# Assessment and Decision Frameworks for Seawall Structures

2013

**Appendix G**

## Case Study Gold Coast

SYDNEY COASTAL COUNCILS GROUP

Coastal Adaptation Decision Pathways Project **(CAP)**

The Sydney Coastal Councils Group (SCCG) is a voluntary Regional Organisation of Councils representing fifteen coastal and estuarine councils in the Sydney region. The Group promotes cooperation and coordination between Members to achieve the sustainable management of the urban coastal environment.

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Cover image:  Coastal seawall. Provided by Douglas Lord

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# Appendix G
# Case Study – Gold Coast

Prepared for

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SYDNEY COASTAL COUNCILS GROUP

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# APPENDIX G PREFACE

This Appendix was prepared by the Griffith Centre for Coastal Management for this Report titled *Assessment and Decision Frameworks for Seawall Structures*. The purpose of the information in this Appendix was to examine a case study involving the planned implementation of the Gold Coast seawall which has been undertaken over a period of approximately 40 years to a consistent design and alignment. The authors of the report were P. Williams and R. Tomlinson. It has been published by the Griffith Centre for Coastal Management as Research Report No 132 *Gold Coast Seawalls: A Case Study*' and was released as Revision 1 in September 2012. It can be viewed also in that format.

The report has been included in its entirety within this Appendix and is a true reflection of the original advice provided by the Griffith Centre for Coastal Management to the project. No additions, edits or changes have been made to their final report, other than minor editorial and layout changes for consistency in appearance. References to sections, figures and tables are to those included within this Appendix.

As appropriate, information from this Appendix has been incorporated or referenced in the main report for this project.

# Executive Summary


The Gold Coast has approximately 42 kilometres of coastline, with many of the beaches populated with oceanfront residences. During the cyclonic period of the 1960s and 1970s, storms created scarps which extended landward past the boundaries of many beachfront properties. The waves and wind seriously damaged buildings and affected the structural integrity of some high-rise buildings and many houses.

As a response, the Queensland State Government, the Gold Coast City Council and many of the residents who owned property adjacent to the beach, constructed protective walls along the beachfront in an attempt to protect property and other structures from future attack. In the majority of cases, these walls were constructed directly on the then-existing erosion scarp, which became known as the A-line.

Following detailed studies, which began in the late 1960s, a standard design for the construction of the seawall was developed, which acknowledged the dynamic nature of the coastal environment. The design was prepared by consultants on behalf of the Co-ordinator General's Department (COG) of the state government. The seawall would be buried in sand during periods of calm weather and exposed during periods of stormy conditions.

Gold Coast City Council estimates the current total length of the A-line to be 31.5 km. However, the total length of the seawall that has been certified through certificates, photos or other documentation, regardless of ownership, has been estimated at only 17.7 km.

The seawall was, of course, designed without incorporating current sea level rise projections, and to date there has been no specific reassessment of the design of the wall under sea level rise constraints. There has been an assessment, however, of the capacity of the seawall built to certified standard to deal with likely extreme wave events over the next 50 years in the context of it being part of an integrated management strategy which includes the ongoing nourishment of the beach to maintain an appropriate buffer against storm erosion. Provided adequate beach width is maintained, the seawall can continue to perform its 'last-line-of-defence' function.

If a decision to adapt to projected sea level rise by altering the design of the seawall is made by Gold Coast City Council, the new design would also need to be included in Council's Planning Scheme. This decision would require liaison with the state government as the local council would require the endorsement of the state to make any changes to the local planning scheme. However, any changes would not be undertaken by Council without first consulting with the Gold Coast community.

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## Glossary

| | |
|---|---|
| accretion | On a beach, deposition of sediment (typically sand) transported naturally to the location by waves, currents and winds |
| active beach zone | The section of the beach from the offshore limit of onshore/ offshore sand movement under waves to the landward limit of wave uprush during storms |
| geotextile | A permeable geosynthetic sheet comprised solely of textiles, used in geotechnical engineering construction. Materials may be either woven or needle punched and are robust Commonly geotextiles provide a filter layer under rock armour or can be fashioned into containers filled with sand used as armour units in a structure |
| groyne | Structure of rock and/or other materials generally built out from the shore seaward in dynamic environments. A groyne creates a physical barrier that slows down or stops the alongshore movement of sand, trapping a sand fillet on the updrift side and correspondingly accelerating erosion downdrift |
| revetment | In coastal engineering applies to protection structures armouring an existing ground slope or erosion/dune escarpment to prevent further erosion of the slope by waves during storms |
| scarp | (or escarpment) A steep face on the side of a hill, a sand dune or the seabed. Commonly refers to the steep dune face eroded by storm waves |
| scour | Erosion, normally by the action of flowing water or wave action |
| sea level rise (SLR) | A rise in mean sea level when averaged over an extended time period. In terms of climate change is usually used to describe the predicted or projected increase in the mean sea level that will occur to a future date measured above the 1990 mean sea level |
| toe | The seaward base of a seawall |
| water table | The upper surface of a zone of saturation, where the body of groundwater is not confined by an overlying impermeable formation. Where an overlying confining formation exists, the aquifer in question has no water table |

## Acronyms

| | |
|---|---|
| AHD | Australian Height Datum |
| GCSMP | Gold Coast Shoreline Management Plan |
| RL | Relative Level |

# 1. Introduction

This document is developed as an appendix to the larger project report: *Assessment and Decision Frameworks for Seawall Structures*, conducted under the Coastal Adaptation Decision Pathways funding program administered by the Department of Climate Change and Energy Efficiency. Much of the material presented in this report was sourced from Gold Coast City Council records including, in particular, a recent report to Council on 21 August 2012 titled *Gold Coast Beaches Seawall Update* (Gold Coast City Council, 2012), and personal communication with council officers.

This appendix presents a case study of the seawall which forms part of the beach protection strategy of the Gold Coast beaches. Although the Gold Coast has some 600 km of waterways, much of which includes revetment structures, this case study will only examine the seawall which fronts the ocean foreshore.

The Gold Coast has approximately 42 km of oceanfront coastline, stretching from Coolangatta to South Stradbroke Island. Beach erosion is a natural part of beach behaviour and really only becomes a problem once property is threatened. The essence of the problem is not that beaches erode but that development has occurred within the zone of these natural beach movements (Beach Protection Authority, 1977). In the case of the Gold Coast, development has occurred in many locations which are in the active zone, and there has been a long history of construction of coastal protection structures such as seawalls.

The seawall which follows the Gold Coast ocean shoreline is a rock wall that has been constructed along what is referred to as the A-line. This is the foreshore seawall line, or the line running parallel to the beach along the rear of the dune which delineates a defined extent of erosion during extreme storm events. The A-line seawall has been designed to be buried below the sand dunes and is therefore not visible to the public unless there has been a storm event that has exposed the seawall.

In the case of the Gold Coast, the stability of the foreshore and beach protection does not rely solely on the construction of the seawall. It is only part of a complex series of beach protection measures that have been continuously implemented by State Government and the Gold Coast City Council, including beach nourishment and dune revegetation.

## 2. HISTORY OF GOLD COAST BEACH PROTECTION

The Gold Coast has a well-documented history of storm events resulting in the beaches being prone to erosion and accretion cycles. The occurrence of extreme storms is also cyclical, with periods from the 1860-1890s, 1930s and 1950-1970s being particularly stormy. In recent times, the worst recorded sequence of storm events occurred in 1967. However, erosion problems have been recorded on the Gold Coast as early as the turn of the twentieth century in Southport (Figure 1).

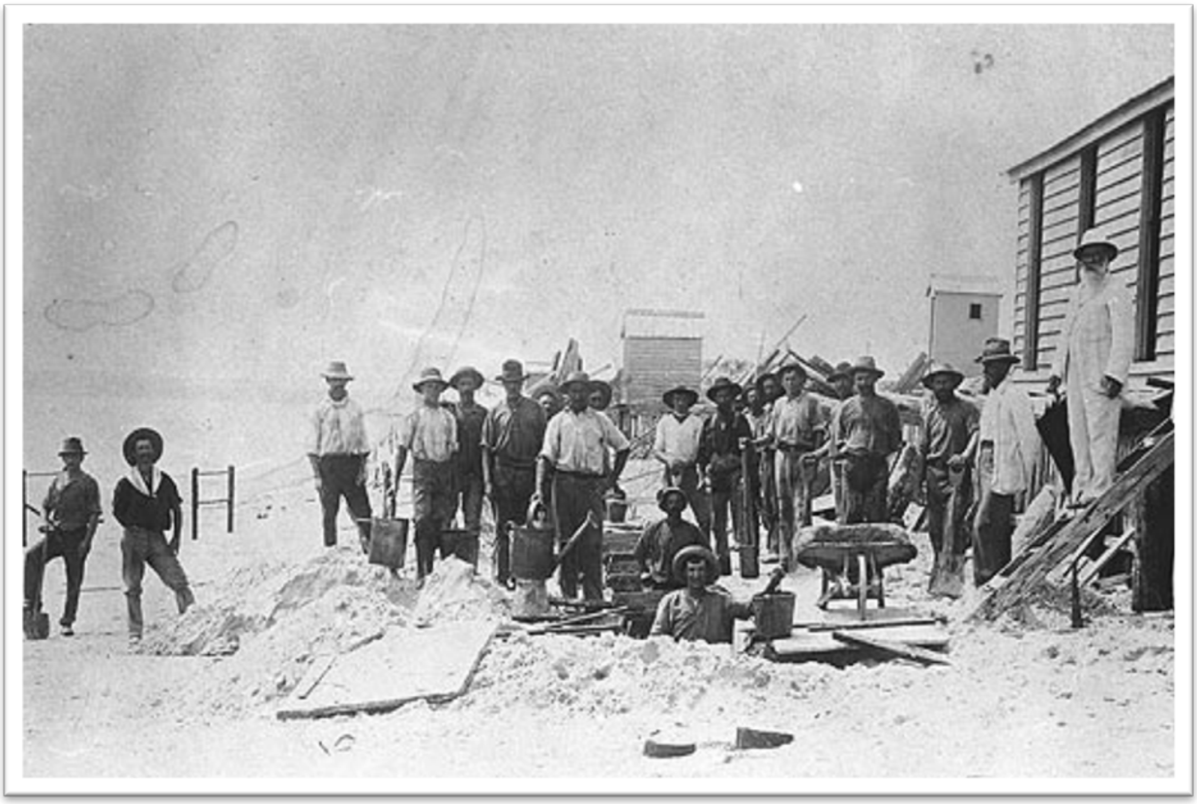

**Figure 1 Building a seawall at Southport in 1902**
(Source: GCCC)

Development on the beachfront was low-key during the first half of the century, but increased from the 1950s, with rapid development from the 1970s onward.

Serious storm erosion was recorded in 1920 at the small beachside resort village of Main Beach at Southport – now part of the Gold Coast city. Reports indicate that a timber log wall was constructed to effectively halt the erosion. This was a typical response using easily obtainable local timber logs that could be easily transported and installed. Such walls were leaky unless suitable gravel was available to place behind them as a filter to retain the sand but allow the elevated watertable behind to escape. They also are very reflective and, if not driven deep enough, fail by toe scour. However, they were often a reasonably successful short-term measure. Remnants of early timber pile walls are still evident in many areas along the coast.

A few years later, the Pacific Highway linking Brisbane and Sydney was threatened at Narrowneck near Surfers Paradise. Timber groynes (Figure 2) proved ineffectual, and eventually a very substantial bitumen-coated timber log wall was constructed, with a rock toe and gravel behind. This was successful and was reinforced with a boulder wall along the front many decades later when the wall was extended. The wall was far enough landward so as to only be exposed during storm events, after which the beach built up again to seaward. Up to the late 1990s this wall was still protecting the road, now not a highway but a local road (and part-time Indy race track).

**Figure 2 Building a timber seawall at Narrowneck, Main Beach**
(Source: GCCC)

A severe cyclone in 1931 caused extensive erosion and, with the rainfall, substantially altered the entrances to creeks, such as Currumbin Creek, where an island near the entrance was completely washed away. (This type of problem occurred 'recently' at Maroochy where the entrance broke through causing widespread damage and loss of some of the council caravan park – a huge asset that was protected.) Another severe cyclone in 1936 caused widespread damage and more timber walls were constructed. Cyclones and severe erosion were noted in various records regularly up to 1974.

The 1967 cyclones, seven back-to-back, caused extensive damage to all of the southern Queensland beaches. In areas with wide, well-vegetated dunes the erosion was slowed, but eventually the dunes collapsed during the battering every high tide (Figure 3).

**Figure 3 Dune cut, 1967 Storms**

It was not just private beach houses and lifesaving clubs that were threatened - the public esplanade roads that had been designed well back from the beach by the early state government planners were severely damaged. This meant that services such as power and water were cut and access to properties was cut off. Surfers Paradise esplanade is shown in Figure 4.

**Figure 4 Surfers Paradise Esplanade, 1967**

No action was not a real option. Emergency protection works aimed at reducing the erosion of the dunes were varied in both their type and effectiveness. However, as there was no regulatory environment for construction of protection at this time, property owners deployed material as was available (Griffith Centre for Coastal Management, 2010). Measures taken included:

- boulders
- car bodies (Figure 5)
- concrete rubble
- concrete slabs (including collapsed swimming pools)
- drums filled with concrete
- gravel
- masonry bricks and blocks as rubble
- plastic sheeting
- pavers
- sand
- sandbags
- timber walls and groynes.

**Figure 5 Use of car bodies to protect against storm erosion in 1967**
(Source: GCCC)

Inadequate walls were next to useless. The most successful were well-constructed boulder walls. However, poor quality or overtopped boulder walls failed quickly. Areas where adequate boulder walls had been constructed over a long length during earlier severe erosion events were the best off.

While they lost the beach, the extent of the erosion was curtailed. Erosion occurred unabated up and down drift without any significant increase in the extent (Figure 6). Recovery of the beach occurred after the storms in all areas. One problem was that with the cyclonic rains, access to quarries for suitable rock was limited.

Other measures that had some success were:

- rubble, where at a flat angle and thick enough
- sandbags, where well interlocked and well filled.

The army was dispatched to deal with the disaster. They brought with them their familiar tool, hessian sandbags (Figure 4 and 7). Larger plastic fertiliser bags were also used by Council and residents but proved less effective due to their low coefficient of friction. Gold Coast City distributed sandbags to owners who filled them using readily available sand from their yards.

**Figure 6 Erosion without protection compared to with adequate protection**

**Figure 7 Sandbags used as emergency protection, 1967 storms**

The behaviour of residents under stress was not always uplifting. Pilfering of sandbag stores and diverting Council trucks loaded with rock to protect roads by residents was commonplace. Requests (demands) by influential beachfront owners on politicians were widespread. Commitments to pay for Council rock were often avoided after the event.

## 2.1 Development of the A-Line Seawall

The earlier responses to storm erosion resulted in seawalls of varying alignment and varying distances from the calm weather shoreline position. The construction materials also varied, and not all properties had walls constructed, leaving numerous gaps along the line of the wall.

By the early 1970s, the effectiveness of these walls had been investigated and the Queensland State Government undertook to develop a standard design. This work was done by consultants for the Co-ordinator General's Department (COG). A key part of the negotiation over beach protection legislation at the time included provision to ensure certainty that the Gold Coast City Council would not be liable for the seawall design.

Council adopted this design and developed a standard installation for the construction of a seawall for all Gold Coast beaches. This standard wall was designed to withstand a low 5% damage value, for between a 1-in-60-year and 1-in-100-year cyclone event (Griffith Centre for Coastal Management, 2001). In 1976, the limit of the protection wall was defined within a line called the 'A-line' and designed with the following principles (Smith, 1990):

> *It was to be continuous and as smooth in plan and curvature as possible. The line should be as far landwards as possible and not be seawards of the 1967 and 1954 erosion scarps. It is preferable that the rear section of the wall be sited landwards of the property line.*
>
> *The plan alignment should be, as far as possible, parallel to the long-term beach profile in plan. In the event, this would be represented by the plan alignment of the original natural leading long-term sand dune.*

The natural dynamics of beach evolution imply that seawalls are covered by sands during accretionary periods or following artificial replenishment schemes, and more or less exposed during erosive periods (Figures 8 and 9). The location of the protection wall thus delimits a safer zone of use and avoids the projection of properties further on the beach. The Gold Coast seawall is thus regarded as the last line of defence against the sea (Smith, 1987). There is, however, uncertainty regarding the effectiveness of the wall given that there have been far fewer significant erosive events since its initial construction.

**Figure 8 Seawall exposed at Palm Beach, 1989**

(Source: GCCM)

The Gold Coast Shoreline Management Plan (GCSMP) (Griffith Centre for Coastal Management, 2010) has identified a requirement for 31.5 km of seawall along urban areas of the coastline, with 22.6 km of A-Line along public urban land and 8.9 km of A-line to protect private beachfront properties.

Council's records indicate that there are currently 17.7 km of the 31.5 km (56%) of beachfront with at least some evidence of a constructed seawall, including 11.1 km of 22.5 km (49%) of public seawall and 6.6 km of 8.9 km (74%) of private seawall. An example of the status of the seawall is given in Figure 10 for the Palm Beach section of the coastline.

The GCSMP identifies an additional 13.8 km of seawall that is recommended for construction along the coastline, including 11.4 km of public seawall and 2.3 km of private seawall.

For the 11.1 km of public seawall, only 1.9 km of seawall has a formal certification on Council's file. Large sections of public seawall were constructed by the State Government prior to the practice of certifying the seawall (e.g. Surfers, Burleigh and Kirra esplanades). Evidence suggests that these larger sections of seawalls along public esplanades are high quality. Other sections of public seawall were constructed as emergency protection and these sections have varying quality.

For the 6.6 km of private seawalls, 4.5 km has a formal certificate and 2.0 km does not. It is a condition of further development of beachfront property, that either:

a) a certificate be produced for the private seawall in its current condition, or

b) maintenance/upgrading works be undertaken to improve the private seawall and then a certificate be produced for its upgraded condition.

**Figure 9 Exposed seawall at Palm Beach, 2012**

(Source: GCCM)

# 3. Gold Coast City Council Planning Scheme Policies

The Gold Coast Planning Scheme requires seawalls to be constructed by developers as a condition of development of structures upon erosion-prone beachfront land. The Planning Scheme also requires that coastal structures include foundations that can resist coastal scour and allowance for wave attack for larger storm events that have breached the seawall.

Council has a works program to construct seawalls that protect areas of urban public land including parks and road reserves. In non-urban areas including South Stradbroke Island, The Spit and Kurrawa Park, there is no approval to construct a seawall, and management of healthy dunes is the preferred method of coastal management. Assets located on erosion-prone land along non-urban sections of the coast or on erosion-prone land seaward of the seawall are sacrificial or relocatable.

In order for the seawall to provide protection against erosion of land west of the A-line, a continuous wall is desirable along urban sections of the coast. Gaps between constructed seawalls may allow erosion to occur between and behind the walls during larger storm events. In non-urban sections of the coastline (e.g. South Stradbroke Island and The Spit), there is no seawall, and management of healthy dunes is the preferred method of coastal management.

Council has a works program for construction of seawalls that provide a level of protection to areas of urban public land including parks and road reserves. The 2012-13 allocation for Seawall Construction is $320,000. In November 2010, Council endorsed the continued program of investment into seawalls as part of the Gold Coast Shoreline Management Plan.

The Planning Scheme (through the Ocean Front Land Constraint Code, Gold Coast City Council (2011)) requires developers to upgrade the seawall for a beachfront property prior to significant investment into development of the property. The location of the seawall is defined by the A-line as shown in Figure 11. This code seeks to ensure that development occurring in the City's ocean beach areas is managed to ensure the protection of the property and the preservation of the beach environment. This code also seeks to:

- protect the oceanfront properties and the beach environment through construction of a seawall and footings that are resistant to erosion
- protect and replenish the sand resources for the preservation and restoration of the City's beaches
- preserve visual amenity of the foreshore
- protect and enhance the coastal environment, including water quality, and
- ensure adequate access for foreshore seawall maintenance.

The code also seeks to ensure the protection and enhancement of the City's beaches as a major attraction, having regard to ecological, economic, recreational, commercial and cultural values.

The design of a proposed seawall must comply with the requirements as outlined in Council's *Gold Coast Planning Scheme Policy 7: Foreshore Rock Wall – Design and Construction* and constructed to

Council's *Standard Drawing N°59402 – Foreshore Seawall* (Gold Coast City Council, 2003) (see section 4 and Figure 12).


**Figure 10 Status of the Seawall at Palm Beach**

(Source: GCCC, 2012)

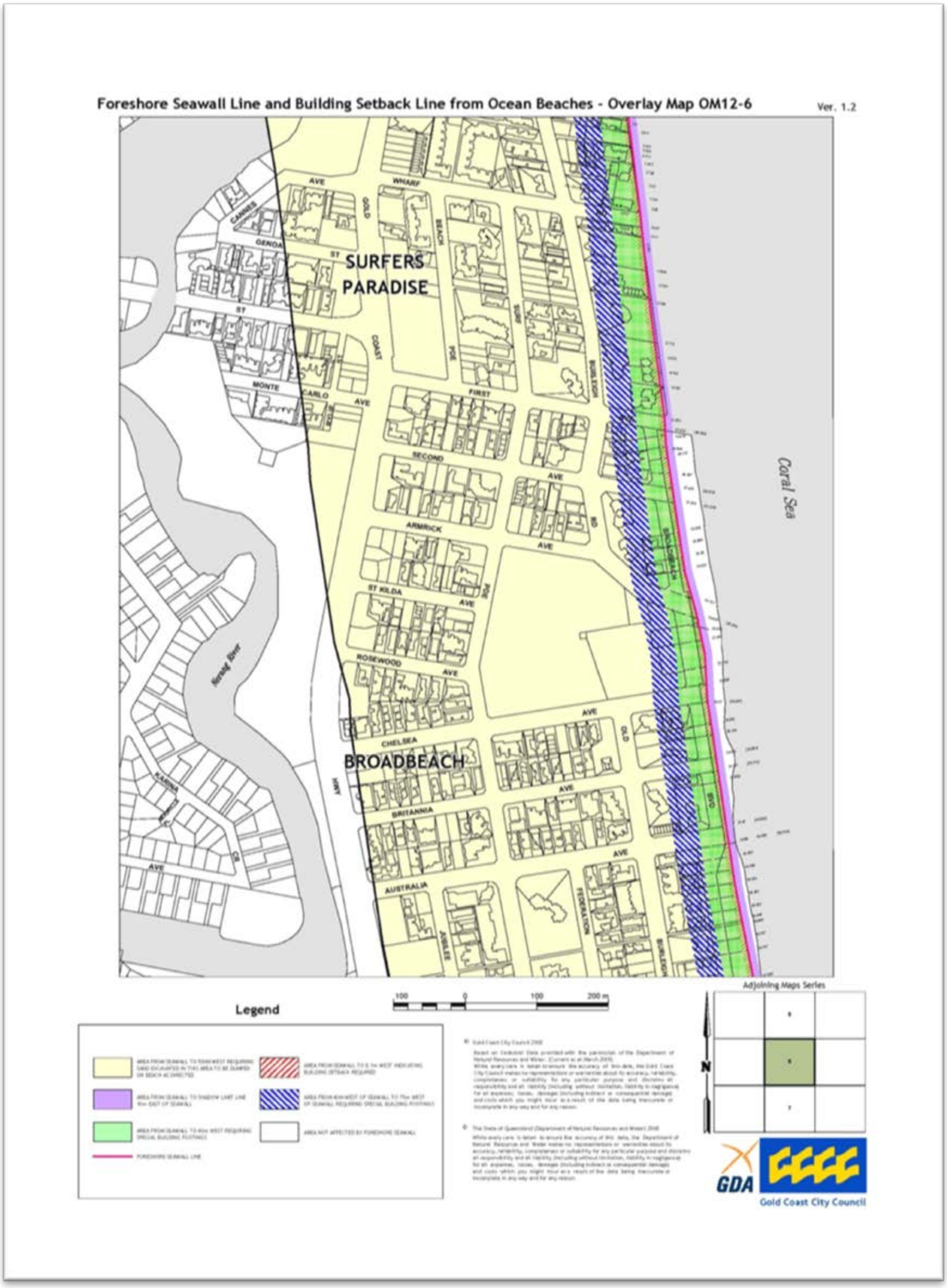


**Figure 11 Foreshore seawall line and building setback line from ocean beaches – OM12-6**

(Source: GCCC)

# 4. Seawall Design and Construction

## 4.1 Materials

Gold Coast seawalls are constructed with large boulders weighing up to 4 tonnes each. The seawall standard was established by the Queensland Government's Coordinator General's Department in consultation with Dutch experts. Seawalls provide some protection for buildings constructed in erosion-prone areas along the beaches.

There are two types of seawalls approved for the Gold Coast A-line seawall (Figure 12). Gold Coast seawalls typically include three layers, including an outer face of boulders supported by rock fill and a filter layer. There are two types of filter layers, one comprising clay/shale and an alternative design using geotextile material.

The Type 1 wall is a clay/shale fill consisting of a mixture of 50% clay and 50% shale and free of organic matter. Type 2 walls incorporate a geotextile material. The geotextile must comply with the following minimum requirements:

- unit weight AS1587 – 1000 g/m$^2$ (min)
- grab tensile strength to AS2001.2.3 – 1000 N (min) in any direction in plane of geotextile
- trapezoidal tear resistance AS01117 – 600 N (min) in any direction
- water permeability (10 cm head) – 30 litres/m$^2$/second (min).

The remainder of the walls consist of rock fill and boulders which will not disintegrate in water. Grading of the materials must be in accordance with the details shown on the drawings. The rock fill and boulders must be clean and free of topsoil and all organic matter. Rock sizes can vary between 90 kg and 360 kg (50% must be over 270 kg). Boulders range between 1.5 tonnes and 4 tonnes (50% must be over 3 tonnes).

## 4.2 Method of Construction

Gold Coast City Council provides the following guidance for the construction of a wall as shown in Figure 13.

6.1 The contractor shall construct foreshore seawalls as detailed on the drawings.

6.2 Type 1 wall incorporating clay/shale shall be constructed as follows:

i) The clay/shale layer from RL 0.60 m AHD to RL 4.9 m (min) AHD shall be installed as a single layer. The layer shall be compacted to ensure stability. The Superintendant shall inspect and certify that the compacted layer complies with the requirements of the specification and the drawings

ii) The rock fill layer from RL 0.00 m AHD to RL 4.9 m (min) AHD shall be installed as a single layer. Rocks shall be laid to ensure maximum interlock. The Superintendant shall inspect and certify that the rock layer complies with the requirements of the specifications and the drawings.

iii) The boulder armour layer from RL 0.00 m AHD to RL 4.9 m (min) AHD shall be installed as a single layer. Boulders shall be laid to ensure maximum interlock. The Superintendant shall inspect and certify that the boulder layer complies with the requirements of the specifications and the drawings.

iv) After certification has been provided for the rock fill layer, sand from the excavation shall be flooded into the voids. Water used for flooding shall be sourced from the nearest Council hydrant stand after paying the appropriate fees.

6.3 Type 2 wall incorporating geotextile material shall be constructed in accordance with the requirements of *Subclause 6.2 ii), iii)* and *iv)* herein.

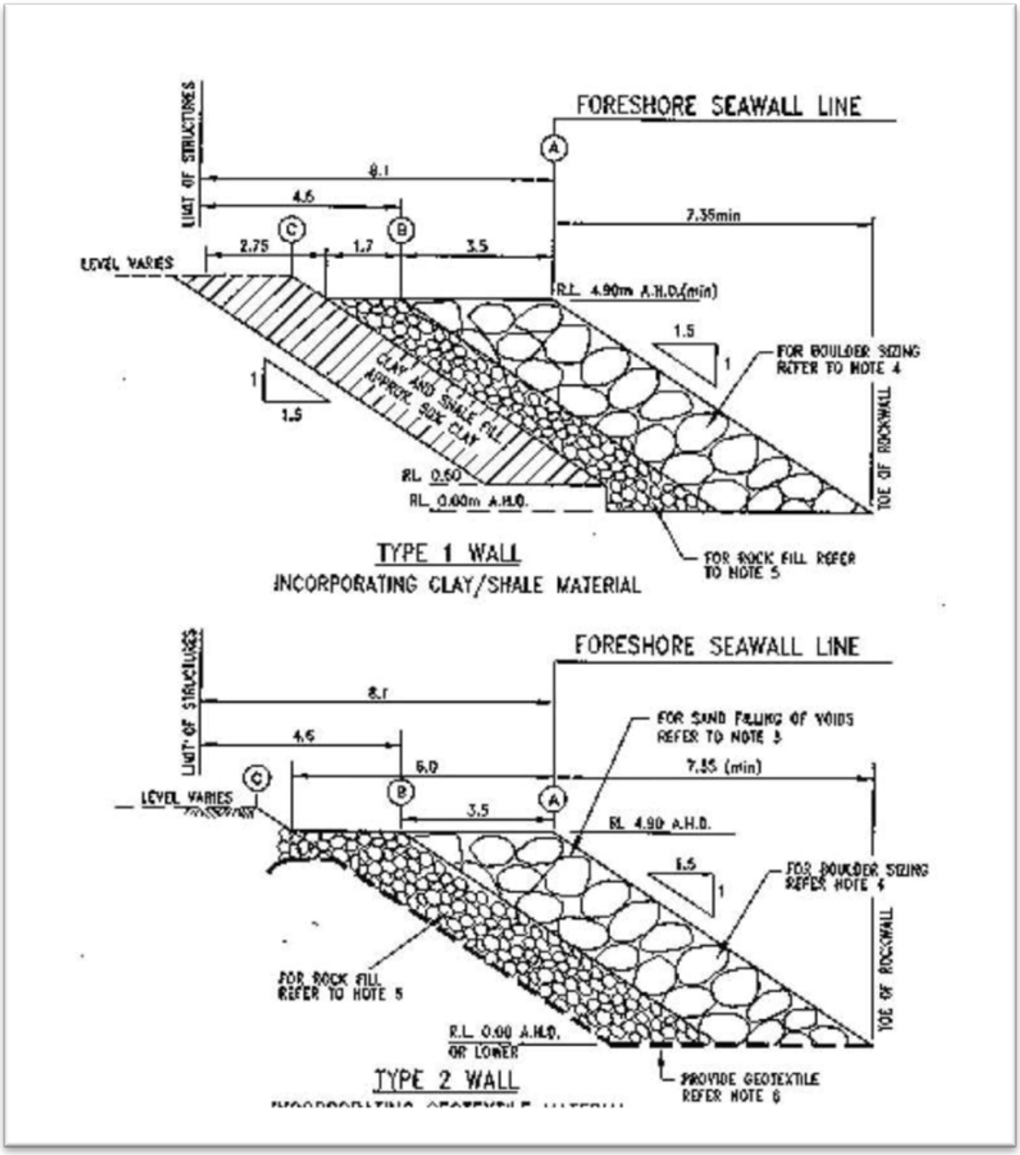


**Figure 12 Type 1 Seawall incorporating clay/shale material and Type 2 seawall incorporating geotextile material**

(Source: GCCC)

All buildings and other structures must be set back 8.1 m (min) from the foreshore seawall A-line to give a 4.6 m (min) flat area clear of all permanent structures, measured from either point B where the level behind the wall is the same as the top of the wall or point C where the level behind the wall is higher.

The Gold Coast seawall is designed to have overtopping which leads to the damage of the ground surface behind the wall during an event. The AHD level of the Gold Coast seawall varies along the coast depending on the ground levels. Beachfront property owners would not want a seawall that came up higher than the natural ground surface. The minimum height for the top of the Gold Coast seawalls is 4.9 m AHD, with some up to 7 m AHD where the sand dunes have been maintained at a higher level.

## 4.3 Maintenance, Upgrade and Ongoing Construction

Maintenance of the seawall is performed infrequently, and mostly involves the placement of extra sand into rock voids which usually occurs after major rain events. This maintenance cost is less than $1000 per annum and can be performed under routine Gold Coast City Council maintenance and funding.

A beach report is completed each week by Council's maintenance supervisor who can identify any problems. Beach and seawall inspections occur more frequently in the aftermath of a coastal event such as a king tide or storm event, or if construction has occurred in the vicinity of the seawall. Since the wall is buried beneath sand, only a visual assessment is performed along the seawall line. Repair work can also be of a reactive nature following a phone call from a member of the public reporting voids. If the seawall is not disturbed by events or construction then it is recommended that conditioning reports are obtained every 10 to 25 years.

Gold Coast City Council would only consider looking at assessing a certified seawall if the toe of the wall was under attack. An assessment of a certified seawall would require undertaking crosscuts of the seawall. However, in the past this was thought to not be required due to historical photographic evidence and the fact that there is a healthy volume of sand on Gold Coast beaches. The current 8.1 m set back allows for a corridor of maintenance, enabling seawalls that have settled at the toe to be topped up with armour rock.

When public seawalls become exposed (Figure 14), Gold Coast City Council maintenance personnel assess and organise the most appropriate means of rectification, which usually involves placing additional sand at the exposed area. If the maintenance supervisor considers that the exposure is major, he will discuss the matter with Engineering Assets and Planning (EAP) (asset owner) staff to discuss the means of rectification and funding.

If damage to the seawall is evident and is considered major, an urgent joint meeting will be held at the scene with maintenance and EAP staff. The means of rectification and funding will be agreed to at this meeting. Factors that would be included in the assessment are type of damage, crest height verification, obvious structural issues and voids. Council also maintains a 600 tonne stockpile of rock at Council's Reedy Creek Quarry to be used for major, urgent repairs to the seawall when required.

The cost of seawall construction varies considerably over years depending on factors such as the availability of machinery and large boulders. As at 2012, and based on a typical cost of $2300 per metre, there is approximately $31.7 million required to construct public and private seawalls and an additional estimated $26 million to upgrade private and public seawalls that do not have a current certificate.

**Figure 13 Construction of a seawall on a Palm Beach street end**
(Source: GCCC)

For public seawalls, approximately $26.2 million is required to construct new seawalls and an additional $21.3 million is required to upgrade seawalls that do not have a current certificate.

For private seawalls, approximately $5.5 million is required to construct new seawalls and up to an additional $4.7 million is required to upgrade seawalls that do not have a current certificate.

**Figure 14 Exposed seawall at Burleigh Beach built to protect the adjacent Justin Park, 2008**
(Source: GCCM)

The actual upgrade cost for existing seawalls that do not have a current certificate may vary from these estimates, depending on the condition of the current seawall and the amount of rock that can be reused.

## 4.4 Responsibilities

Private beachfront property owners are responsible for the construction and maintenance of seawalls that protect buildings on their property. This responsibility is similar to that for the construction and proper maintenance of a range of structures that benefit their land, including driveways, pontoons, retaining walls and revetment walls.

Council is responsible for the management and control of a range of land tenures, including road reserves, park reserves and other types of land tenure. This includes seawalls that protect public urban areas such as public buildings, urban parks, street ends and road reserves. If private structures on public reserves pose a risk to the public then Council has a responsibility to require owners to maintain their structures to an acceptable standard. The underlying ownership for all structures located on State land including all parks and road reserves is with the Queensland State Government. The Gold Coast Planning Scheme maps designate which beachfront property owners are responsible for the construction of a seawall.

Private owners and all other members of the public have free and unrestricted access along public roads and parklands on the Gold Coast. Some areas of parks and foreshores are fenced off to prevent damage to dune vegetation and other sensitive landscapes. Council may install signage and fencing that controls where pedestrians can access reserve areas. Council also has an ability to control where various types of vehicles can travel within road and park reserves.

The construction of seawalls within the Gold Coast City Council jurisdiction is covered by the Council's scheme of works, however following storm events in 2009, Council resolved to address legislative issues and consult about options for beachfront property owners who contribute towards completion of a continuous seawall. When a property owner has a good quality seawall but his/her neighbour does not have a seawall, then there is a risk that future erosion could progress through the neighbour's property and affect their home. Some beachfront owners have expressed a desire for Council to obtain powers to require their neighbouring beachfront property owners to construct seawalls, even if their neighbours are not otherwise investing into their beachfront property. These and other matters of responsibility and potential liability are currently being examined by Council's legal team, with the intent of drafting a local law to empower Council to require owners of land to construct or renew a seawall to the standard required by Council.

# 5. Vulnerability to Climate Extremes and Sea Level Rise

The current status of the seawall was addressed in the Gold Coast Shoreline Management Plan (Griffith Centre for Coastal Management, 2010) as part of a review of beach management strategies and recommendations to ensure Gold Coast beaches could withstand extreme events over the next 50 years. The plan made a high priority recommendation for the completion of the A-line seawall along the whole of the developed coastline. In response to the plan, Council has identified the need for extra investment above and beyond its current beach management budget over the next 15 years to undertake recommended capital works. In a recent assessment (Gold Coast City Council, 2012), the cost of completing the seawall was estimated at around $57 million.

The seawall was, of course, designed without incorporating current sea level rise projections, and to date there has been no specific reassessment of the design of the wall under sea level rise constraints. There has been an assessment, however, of the capacity of the seawall built to certified standard to deal with likely extreme wave events over the next 50 years, in the context of it being part of an integrated management strategy which includes the ongoing nourishment of the beach to maintain an appropriate buffer against storm erosion. Provided adequate beach width is maintained, the seawall can continue to perform its last-line-of-defence function.

If a decision to adapt to projected sea level rise by altering the design of the seawall is made by Gold Coast City Council, the new design would need to be included in the Council's Planning Scheme. This decision would require liaison with the state government as the local council would require the endorsement of the state to make any changes to the local planning scheme. Council would not undertake significant changes to the height and thickness of the seawall without consulting the community first, as this would have implications especially with regard to drainage behind the seawall, loss of views and also the loss of public access to the beach.

# 6. REFERENCES


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