:

- ▶ Maintenance of physical coastal processes;
- ▶ Conservation and protection of coastal resources;
- ▶ Continuance of public awareness and appreciation of coastal resources;
- ▶ Retention and enhancement of public access to the coast;
- ▶ Protection of life and property from coastal hazards (such as coastal erosion and storm tide inundation); and
- ▶ Ongoing ecologically sustainable development of the coastal zone.

The State Coastal Management Plan is currently being reviewed and a draft State Coastal Management Plan has been prepared and released for public consultation. The draft plan has



been significantly restructured to clarify guidance for land managers as well as for development assessment. Both these aspects of the draft plan are relevant to the development of this SEMP and to coastal management option selection. Until the draft State Coastal Management Plan has been approved, the State Coastal Management Plan will continue to apply. All further discussion will therefore focus on the plan currently in force.

The State Coastal Management Plan and South East Queensland Regional Coastal Management Plan policies of particular relevance to this SEMP are:

- ▶ **2.1.8 Dredging** – planning for coastal management should consider the impacts of dredging to source sand for beach nourishment or otherwise, in terms of natural resources, cultural heritage values and material placement issues.
- ▶ **2.1.9 Reclamation** – land below HAT should remain in its natural state and reclaimed only where necessary for erosion control or beach nourishment purposes, protecting environmental or other values or for operating a facility or canal.
- ▶ **2.2.1 Adaptation to climate change** – planning must address the potential impacts of climate change using the hierarchy of avoidance, planned retreat, accommodation, and lastly protection.
- ▶ **2.2.2 Erosion prone areas** – retain as undeveloped to the extent practicable. In areas under constant erosion threat, planned retreat is preferred. Property protection works are considered to be a last resort where erosion presents an immediate threat to public safety or property and infrastructure that is not expendable or if retreat is impractical. The property protection works are to be designed to avoid any significant adverse impacts.

Erosion Prone Areas for the study area are generally 40m landward of MHWS or 10m above revetment structures where they exist (refer to the Erosion Prone Area map in [Appendix B](#)). The southern extent of Bribie Island is mapped with an Erosion Prone Area of 400 m.

The regional plan specifically seeks to avoid property protection works such as revetments and boulder walls, only supporting these works where:

- a) there is an immediate or critical threat of loss or damage to existing development from erosion impacts;
  - b) no viable alternatives such as revegetation or bank reconstruction have been demonstrated to provide a similar or adequate level of protection from erosion; and
  - c) potential adverse impacts on coastal processes and scenic amenity are minimised through remedial actions, such as beach nourishment to restore the beach and minimise impacts on adjacent coast.
- ▶ **2.2.3 Shoreline erosion management** – the preparation of shoreline erosion management plans for all priority erosion management is strongly encouraged. Within these areas, preference should be given to coastal management options that maintain natural coastal processes and visual and recreational amenity. Where erosion control structures such as seawalls and groynes are considered necessary as part of a shoreline erosion management plan, beach nourishment, revegetation or similar actions are to be investigated to mitigate any adverse impacts on the adjacent coast. The regional plan specifically identifies the



Sylvan Beach to Banksia Beach foreshore within the current study area as a priority area for plan preparation.

- ▶ **2.2.5 Beach protection structures** – will only be approved where there is a demonstrated public need and a comprehensive investigation has demonstrated no significant adverse impacts on the longshore transport of sediments and no localised increase in coastal hazards.
- ▶ **2.4.6 Acid sulfate soils** – potential impacts to acid sulfate soils should be addressed in accordance with the *State Planning Policy 2/02: Planning and Managing Development Involving Acid Sulfate Soils*.
- ▶ **2.4.7 Algal blooms** – the entire study area has been classified as having a high indicative nutrient export potential for nuisance algal blooms. In addition, the Sandstone Point area has been the site of a recorded outbreak of the cyanobacterium *Lyngbya majuscula* (Lyngbya), which poses a significant threat to human health, biodiversity, water quality and the recreational and commercial values of coastal waterways. Appropriate management, in particular best practice water quality management, of the study area in accordance with strategies such as the *Lyngbya Management Strategy 2002* and the *Queensland Harmful Algal Bloom Response Plan* is required to minimise the occurrence of harmful algal blooms. The principles and objectives of the draft State Planning Policy Healthy Waterways should be considered in management of the Pumicestone Passage waterways.
- ▶ **2.5.1 Indigenous Traditional Owners cultural resources** – consideration of sites and items of cultural heritage significance should be protected as per the *Aboriginal Cultural Heritage Act 2003*.
- ▶ **2.6.2 Cultural heritage** – places of European and Indigenous significance should be identified, conserved and managed in accordance with the *Queensland Heritage Act 1992* and *Aboriginal Cultural Heritage Act 2003*, including Turner's Camp memorial site.
- ▶ **2.8.1 Areas of state significance (natural resources); 2.8.2 Coastal wetlands** – the entire study area is classified as a State significant coastal wetland. In particular, any development in the area should be compatible with the protection, maintenance and enhancement of the area's coastal resources and values and maintain and protect the current extent and diversity of significant coastal wetlands.
- ▶ **2.8.3 Biodiversity** – to be conserved and appropriately managed to maintain the diverse range of habitats such as seagrass, benthic communities, dune systems, saltflats, coastal wetlands and riparian vegetation. In particular, development and activities are to avoid or minimise (in order of preference) disturbance to shorebird habitat, including nesting, roosting and feeding sites.
- ▶ **2.8.4 Rehabilitation of coastal resources** – priority for the rehabilitation and enhancement of coastal resources and values is to be given to the rehabilitation of dunes at Buckley's Hole. General areas for priority rehabilitation and enhancement comprise:
  - re-establishment and maintenance of vegetation along the Pumicestone Passage foreshore;
  - habitat corridors, and foreshore and riparian vegetation (policy 2.8.3);
  - shorebird nesting, roosting and feeding sites (policy 2.8.3);



- coastal wetlands (policies 2.8.1 and 2.8.2); and
  - indicative nutrient export areas rated high to very high, particularly riparian areas (policy 2.4.7).
- ▶ **2.9.3 State land on the coast** – land on the coast (including land under water) is to be recognised as having importance in decision-making for achieving coastal management outcomes.
  - ▶ **2.10.2 Inter-agency coordination** – State agencies (as well as local and Commonwealth stakeholders) should approach the collation and exchange of information in a coordinated manner.

Coastal development is managed and made assessable through Coastal Management Districts, which cover all tidal waters and most adjacent land (refer to the Pumicestone South Coastal Management District map in [Appendix B](#)). The Coastal Act regulates tidal works through the SPA and the IDAS approval process.

### **10.2.3 Marine Parks Act 2004**

The *Marine Parks Act 2004* provides for the conservation of the marine environment. This is achieved through the declaration of marine parks through the *Marine Parks (Declaration) Regulation 2006*, the establishment of zones within these, and the coordinated management of these parks. The *Marine Park Regulation 2006* and the subordinate legislation *Marine Parks (Moreton Bay) Zoning Plan 2008* establishes zones and states the objectives and activities in each zone that are either allowed, prohibited, or require a permit to occur. Zones that have been nominated in Moreton Bay include the general use, habitat protection, conservation park and marine national park zones (refer to the zoning map in [Appendix B](#)). Pumicestone Channel is dominated by the conservation park zone, which restricts the intensity of fishing and crabbing, and prohibits netting, trawling and coral collecting. Activities that are consistent with the objectives of the zone can be carried out with permission. The western shoreline of Bribie Island that is within the SEMP study area from Bongaree to Wrights Creek is zoned for habitat protection, which allows most fishing activities but restricts trawling and coral collecting. Permission is required within a habitat protection zone for carrying out works where they are consistent with the objectives for the zone.

### **10.2.4 Other Queensland legislation**

The *Fisheries Act 1994* establishes assessment criteria relating to fisheries matters, such as for development occurring within declared Fish Habitat Areas and the disturbance of marine plants. The Buckley's Hole area is contained within the Pumicestone Channel declared Fish Habitat Area (management level B) and the Turner's Camp area is adjacent to the declared Fish Habitat Area on the western side of the channel. The extent of the Fish Habitat Area is shown in [Appendix B](#).

The *Environmental Protection Act (EP Act) 1994* sets out key considerations for dredging work. There are also additional dredging policies under the State and Regional Coastal Management Plans that will need to be considered.



The *Vegetation Management Act 1999* applies to the clearing of certain native remnant and regrowth vegetation. Official mapping from the Department of Environment and Resource Management (DERM) is available to identify vegetation on land regulated under the Act.

Permission from the State government under the *Land Act 1994* is required to undertake any development on land owned by the State, and is usually required as part of making any applications under the SPA. The tenure of most intertidal areas is Unallocated State Land.

The *Nature Conservation Act 1992* and associated regulations provide for the protection, conservation and or management of natural areas relating to certain flora and fauna species. Each species listed in the relevant regulation is assigned a level of protection or management, such as rare, threatened or prohibited. The Buckley's Hole Conservation Park at the southern end of the study area is a declared protected area. Several significant species listed in the relevant Regulation are known to inhabit the study area. The Act also allows for the preparation of conservation plans and management plans to guide protection and management of natural areas. Clearing permits would be required for the disturbance of any 'least concern' (or higher status) plant species listed under Schedule 6 of the Regulation.

Consideration of Aboriginal cultural heritage must also be incorporated into the planning of any coastal protection works. The *Aboriginal Cultural Heritage Act 2003* provides guidance on ensuring that activities do not harm Aboriginal cultural heritage.

Notification of traditional owners about proposed works is also required under the *Native Title (Queensland) Act 1993* and the *Commonwealth Native Title Act 1993* where they are proposed on Unallocated State Land. A midden, bora ring and fish trap are known to be present within the immediate vicinity of the study area.

### **10.2.5 Commonwealth legislation**

The protection and management of nationally and internationally important flora, fauna, ecological communities and heritage places is regulated under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The EPBC Act applies to certain matters of national environmental significance. As at the end of March 2010, the website of the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) identified the following known matters of environmental significance for the study area:

- ▶ wetlands of international significance (Ramsar sites) – one (Moreton Bay);
- ▶ threatened species – 37 (includes birds, frogs, mammals, reptiles, sharks and plants); and
- ▶ migratory species – 62 (includes birds, mammals, reptiles and sharks).

Given the environmental sensitivity of the area, the selection and design of any coastal management options will need to minimise any adverse impacts on the wetlands and species identified above.

Approvals under the EPBC Act can be processed alongside Queensland government approvals in certain circumstances, however in this instance, given the scale of this project it is more likely that a separate application will need to be made to the DEWHA for any works with potential to impact on matters of national environmental significance.



### 10.2.6 Planning requirements

The SEQ Regional Plan establishes a number of principles relevant to the selection and design of coastal protection works. The policies on sustainability require that development is to incorporate protection from natural hazards, including the impacts of climate change, whilst retaining the integrity of natural areas and protection of biodiversity values.

In addition, specific policies on climate change and natural hazards require:

- ▶ The establishment of adaptation strategies to minimise vulnerability to storm tide and sea level rise inundation, and coastal erosion;
- ▶ The establishment of adaptation strategies to minimise vulnerability to cyclones and severe winds; and
- ▶ Development decisions to be in accordance with the Queensland Coastal Plan, including the range of potential sea level rises.

The SEQ Regional Plan coastal management policies seek to maintain, protect and enhance the values of the region's coast, including the foreshore, coastal wetlands, dunes, coastal processes, marine ecosystems, significant coastal values and marine waters. In particular, they require:

- ▶ Coastal development to be located, designed and managed to avoid or mitigate adverse effects on coastal values;
- ▶ Development other than maritime infrastructure to avoid erosion prone areas, storm tide inundation hazard areas, and undeveloped sections of tidal waterways in accordance with the Queensland Coastal Plan;
- ▶ Development on the coast or in tidal waters to maintain natural physical coastal processes or ensure that there is no increased risk of shoreline erosion to adjacent areas of coastline;
- ▶ Maintenance and enhancement of safe public access to the foreshore and coastal waters and ensuring public access is designed and maintained to conserve coastal resources; and
- ▶ Management of erosion prone areas to reduce the risk of erosion.

The South East Queensland Natural Resource Management Plan includes regional targets to support the sustainability framework of the SEQ Regional Plan. Specific targets for the coastal zone of relevance to the study area seek to:

- ▶ Maintain or improve the extent and condition of seagrass, coastal wetlands and mangrove ecosystems and habitat for key species;
- ▶ Maintain or enhance the condition of open coastlines; and
- ▶ Reduce the extent and frequency of coastal algal blooms.

In addition, the Moreton Bay Regional Council's Caboolture Shire Plan contains requirements for development. Although it is recognised that works carried out by local government for the community are not subject to the requirements of the planning scheme, consistency with the objectives of the scheme should be achieved.

Consideration must also be given to the disturbance of potential acid sulfate soils in the selection of coastal management options. *State Planning Policy 2/02 – Planning and managing*



*development involving acid sulfate soils* provides guidance on the management of any acid sulfate soils encountered.

### **10.2.7 Other management tools**

The Moreton Bay Shorebird Management Strategy provides guidance on the protection of Moreton Bay's shorebird populations, by promoting their values and managing threats to their survival. The listing of Moreton Bay's wetlands as a Ramsar site recognises its status as a wetland of international significance, and shorebirds are an integral component of this ecosystem.

The "Climate Proofing Bribie" report was produced by SEQ Catchments in May 2010 (SEQ Catchments 2010) through a process in which the community of Bribie Island and its three tiers of government developed a collective adaptation action plan facilitated by SEQ catchments and the University of the Sunshine Coast. The development and implementation of a Shoreline Erosion Management Plan is identified in the report as being a priority action to address specific issues related to shoreline management. The Climate Proofing Bribie report makes a number of recommendations as to the way forward. One of these is to ensure that a collection of historical records and photographs is made to develop a collective understanding of change and vulnerability – the SEMP has made a start on this process in terms of the foreshore areas, with the collation of historical records for each of the compartments in the SEMP study area, the collection of historical photographs from residents, and the analysis of historical aerial photography to identify where changes in beach alignment and foreshore vegetation have occurred.

## **10.3 Management Options and Actions**

### **10.3.1 General**

A range of options present themselves for the ongoing management of the various coastal processes within the study area. These include:

1. Non-protective actions, including approaches that involve:
  - Do nothing;
  - Planned retreat; and
  - Controlled beach access.
2. Non-structural protection options, including:
  - Beach nourishment;
  - Dune management; and
  - Geotextile structures.
3. Structural protection options, such as:
  - Seawalls;
  - Groynes and artificial headlands; and
  - Offshore breakwaters and submerged reefs.



It is likely that a mix of some of the above activities may be necessary to assist in the management of the coastal processes evident in the study area. Further consideration of these has been provided in Section 13 of this report.

Irrespective of what actions may or may not be required, it is important that the appropriate monitoring of the shoreline alignment is carried out on a regular basis. When analysed the data collected will provide an analysis of this data, combined with the results of the investigations into coastal processes in this report, will provide an improved understanding of the long term behaviour of the coastline and allow better informed coastal management decisions to be made.

### **10.3.2 Management of Beach Erosion**

A more detailed analysis of alternative means of combating beach erosion is presented below. The information presented has been sourced from the Beach Protection Authority Newsletter, Beach Conservation Number 29 main article entitled "Alternative means of combating beach erosion".

#### ***The Beach Erosion Problem***

Beach erosion is a natural part of beach behaviour and becomes a problem only when it threatens property and improvements. The essence of the problem is not that beaches erode but that development has occurred within the zone of these natural beach movements.

Combating any particular beach erosion problem is usually a very expensive business which, in the case of future development, can be completely avoided simply by the provision of an adequate buffer zone between the development and the beach.

However, where existing development is experiencing erosion problems, remedial action can be taken by implementing one or more of the measures outlined below.

#### ***Alternative Erosion Control Measures***

The selection of the most appropriate method of combating an erosion problem is by no means simple and will be influenced by the type of beach, the erosion mechanisms at work and the availability of funds for the project.

There are six basic ways of dealing with beach erosion problems which can be implemented individually or in various combinations. These are:—

1. No Action — allowing nature to take its course and accepting the resulting property losses
2. Relocating Development — removing the problem by relocating development outside the threatened zone.
3. Rock Revetment — providing a physical barrier to further erosion.
4. Groynes — to trap sand in the eroding areas.
5. Offshore Breakwaters — to reduce wave energy behind the breakwater and to trap sand in the eroding areas.
6. Beach Nourishment — rebuilding eroding beaches by direct placement of sand onto the beach.

Each of these six alternatives is discussed in more detail below:





### **1. No Action** (See No. 1 in [Figure 47](#))

A decision to take no action and allow erosion to continue is the best course of action when the threatened development has little value. Such a course of action requires no expenditure on protective measures and involves minimal interference with existing beach behaviour.

However, residents will naturally take action to protect their homes and Government agencies will also wish to protect their assets and amenities, making this method often impractical. Before this course of action is rejected as unacceptable, it is essential that the costs of the protective measures and the value of the assets to be protected be compared objectively. This has not always been done in the past.

### **2. Relocate Development** (See No. 2 in [Figure 47](#))

In cases where the development can be re-established elsewhere at reasonable cost, buffer zones can be provided where they previously did not exist. Such provision may necessitate moving amenities, roads and even domestic houses with payment of compensation to the owners involved.

The financial and social costs involved in resumption and compensation payments are usually very high especially in densely populated areas and public reaction against this general approach is understandably strong. In spite of its apparent drawbacks, in some areas relocation may well be cheaper in the long run than expensive protection works.

### **3. Rock Revetment** (See No. 3 and 3.A in [Figure 47](#))

Rock revetment is probably the most commonly adopted method of combating erosion problems in Queensland. Rock walls are surprisingly expensive, but can be provided at short notice and, for this reason, are commonly used for erosion control during cyclones and severe storms where flooding does not prevent access to rock sources. They also give property owners a feeling of security by their solid appearance but this will be an illusion unless the wall has been properly designed and constructed to resist severe wave attack.

Once provided, rock walls constitute a lasting artificial impediment to natural beach behaviour and generally result in an appreciable drop in the level of the beach. Erosion can still continue at each end of the rock wall and may even be accentuated at these locations. Rock revetment offers protection against further erosion but only at the expense of the beach which may need beach nourishment to restore its value as a recreational asset.

### **4. Groynes** (See No. 4 in [Figure 48](#))

Groynes are a common but sometimes misunderstood method of combating erosion. Groynes function by trapping sand moving along the coast on the updrift side of the groyne but starve the beach of sand supply on the downdrift side. Groynes can only function if there is a significant drift of sand along the coast in a predominant direction.

One of the main problems with groynes is they do not solve an erosion problem but merely transfer it along the beach. Often this leads to the construction of a series of groynes (a groyne field) with the result that the erosion problem becomes concentrated on the downdrift side of the last groyne.

During severe wave attack, groynes do not prevent erosion because they have no effect in reducing the movement of sand in the offshore direction (i.e. at right angles to the beach).



However, by trapping sand on the updrift side they do help to provide a wider beach to accommodate erosion. At the same time, the depleted beach on the downdrift side of the groyne will be more susceptible to erosion than before.

The erosion problems associated with groynes can be compensated for to a large extent by beach nourishment. As a general rule a combined approach is preferable to using a groyne construction by itself unless the concentration of erosion on the downdrift side is acceptable.

#### **5. Offshore Breakwaters** (See No. 5 in Figure 48)

Offshore breakwaters constructed parallel to the beach alter the height and direction of waves reaching the beach. They create a sheltered zone behind them into which sand may be moved by longshore transport processes but out of which longshore transport will be greatly reduced because of the altered wave climate. In addition, short term storm erosion will be reduced as much smaller waves will reach the beach.

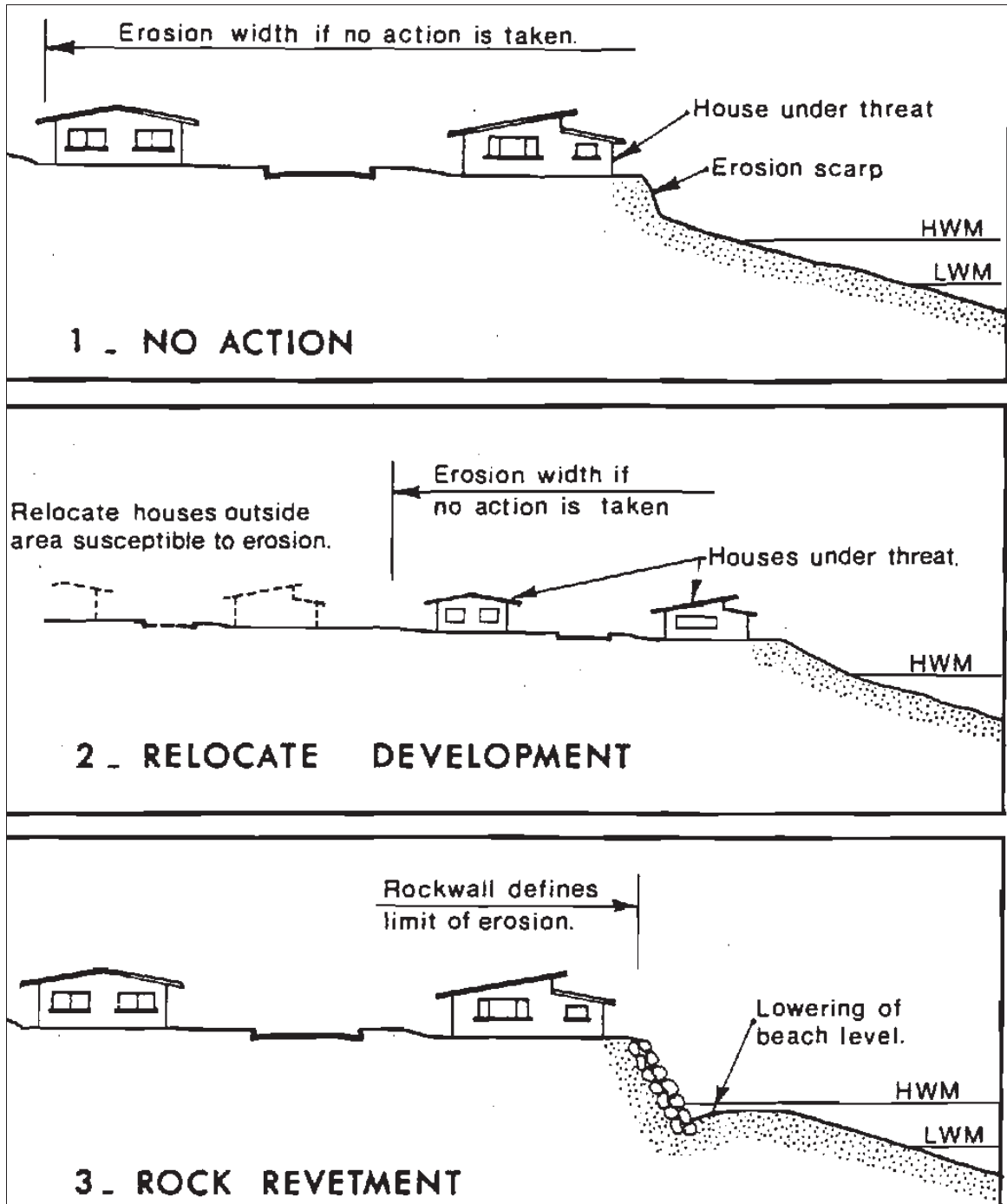
Offshore breakwaters, like groynes, cause erosion on the downdrift side of the structure and usually will need to be complemented by beach nourishment. The construction of offshore breakwaters is difficult and expensive and the cost is generally prohibitive unless other benefits such as a small craft harbour are involved.

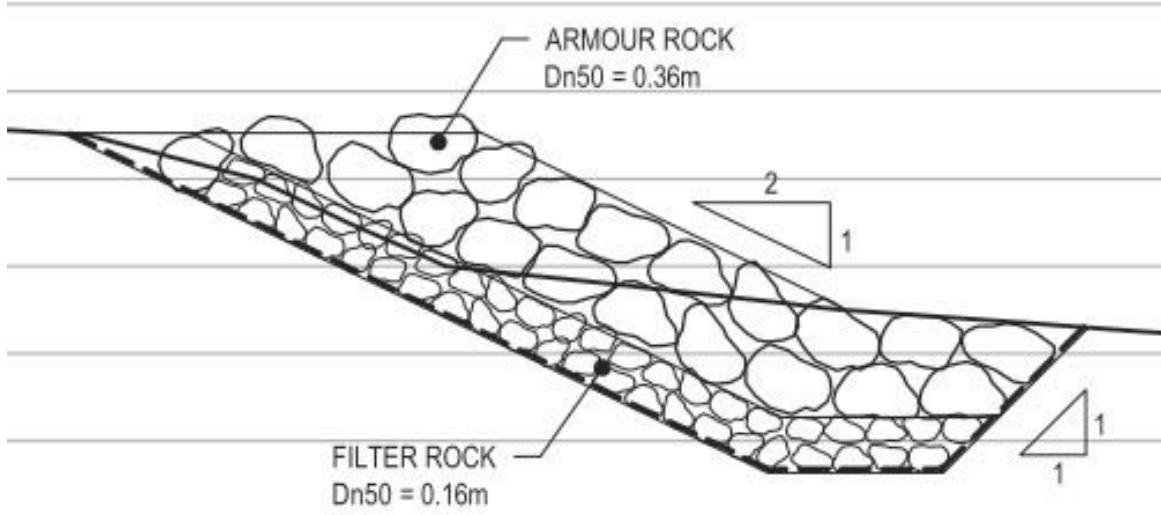
#### **6. Beach Nourishment** (See No. 6 in Figure 48)

Beach nourishment refers to the deposition of sand onto beaches by pumping or other means with a view to restoring an adequate buffer zone in front of the threatened property. Suitable sources of the sand for beach nourishment are usually nearby estuaries or offshore areas but they must not be part of the active beach system.

The attraction of beach nourishment as a method of erosion control is that it improves the beaches while providing protection to previously threatened property. The approach has no adverse effects on adjacent beaches and is currently recognised as the best solution to erosion problems in areas where a suitable sand source is available nearby. Beach nourishment has been carried out successfully at a number of beaches in Queensland from the Gold Coast to Cairns. The closest local example of beach nourishment is at Woorim.

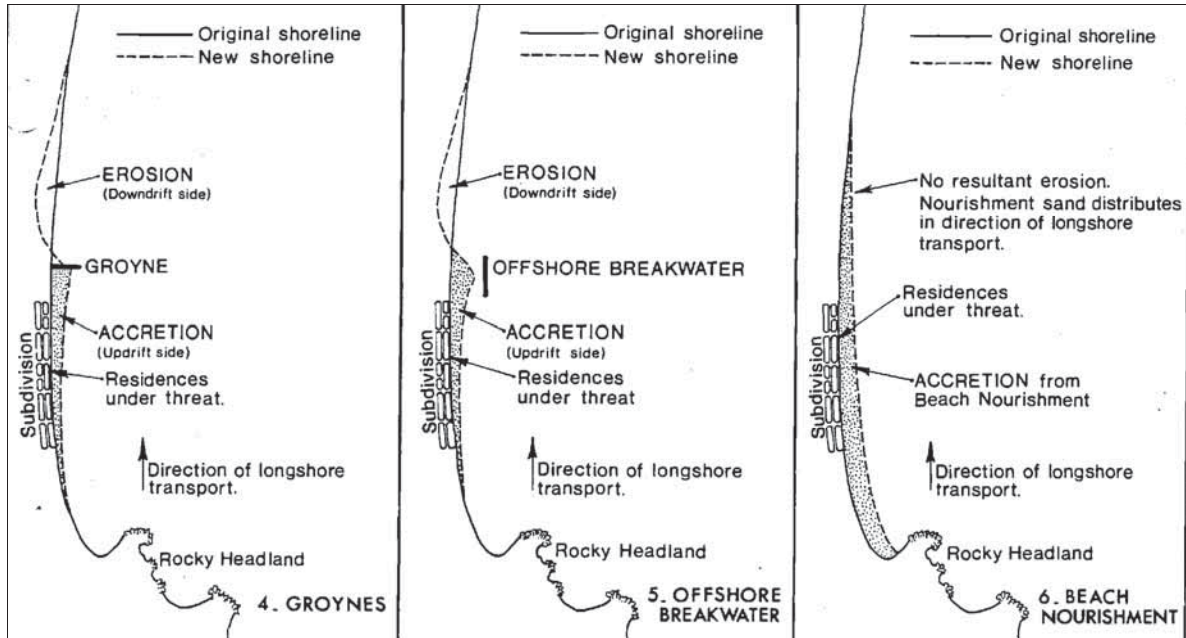
Figure 47 Alternative Erosion Control Measures – No Action, Relocate Development and Rock Revetment





3.A Rock revetment cross section

**Figure 48 Alternative Erosion Control Measures - Groynes, Offshore Breakwater and Beach Nourishment**





**Table 6 Comparison of Erosion Control Measures**

Erosion control measures	Key Advantages	Key Disadvantages	Comments
1. No action	(a) Beach continues to behave naturally (b) No direct expenditure required on protective measures	(a) Property and improvements are lost by continued erosion	This approach is only practical where threatened property is of limited value, and its loss can be accepted.
2. Relocate development	(a) Effectively solves the beach erosion problem (b) Beach continues to behave naturally	(a) Public reaction against relocation is usually strong (b) Compensation payments may be prohibitive	In spite of its apparent drawbacks it may be cheaper in the long run in some areas.
3. Rock Revetment	Well suited to emergency erosion control	(a) Only effective if properly designed and constructed (b) Adversely affects the beach	Should only be used in emergency situations and to provide "last line of defence" protection to important infrastructure that cannot be relocated. .
4. Groynes	(a) May be effective in building up the beach on updrift side. (b) Unlikely to be of any benefit in Pumicestone Passage in isolation due to low rates of longshore transport.	(a) Doesn't solve the erosion problem — merely transfers it	Only useful in conjunction with beach nourishment or if erosion on downdrift side is acceptable.
5. Offshore breakwaters	(a) May be effective in building up beach on updrift side (b) Shelters beach from storm attack	(a) Cost is usually prohibitive (b) Results in erosion on downdrift side	Cost is prohibitive unless other benefits are provided e.g. small craft harbour. Unlikely to be of any benefit in



Erosion control measures	Key Advantages	Key Disadvantages	Comments
6. Beach Nourishment	<ul style="list-style-type: none"> <li>(a) Increases buffer zone width</li> <li>(b) Enhances natural beach</li> </ul>	<ul style="list-style-type: none"> <li>(a) Sources of nourishment sand not always close by.</li> </ul>	<p>Pumicestone Passage due to limited wave action and low rates of sediment transport.</p> <p>Appears to be the best approach to many of Queensland's erosion problems.</p> <p>In Pumicestone Passage, beach nourishment is an excellent means of combating erosion given the low loss rate from longshore transport processes.</p>



### **10.3.3 Monitoring**

Monitoring of the shoreline alignment can be achieved through the implementation of a number of relatively simple measures but can also involve highly sophisticated and relatively expensive projects aimed at monitoring specific beach properties. The simple measures can range from regular ground photography from a fixed point to beach profile measurements by trained volunteers using simple instrumentation, to surveyed beach profiles and full contour surveys. The more sophisticated measures include aerial photography and aerial survey techniques such as LiDAR surveys.

In terms of monitoring, it is suggested that a cost effective way of acquiring aerial photography and surveys is to have beach areas included in larger scale projects covering adjacent areas as they occur. This will provide valuable data but will be on an opportunistic basis and not have the regularity required to distinguish seasonal or even yearly changes in the shoreline.

Monitoring of beach movements by trained volunteers has proven to be a cost effective method of collecting good quality data provided there are volunteers available, they are adequately trained, and the methodology is clear and straightforward. A good example of such a program is the Coastal Observation Program Engineering (COPE) that was run by the Beach Protection Authority during the 1970s and 1980s. Volunteer observers in such a program can be local residents, Council officers, and even school children.

Using surveyors to carry out detailed measurements of beach profiles and shoreline movement is an important part of monitoring and can be implemented on a less frequent basis if combined with more frequent measurements by volunteers or regular ground photography.





#### **10.3.4 Summary**

A brief comparison of the various alternative means of combating erosion problems is shown in Table 6. In many instances, a combination of methods may be more applicable than relying solely on any individual approach. The "no action" and "relocate development" approaches are very reliable as they involve no interference with natural beach behaviour. However, they are often socially unacceptable or financially prohibitive. Structural solutions such as rock revetment, groynes and offshore breakwaters are effective in some cases but all have potentially disastrous side effects which may require ongoing management action. Beach nourishment however, has no adverse side effects and offers the greatest scope for the least cost solution to beach erosion problems in Queensland.