Draft guidelines for assessing the impacts of seawalls

Submissions invited

Comments are invited on this draft. Where concerns are raised, recommended changes to address these concerns would be valued.

Please send your submissions by email to:
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Note on consultation draft

This draft document has been prepared to support the *Coastal Protection and Other Legislation Amendment Act 2010*, which is to commence on 1 January 2011. This Act will amend the *Coastal Protection Act 1979, Environmental Planning and Assessment Act 1979*, the *Local Government Act 1993* and regulations including the Environmental Planning and Assessment Regulation 2000.

The Minister of Planning also intends to amend provisions of the *State Environmental Planning Policy (Infrastructure) 2007* in relation to coastal protection works. These amendments are also intended to commence on 1 January 2011.

This document has been prepared as if these amendments have commenced. For information on the current statutory provisions relating to seawalls, refer to www.legislation.nsw.gov.au.

1 Introduction

The purpose of these guidelines is to advise proponents of seawalls, their consultants and consent authorities on assessing the potential impacts of seawalls along the NSW coastline or at the entrance to a coastal lake. They provide guidance to support consideration of the social, environmental and economic impacts of seawalls.

The guidelines can be used by or on behalf of landowners proposing to construct seawalls under the provisions of *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP). Under clause 129A of this SEPP, development for the purposes of a seawall may be carried out by any person with consent on the coast or at the entrance to a coastal lake.

Under s. 55M of the *Coastal Protection Act 1979,* a consent authority for a seawall development must be satisfied that adequate arrangements have been made to restore a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the seawall. This is in addition to consideration of matters under s. 79C of the *Environmental Planning and Assessment Act 1979*.

Under amendments to the Infrastructure SEPP, consent authorities will also be required to consider matters listed in clause 8 of *State Environmental Planning Policy No 71 – Coastal Protection*. These requirements include the need to consider the likely impacts of coastal processes and coastal hazards on a seawall and any likely impacts of the seawall on coastal processes and coastal hazards.

These guidelines will help proponents and consent authorities to consider and assess the likely impacts from a proposed seawall to meet some of these requirements.

The guidelines can also be used by public authorities considering the use of seawalls to assist with their environmental impact assessment under Part 5 of the *Environmental Planning and Assessment Act 1979*. From 1 January 2011, Clause 228(2)(p) of the Environmental Planning and Assessment Regulation 2000 requires this environmental impact assessment to include considering impacts on coastal processes and coastal hazards, including those under projected climate change conditions.

These guidelines are laid out as follows:

- section 2 – the potential impacts of a seawall
- section 3 – the potential impacts of a seawall on erosion, and guidance on estimating these impacts
- section 4 – the potential impacts of a seawall on ecosystems
- section 5 – considerations for consent authorities in assessing development applications for seawalls.

These guidelines do not advise on the engineering design of seawalls.

2 Potential impacts of seawalls

The potential **physical impacts** of a seawall which should be considered in the impact assessment include:

- altered erosion and accretion seaward of the wall
- altered erosion and accretion along the shore from the wall
- altered recession (a net long-term landward movement of the shoreline caused by a net loss in sediment) and progradation (a net long-term seaward movement of the shoreline caused by a net gain in sediment) along the shore from the wall
- the propensity for the seawall to form rips
- changes to wave run-up
- reduced erosion landward of the seawall.

The potential **social impacts** of a seawall which should be considered in the impact assessment include:

- reduced recreational beach amenity
- reduced public access to beaches
- changes to surfing amenity
- public safety risks from the seawall, including effects of wave overtopping due to smooth and hard structures
- benefits through erosion protection of property located landward of the seawall
- potential benefits through provision of additional, improved or more secure public recreational space landward of the seawall, which could be integrated with recreational facilities, for example, a cycleway.

The potential **environmental impacts** of a seawall which should be considered in the impact assessment include:

- impacts on the foreshore, including dune vegetation
- impacts on inter-tidal ecosystems (see section 4 for details)
- impacts on bird breeding sites.

The potential **economic impacts** of a seawall which should be considered in the impact assessment include:

- changes to property values
- the capital cost from seawall construction and recurrent costs associated with seawall maintenance and managing any off-site erosion impacts
- erosion impacts on adjacent properties
- visual amenity and beach access impacts.

3 Potential erosion impacts

Note: a comprehensive assessment of the potential erosion impacts from seawalls is available in Carley et al 2010, which provides supporting information for these guidelines.

Recommended assessment approach

It is recommended that the assessment approach described in Carley et al 2010 is used for seawalls on the coast. This approach may be modified by an experienced coastal engineer using contemporary techniques and professional judgement. Substantial deviation from this approach may require independent peer review.

Physical impacts are likely to differ between different seawall construction types and slopes (e.g. vertical versus sloping, smooth versus rubble, overtopping versus non-overtopping). This is in part due to different wave absorption and reflection characteristics. As Carley et al 2010 also noted that there is insufficient information to separate these variables, it is recommended that the physical impacts of all seawall types should be evaluated using the same approach.

This method involves estimating additional erosion and recession attributed to the seawall, based on the location of the seawall on the beach. This approach is summarised in Table 1.

Table 1 – Physical assessment summary (from Carley et al 2010)

Position on sandy beach (a)	**Indicative average sand level for open coast (a)**	**Technique for additional erosion close to end of wall – cross shore extent (d)**	**Technique for additional erosion at end of wall – alongshore extent (e)**	**Technique for additional recession – cross shore and alongshore (f)**
Above 100-year average recurrence interval (ARI) run-up level and zone of slope adjustment (ZSA) (b)	> 8 m above mean sea level (MSL) (c)	Not needed	Not needed	Not needed
Between 1-year ARI and 10-year ARI run-up levels and ZSA	4–8 m MSL	Increase by 80%	Lesser of 70% of the length of the seawall or 500 m	Not needed
Between 1-year ARI run-up level and ZSA and intertidal zone	1–4 m MSL	Increase by 80%	Lesser of 70% of the length of the seawall or 500 m	Longshore transport modelling (g)
In intertidal zone or below low water	Below 1 m MSL	Increase by 80%	Lesser of 70% of the length of the seawall or 500 m	Longshore transport modelling

Notes:

(a) Including allowances for erosion, ongoing recession, sea level rise (SLR) recession and SLR over the life of the structure. Values for open coast are indicative only. Individual calculations are needed for more sheltered waterways.

(b) ZSA is Zone of Slope Adjustment (Nielsen et al 1992).

(c) Values are given for mean sea level (MSL) rather than Australian Height Datum (AHD). AHD is approximately present day mean sea level, but future mean sea level will increase with projected sea level rise.

(d) As per work of Gordon 1987 for 'high demand rip heads'.

(e) As per McDougall et al 1987, but limited to 500 m for long walls based on observations (recession calculated separately).

(f) Underlying recession rates need to be determined by photogrammetry prior to undertaking modelling.

(g) Care is needed in operating a shoreline model so the likely range of water levels are incorporated – if the model is operated only at mean sea level, no shoreline recession will be predicted where structures are landward of the mean waterline.

It can be seen that an assessment of additional recession is only required when the structure will be affected by wave run-up more than once a year.

In assessing impacts along the shore, the most critical issue is the range of sand levels along the front of the structure over the seawall's expected life. Average, minimum and maximum sand levels at any proposed structure should be derived from photogrammetry (where possible). Potential minimum values (which are likely to be missed in photogrammetry) should also be derived with erosion modelling or assessment, and adjusted for long-term recession and sea level rise.

In assessing the additional erosion that may result from a seawall, the estimated design erosion volume should be increased by 80% near the wall and increased above the design value for a distance of up to 70% of the length of the seawall along the shore or 500 m, whichever is the lesser.

The design erosion volumes should be calculated from Gordon 1987 and may be reduced along locations without full open coast exposure. On exposed coasts, the Gordon 1987 erosion volumes may be **supplemented by** numerical models. On lower energy coasts, the Gordon 1987 erosion volumes may be **replaced by** numerical models where the models can be calibrated and validated. The design eroded profile should be the Zone of Slope Adjustment from Nielsen et al 1992.

Future recession due to sea level rise should be calculated by appropriate application of the Bruun Rule (see Ranasinghe et al 2007), with the profile truncated at the seawall, or alternatively from the use of shoreline evolution modelling that considers the sensitivity of shorelines to other less certain climate change projections such as changes to predominant wave directions. The sea level rise benchmarks from the NSW Sea Level Rise Policy Statement (DECCW 2009) should be used to provide guidance on projected sea-levels.

Longer term underlying recession, independent of sea level rise, should be derived from photogrammetry covering available dates (Watson and Lord 2001). Typically, upper contours (e.g. 4 m AHD) are a good indicator of long-term recession, but engineering judgement is needed in selecting an appropriate indicator. Sand volume may be the best indicator on coasts which have been mined or have existing seawalls.

For assessing the additional recession that may result from seawalls protruding into the active littoral zone, longshore transport and evolution models should be applied. This application is limited to coasts with a strong net littoral drift, although in general almost all coasts exhibit some form of gross littoral drift, and such modelling may be required to assess these impacts.

Mitigating erosion impacts

There are three broad approaches to mitigating the erosion impacts from seawalls:

- the seawall’s location – erosion impacts decrease with distance from the sea, therefore locating seawalls in the most feasible landward position will reduce erosion, e.g. landward of the 1-year ARI runup level.
- the seawall’s design – seawalls constructed with a vertical face are likely to have more erosion impacts than those with a sloping face. In addition, seawalls constructed from concrete and rocks will normally have more erosion impacts than those made from more flexible materials such as sand-filled geotextile containers
- beach nourishment – this involves placing sand on a beach to replace eroded sand. Sand can be placed directly on the beach or off-shore in a location where it can be washed onto the beach by wave action during non-storm periods.

4 Potential ecosystem impacts

Note: a comprehensive assessment of the potential ecological impacts from seawalls is available in Cardno Ecology Lab 2010, which provides supporting information for these guidelines.

Potential impacts

The nature and extent of impacts of coastal protection works on ecosystems depend on a number of factors including:

- the type of protection work (e.g. seawall, beach nourishment)
- the scale of the work
- the location of the protection work (e.g. estuary, ocean beach)
- the nature of the surrounding environment (e.g. intertidal soft sediments, rocky reef, seagrass, algal beds).

Similar structures can have different impacts depending on their location, and potential impacts may be different if combinations of coastal protection works (i.e. beach nourishment and groynes) are employed. All coastal protection works affect both the natural habitat and local biodiversity. Seawalls can also lead to a loss of habitat on the beaches above higher water level, which can adversely affect a range of animals including invertebrates, turtles and shore birds.

The type of structure built can influence the nature of marine and estuarine communities that develop on it. Evidence suggests that hard artificial structures such as seawalls can facilitate the establishment of exotic and invasive species (Bulleri and Airoldi 2005, Glasby et al 2007, Vaselli et al 2008), although there is little evidence of invasive or pest species in soft habitats created or maintained by methods such as beach nourishment. Seawalls constructed of smooth concrete blocks or dressed stone also have limited potential to provide habitat for marine organisms, although they can be colonised by marine biota normally associated with rocky reefs (and thus biota may be native but not native to this habitat).

Impacts on marine ecology can be considered on two timescales: impacts associated with the construction of the seawall and those associated with maintenance of the structure. Timescales of disturbances are important because they can impact differently on marine and estuarine communities. Typically, impacts during construction are apparent (i.e. arrival of new habitats, disappearance of other habitats, disturbance to mobile species such as fish and birds), but apart from habitat changes, most impacts are temporary. Post-construction impacts such as changes in habitat type are generally considered to be negative and long-term in nature, while intermittent impacts are considered to be largely negative but only temporary (Govarets and Lauwerts 2009). Intermittent impacts due to maintenance may be more subtle in their effects on ecological parameters such as species abundance, diversity and the structure of communities.

Some aspects of habitat change can also have different impacts on different members of marine and estuarine communities. For example, construction of training walls at the entrance of embayments that replace sand habitat required for the nesting of bird species such as little terns can lead to local reductions in population size, while increasing roosting habitats for other shorebirds. Another example might result in the loss of subtidal soft-sediment benthic habitats reducing food for bottom-feeding fish, but increasing the populations of invertebrates that live on hard substrata, therefore providing food for a different type of fish species associated with reef communities.

Impact assessment

To adequately assess the ecological impacts of seawalls, the following minimum information should be acquired:

- the location and nature of the shoreline where the seawall will be constructed, including information on the nature of the land immediately behind and adjacent to the proposed construction (i.e. urban structures, previously reclaimed land, type of substrate).
- the type and extent of the structure/works to be built
- characteristics of the hydrology of the location (i.e. currents, tides, depth, exposure) and any probable cause(s) of erosion
- habitats, communities and species in the vicinity of the proposed works – any requirements under the *Threatened Species Conservation Act 1995* should also be addressed; the area over which sensitive habitats, communities and species should be identified should encompass the area over which altered physical processes have been identified, including those areas that are the source and location of any sediments
- assessment of the impacts of predicted alteration in hydrology including altered patterns of erosion on aquatic habitats such as seagrass, algal beds, unvegetated sediments and rocky reefs
- assessment of possible short, medium and long-term ecological impacts on the coastal environment both during and post-construction and as a result of maintenance activities.

Mitigating impacts

One of the most common consequences of the construction of artificial structures for coastal protection is a reduction of biodiversity. Apart from the loss of the original habitat (i.e. soft sediment), the nature of the materials and construction methods used produce homogeneous structures characterised by smooth surfaces with few features. Such structures have little potential to support a diversity of marine biota. Research shows that biodiversity is greater on structures that provide a variety of habitats, such as crevices, holes and slopes ranging from vertical to horizontal (Chapman and Bulleri 2003). In view of this, mitigation usually involves engineering modifications that provide greater surface complexity to encourage marine growth (Chapman and Blockley 2009, SMCA and DECC 2009). This is likely to be most applicable where wave energy is relatively low, e.g. estuaries.

5 Considerations for consent authorities

Development for the purposes of a seawall may be carried out by any person other than a public authority with consent, pursuant to clause 129A of the Infrastructure SEPP.

When a consent authority is considering a development application for a seawall, they must take into account all statutory requirements, specifically s. 55M of the *Coastal Protection Act 1979*; Part 2(8)(j) of the *State Environmental Planning Policy No 71 – Coastal Protection;* s. 79C of the EP&A Act, and clause 129A(3) of the Infrastructure SEPP.

The consent authority should consider issuing consent conditions relating to maintenance of the seawall and managing any erosion impacts, including securing adequate funding for these actions as well as maintaining public access and ensuring no likely threat to public safety. Such funding may be provided by the council as coastal protection services under s. 496B of the *Local Government Act 1993* (see DECCW 2010 for more information).

The consent authority should consider the specific issues below when setting consent conditions.

Applicable approvals

The consent authority may require the proponent to obtain all applicable approvals to carry out off-site mitigation works (e.g. beach nourishment on Crown land) as part of the development application.

Annual condition survey

The consent authority should consider requiring the proponent to arrange for a coastal engineer to inspect the seawall annually to check its structural integrity, assess if there are any off-site adverse impacts (e.g. beach erosion), identify any risks to public safety and check that reasonable public access to the beach is being maintained. The survey will also recommend remedial actions to correct non-performance.

Seawall management plan

Proponents should include a draft seawall management plan with their development application. Issues to cover in the seawall management plan include:

- actions, resources (cost estimates for each activity, human resources, physical resources) and timeframes required to ensure the structural integrity of the seawall so it continues to meet its design criteria in the most cost effective way.
- all planned activities for short-term, medium-term and long-term maintenance, repair, monitoring, and impact management.
- proposed management responses if any increased erosion of the beach or adjacent land is caused by the presence of the seawall – such responses should include the type of monitoring required to check if erosion is occurring and beach nourishment proposals for managing predicted off-site erosion impacts (including defining the monitoring results that may trigger beach nourishment activities). The source and suitability, e.g. grain size, of sand for beach nourishment should be identified in the draft seawall management plan.

The consent authority would normally require that the draft seawall management plan that is submitted as part of a development application be finalised once the seawall is constructed. The management plan should then be updated annually (to incorporate recommendations from the annual condition survey) and after every major storm if damage or off-site impacts are incurred. The consent authority may consider requiring a more thorough review of the seawall management plan periodically, perhaps every four years.

Decommissioning and funding arrangements

The development application should identify the design life of the seawall and indicate whether decommissioning will be required. Decommissioning includes actions related to the seawall (e.g. removal) as well as actions to rehabilitate the area. The consent authority should consider the adequacy of the planned arrangements for decommissioning the seawall.

Arrangements where multiple landowners are responsible for seawall maintenance and impact management

There may be situations where a seawall is voluntarily constructed by more than one landowner. The proponents should identify in the development application the percentage share, for each landowner, of the total funding for ongoing maintenance and impact management in accordance with s. 55M(3) of the *Coastal Protection Act 1979*. The percentage share could be based on the proportional contributions made by each landowner to the construction costs. The costs could be shared based on the proportion of land frontage, or some other arrangement agreed by the landowners submitting the development application.

Abbreviations

AHD	Australian Height Datum
ARI	Average Recurrence Interval
CP Act	Coastal Protection Act
CZMP	Coastal zone management plan
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
EP&A Act	Environmental Planning and Assessment Act
MSL	Mean Sea Level
SMCA	Sydney Metropolitan Catchment Management Authority
ZSA	Zone of Slope Adjustment

Glossary

Accretion	The onshore movement and deposition of sediment to a beach.
Beach	The area of unconsolidated material between the lowest tidal or lake water level and the highest level reached by wave action.
Beach nourishment	The supply of sediment by mechanical or artificial means to supplement existing sediment or build up an eroded beach.
Erosion	The offshore movement and removal of sediment from the beach.
Groyne	A low wall built perpendicular to a shoreline to trap the longshore movement of sediment along a beach.
Littoral transport	The process in which sediment is moved alongshore as a result wave and current action.
Progradation	A net long-term seaward movement of the shoreline caused by a net gain in sediment.
Recession	A net long-term landward movement of the shoreline caused by a net loss in sediment.
Rip	A concentrated current flowing back out to sea perpendicular to the shoreline.
Seawall	A wall built parallel to the shoreline to limit shoreline recession.
Training wall	A fixed wall constructed at the entrances of estuaries and rivers to maintain open entrance conditions and improve navigability for water vessels.
Wave overtopping	When a wave or wave run-up flows or splashes over the crest of the surface or barrier.
Wave run-up	The vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.

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