Coast Protection Board Policy

Revised October 2022

Government of South Australia

Coast Protection Board

Coast Protection Board Policy Document: Revised October 2022

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1. Policy. 2 Coast. 3 Coast Protection Board. 4 Protection. 5. South Australia

Acknowledgement of Country

The Coast Protection Board acknowledges Aboriginal people as the First Peoples and Nations of the lands and waters we live and work upon and we pay our respects to their Elders past, present and emerging.

We acknowledge and respect the deep spiritual connection and the relationship that Aboriginal and Torres Strait Islander people have to Country.

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Introduction

Vision Statement

The Coast Protection Board recognises that the South Australian coast is one of the State's most valuable assets.

The coastal zone comprises diverse marine, estuarine and terrestrial ecosystems which are subject to great natural change and variability.

The diversity of coastal and marine plants and animals is rich and includes many unique species.

Many special areas need identification and protection.

The Coast Protection Board recognises the need for governments, the community and industry to work together to develop and manage coastal and marine resources sustainably.

The coast is a place of great natural beauty, which is a source of inspiration for many South Australians, and a space for reflection and relaxation.

Coastal waters and much of the land immediately abutting the coast is in public ownership, resulting in a strong tradition of access to the shore. The Board supports the continuation of the high level of public ownership of coastal lands.

The Coast Protection Board seeks to enhance the sense of stewardship that South Australians feel for their coastal and marine areas, by encouraging participation within all spheres of government, local government and the community in the planning and management of our coast.

Coast Protection Act 1972

The Coast Protection Act came into operation in 1972, providing the basis for the creation of the Coast Protection Board.

Duties of the Coast Protection Board

The Board's duties as defined in the Act are:

(a) To protect the coast from erosion, damage, deterioration, pollution and misuse;
(b) To restore any part of the coast which has been subjected to erosion, damage, deterioration, pollution or misuse;
(c) To develop any part of the coast for the purpose of aesthetic improvement, or for the purpose of rendering that part of the coast more appropriate for the use or enjoyment of those who may resort thereto;
(d) To manage, maintain and, where appropriate, develop and improve coast facilities that are vested in, or are under the care, control and management of, the Board;
(e) To report to the Minister upon any matters that the Minister may refer to the Board for advice; and
(f) To carry out research, to cause research to be carried out, or to contribute towards research, into matters relating to the protection, restoration or development of the coast.

Coast Protection Board Membership

The membership of the Board comprises:

- Chief Executive of Department for Environment and Water or nominee;
- Chief Executive of Department for Infrastructure and Transport or nominee;
- Chief Executive of South Australian Tourism Commission or nominee;
- A person with expertise in Local Government;
- A person with expertise in biological sciences and environmental protection; and
- A person with expertise in coast protection.

Definitions of the Coast

The *Coast Protection Act 1972* defines the coast as:

"All land that is:

(a) Within the mean high water mark and the mean low water mark on the seashore at spring tides; or
(b) Above and within one hundred metres of that mean high water mark; or
(c) Below and within three nautical miles of that mean low water mark; or
(d) Within an estuary, inlet, river, creek, bay or lake subject to ebb and flow of the tide; or
(e) Declared by regulation to constitute part of the coast for the purposes of this Act".

"Coastal land", defined by regulation under the *Planning, Development and Infrastructure Act 2016* for planning purposes, means land that is within the Coastal Areas Overlay under the Planning and Design Code. Certain classes of development and activities listed within the Coastal Areas Overlay are referred to the Coast Protection Board for direction.

Within the Coast Protection Board Policy, coastal land is taken to include land (including seabed), seawater, air and biota within the boundaries indicated above.

Key South Australian legislated coastal management responsibilities

The Coast Protection Board works in partnership with various other bodies in undertaking management of the coast, particularly coastal councils. Councils have responsibilities under several pieces of legislation that affect who is responsible for activities affecting the coast. In relation to land tenure and care, control and management of the coast by councils, the following are key South Australian legislation.

Section 18(4) of the *Harbors and Navigation Act 1993* provides that, subject to certain exclusions such as for private land and harbours, adjacent and subjacent land within the area of a council is under the care and control of the council.

Adjacent and subjacent lad are defined in the Harbors and Navigation Act as:

> ***adjacent land*** means—
>
> (a) land extending from the low water mark on the seashore to the nearest road or section boundary, or to a distance of 50 metres from high water mark (whichever is the lesser distance); or
>
> (b) land extending from the edge of any other navigable waterway or body of water in the State to the nearest road or section boundary or for a distance of 50 metres (whichever is the lesser),
>
> (but does not include land vested in fee simple in any person other than the Minister or land withdrawn from the Minister under the transitional provisions);
>
> ***subjacent land*** means land underlying navigable waters within the jurisdiction;

There are large amounts of Crown land along South Australia's coast. Of that, unalienated Crown Land is under the care and control of the state government. Section 18 of the *Crown Land Management Act 2009* allows the Minister to dedicate dedicate unalienated Crown land for a purpose specified in the instrument of dedication.

The Crown land is then under the care, control and management of the body to which the land is dedicated, subject to powers, conditions and responsibilities described in the Crown Land Management Act. Crown land is commonly dedicated to councils for various purposes, including as community land, in accord with the *Local Government Act 1999*.

Coast Protection Board Policy Objectives

The objectives of the Coast Protection Board Policy with regard to the coastal, estuarine and marine areas of South Australia are:

A. *To provide for fair, orderly and ecologically sustainable use and development;*

B. *To conserve the variety of all life forms and to ensure that the productivity, stability and resilience of ecosystems is maintained. Where there are threats of serious or irreversible environmental damage, lack of scientific certainty is not to be used as a reason for postponing measures to prevent environmental degradation;*

C. *To promote the sharing of responsibility for resource management and planning between the different spheres of government, the community and industry in the State; and*

D. *To promote the enhancement of knowledge and expertise for coastal resource management and planning.*

Coast Protection Board Policies

Coast Protection Board policies are grouped into six areas:

1. **Development**
2. **Hazards**
3. **Protection Works**
4. **Conservation**
5. **Heritage and Landscape**
6. **Access**

Development Policy

Coastal developments are of major social and economic value to South Australia. The development of coastal resources for these activities needs to be constrained by the capacity of those resources to meet the foreseeable increasing needs of future generations and social sustainable goals and so that they can be adapted to meet the challenges of a changing climate.

The benefits of competing commercial activities such as recreational access, eco-tourism and aquaculture, need balance through integrated planning. Individual sectoral decisions should not unwittingly foreclose on multiple or sequential use, requiring understanding of each other's needs and proposals.

The interrelationship between management and use of the land and the effects of that use on marine and coastal environments must be factored in to the planning process. Continuing population pressures on the coast and associated development of housing, industry and support infrastructure means coming to grips with these issues. Failure to do so will see the continuing degradation and decline of coastal, marine and estuarine habitats and species and an inability to develop and sustain new and existing marine industries.

Competition for coastal sites for development, together with the fragile and dynamic nature of many coastal ecosystems and increasing impacts from climate change imposes special difficulties in achieving sustainable development. Stewardship of the coast is a particular duty of the Coast Protection Board under the *Coast Protection Act 1972* and this is reflected in the Board's comments on strategic planning documents and development applications.

Development Policy Objectives

The Board's objectives are to:

- Retain coastal open space;
- Minimise impacts of development on the coast;
- Maintain compact coastal settlements and restraining 'sprawl' along the coastline;
- Protect scenic amenity;
- Protect coastal biodiversity;
- Enable planning and delivery of adaptation measures to the foreseeable impacts of climate change on coastal development, environments and uses;
- Minimise or stop development in areas subject to coastal hazards (including coastal flooding, erosion, dune drift and acid sulphate soils);
- Minimise future protection costs by ensuring new development satisfies the Board's flooding and erosion policies; and
- Conserve developed coastal areas for land uses that require a coastal location.

Policy 1.1

The Board will seek:

(a) Integrated coastal management.
[In doing so, it recognises that ecosystem integrity, wealth generation, resource usage and equity policies extend beyond the coast and need to be taken into consideration in coastal management decision making]

(b) To promote a strategic pro-active management of coastal areas.
[In doing so, the Board will involve state agencies, local government and the community in these strategic and regional planning processes, which involve coastal matters.]

(c) The incorporation of its policies into relevant planning instruments under the *Planning, Development and Infrastructure Act 2016*, such as the State Planning Policies for South Australia and the Planning and Design Code.

Policy 1.2

The Board will **direct** planning authorities on individual development applications. The Board's direction will include:
[Certain classes of development and activities listed within Coastal Areas Overlay Coastal Areas Overlay under the Planning and Design Code are referred to the Coast Protection Board for direction.]

(a) An assessment of hazard exposure and any hazard strategies provided by the developer for compliance with the Board's Hazard Policies.

(b) An assessment of the potential coastal impacts of the development on;
- Ecological processes;
- Physical processes;
- The environment;
- The visual amenity, and
- Public open space.

Policy 1.3[i]

The Board will identify specific areas of the coast that require particular management actions.
[In doing so, it shall have regard to coastal flooding and erosion, dune drift, acid sulfate soils, areas of conservation significance and landscape amenity values. The Guidelines relating to Flooding and Erosion and Acid Sulfate Soil are contained in Appendix 1 and 2, respectively of this Policy Document.]

Policy 1.4

The Board will **seek** to:

(a) Have areas identified as requiring particular coastal management action, included in relevant Overlays, Zones or Subzones under the Planning and Design Code.

(b) Minimise the exposure of new and existing development to risk of damage from coastal hazards and risks to development on the coast.
[This will be achieved by assisting/working with appropriate groups and agencies to prepare protection strategies. These strategies will include monitoring guidelines and remedial strategies for development in these areas.]

(c) Ensure development avoids or minimises the impact on areas that may be required for climate change adaptation, including blue carbon ecosystems[1].

(d) Minimise the impact of stormwater discharge to the coast and nearshore waters.
[Stormwater should preferably be directed to wetlands or when appropriate to natural drainage channels.]

(e) Have adequate buffer distances between development and the coast.

(f) Ensure that the siting and design of development on the coast minimises its impact on the environment, heritage and visual amenity of the coast.
[In doing so the Board will have regards to areas of important visual significance, built heritage and aboriginal sites of significance.]

(g) Minimise development on public land.
[In doing so, the Board will recognise the need for public facilities on the coast, for which a lower hazard risk standard may be acceptable for such facilities, providing the applicant is aware of and accepts the risk.]

[1] Blue carbon ecosystems are coastal ecosystems – mangroves, saltmarsh and seagrass meadows that capture and store carbon.

Policy 1.5[ii]

The Coast Protection Board opposes:

(a) Linear or scattered coastal development, with the exception of tourist accommodation development or that which has a significant public or environmental benefit. The Board prefers development to be concentrated within existing developed areas or appropriately chosen nodes

(b) Development, including land division, which is subject to coastal hazards or will impact on areas of significance.

(c) Development in sand dunes, wetlands, coastal estuaries and marine vegetation.

[In doing so the Board will, however, have regard for development that provides coastal protection or has a significant public or environmental benefit.]

(d) Land division that increases the number of allotments abutting the coast, except where the subdivision is an orderly development of existing developed areas or concentrated into appropriately chosen nodes.

(e) Aquaculture development, particularly finfish culture, over sensitive habitats, such as seagrass and algal communities.

[In doing so the Board will have regards to the extent of the sea grass beds, potential for de-stabilisation of the sea bed from the development, impacts of fish food and fish excrement on sea grasses, coastal processes, etc.]

(f) Works which significantly affect coastal processes unless:

- A binding management plan is in place, which prevents unacceptable effects on the coast
- The works are designed to modify coastal processes with a demonstrable net improvement in the protection of the coast, or
- Compliance with Section 3 - Protection Policies, can be demonstrated.

(g) Unauthorised development on the coast that does not comply with the Board's policies.

[The Board will seek the removal of such development. In doing so the Board will have particular regard to coast protection works, development in sensitive coastal areas and areas at risk from coastal hazards.] [iii]



Policy 1.6[iv]

The Coast Protection Board *may* support development, including tourist accommodation or that which has a significant public or environmental benefit, in coastal areas outside of urban areas provided:

- It is sited and designed in a manner that is subservient to important natural values within the coastal environment;
- It is not subject to unaddressed coastal hazards;
- Adverse impacts on natural features, landscapes, habitats, threatened species and cultural assets are avoided or minimised; and
- It will not significantly impact on the amenity of scenic coastal vistas.

[Guidelines for proposed coastal development outside of urban areas are contained in Appendix 3 of this Policy Document.]

Policy 1.7[v]

Proposed boat ramps (or modifications) should:

- Minimise interruption to natural coastal processes;
- Avoid or minimise impacts on the environment, amenity and public access along the coast; and
- Only be provided where there is a demonstrated need in the public interest.

Boat ramps should not be located:

- Where public boat ramp facilities are already available in the locality;
- Where coastal processes may render the ramp practically unusable and or prohibitively expensive to maintain (e.g. via changes in beach levels, accumulation of beach-cast wrack[2], etc.)
- In locations that will require high levels of ongoing maintenance;
- Where it is likely the facility will cause unacceptable coastal impacts on adjoining property or foreshore (e.g. erosion, amenity implications etc.); and
- In, or adjacent, areas of high cultural significance or environmental value.

[*Assessment guidelines for proposed boat ramp facilities or modifications are contained in Appendix 4 of this Policy Document*.]

[2] Beach-cast wrack is the accumulation of organic material, such as seagrass and algae that is washed onto the beach by natural processes. Further information on beach-cast wrack and its ecological importance can be found in Coastline Factsheet 38 (March 2017), an initiative of the Coast Protection Board.

Hazard Policy

Coastal flooding, erosion and sand drift are natural features of the dynamic coastal environment whereby beaches erode, prograde or are in dynamic equilibrium, cliffs erode and low lying land is periodically flooded during storm surge events.

Such phenomena become hazards where life or development is placed at risk. In some locations the public may be placed at risk by un-managed access to dangerous or unstable cliffs. Often development has been located in coastal areas which were considered safe at the time, but which later were revealed to be at risk from extreme events or changing coastal dynamics. The level of risk in many instances will change over time, due to global sea level rise or local relative sea level change, or from a local long -term erosive trend.

The Coast Protection Board accepts that mean global sea level has been rising over recent decades at a global average rate of approximately 3.4 mm per year[3].

The Inter-governmental Panel on Climate Change (IPCC) has modelled global climate and climate influences and produced scenarios of accelerated sea level rise. This predicted rise in sea level is due to global warming consequent upon the accumulation of Greenhouse gas emissions in the atmosphere, (these assessments have been frequently updated, with reports released in 1991, 1996, 2001, 2007 and 2014).

The Board believes it has taken the best advice available (Coast Protection Board sub-committee on Mean Sea Level 1989 to 1993 and Sea Level Rise Advisory Committee 2009-2011) in resolving to base the sea level rise aspects of its hazards policy on the IPCC sea level rise projections.

In its most recent 6th assessment, the IPCC has laid emphasis on increased magnitude and frequency of extreme events, including storm surge, as part of the climate change scenario, and that "…sea level is committed to rise for centuries to millennia due to continuing deep-ocean warming and ice-sheet melt and will remain elevated for thousands of years (high confidence)."[4]

Furthermore, in its *Climate Change 2022: Impacts, Adaptation and Vulnerability* report, the IPCC states: "Climate change risks to cities, settlements and key infrastructure will rise rapidly in the mid- and long-term with further global warming, especially in places already exposed to high temperatures, along coastlines, or with high vulnerabilities (*high confidence*). Globally, population change in low-lying cities and settlements will lead to approximately a billion people projected to be at risk from coastal-specific climate hazards in the mid-term under all scenarios, including in Small Islands (*high confidence*). The population potentially exposed to a 100-year coastal flood is projected to increase by about 20% if global mean sea level rises by 0.15 m relative to 2020 levels; this exposed population doubles at a 0.75 m rise in mean sea level and triples at 1.4 m without population change and additional adaptation (*medium confidence*)."[5]

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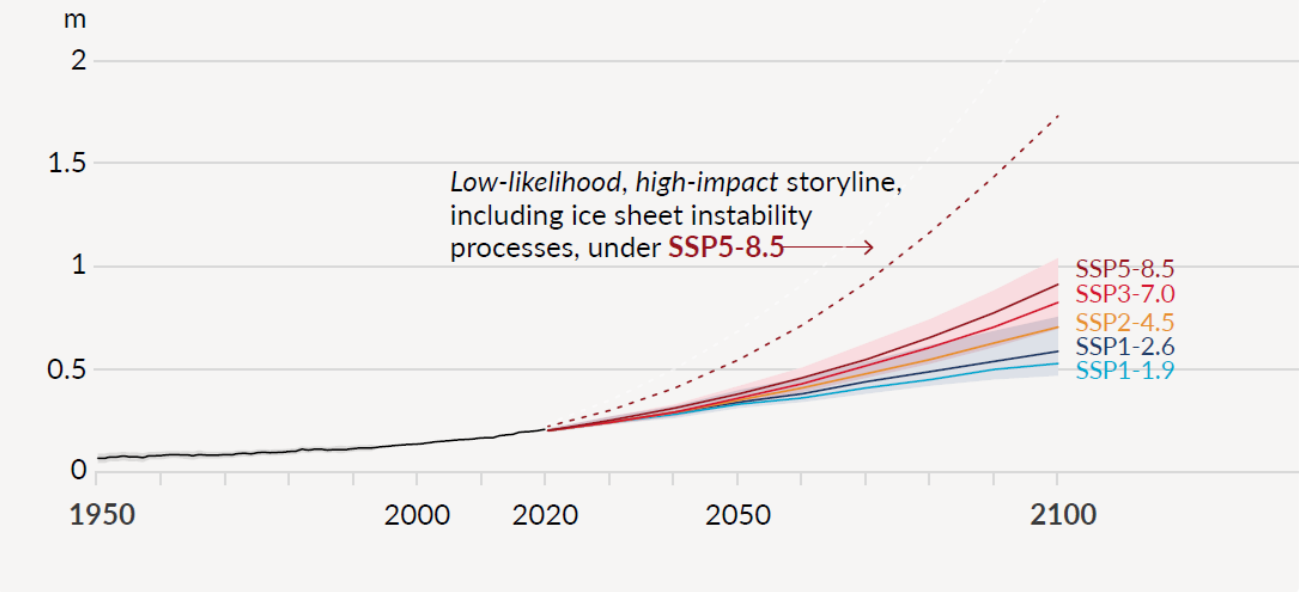
[3] NASA Sea Level Change Portal, accessed 26 September 2022.
[4] IPCC 2021: Intergovernmental Panel on Climate Change 2021, *Climate Change 2021 The Physical Science Basis: Summary for Policymakers*,
https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf
[5] IPCC 2022: Intergovernmental Panel on Climate Change 2022, *Climate Change 2022 Impacts, Adaptation and Vulnerability: Summary for Policymakers*,
https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf



Global mean sea level change: historical and projected changes in global sea level, low and high emissions scenarios. The dashed curve indicates the potential impact of deeply uncertain processes – the 83rd percentile of very high emissions scenario projections that include low-likelihood, high-impact ice sheet processes that cannot be ruled out. Because of low confidence in projections of these processes, this curve does not constitute part of a likely range. (Source: IPCC 2021).

In order to recognise this situation and to minimise future risks to developments proposed now, the Board has developed policy and standards, which apply to new development. State and local governments have endorsed the Board's standards and policy. The policy shows the intent of the Board; the standards apply to site specific locations and site levels of development proposals. The standards are detailed in Appendix 1 of this policy document. These standards may need to be adjusted from time to time, as knowledge of accelerated global sea level rise improves. The standards were written into the Development Plan, through the Regional Coastal Areas Policies Amendment, by the Minister, 1994. Specific application of the flooding standards on a town by town basis is applied via a Technical Numeric Variation under the Planning and Design Code, which will require periodical review.

Policy 2.1 [vi]

The Board will **formulate** hazard standards for the state of South Australia with reference to:

- Risk management approaches to hazard management using the Inter-governmental Panel on Climate Change's recommendations to policy makers; and
- Commonwealth recommended approach to management of Coastal Acid Sulfate Soils.

[In doing so the Board shall seek to have these standards widely disseminated and referred to by State Policy, Planning Instruments under the Planning, Development and Infrastructure Act 2016 and Coastal Management Plans.

The Guidelines relating to Flooding and Erosion and Acid Sulphate Soil are contained in Appendix 1 and 2, respectively of this Policy Document.]

Policy 2.2 [vi]

The Board will **facilitate**;

(a) The use of strategic and legally enforceable agreements to manage the risk of damage from coastal hazards on development.

(b) A program of vulnerability assessment to ensure that sufficient coastal buffer zones are provided for predicted physical processes and to accommodate public infrastructure, use and access.
[In doing so the Board shall have regard to the identification of Coastal Acid Sulfate Soil areas.

In relation to coastal flooding, erosion and sand drift a planning period of 100-years will be applied for small development and a 200-years for new significant development, e.g. power stations.]

Policy 2.3 [vi]

The Board will **advise** on development proposals within coastal areas.
[The standards to be applied to Flooding and Erosion and Acid Sulfate Soil are contained in Appendix 1 and 2, respectively of this Policy Document.

The coastal erosion potential, storm surge likelihood, land subsidence and sea level change, including sea level incorporate scenarios set by the Intergovernmental Panel for Climate Change. Protection standards will be based on hazard events with a 1% Annual Exceedance Probability (AEP), and design periods of 50 years for minor development, 100 years for strategic planning in existing settled areas and 200 years for new settlements.

Development in areas identified as being at risk from CASS, the Board shall seek the following information before providing advice to the relevant planning authority:

- *Specific site and water table levels, relative to Australian Height Datum (AHD);*
- *Soil and water sampling and analyses to determine presence of coastal acid sulfate soils contamination; and*
- *Where CASS are confirmed seek additional information on remedial strategies to minimise surface and ground water contamination, and a management plan for ongoing monitoring and best-practice management of the area.]*

Policy 2.4

The Board will **assist** with identifying public risk areas along the coast:
[In doing so the Board will have regards to:

- *Unstable cliffs;*
- *Areas subject to storm inundation; and*
- *Areas at risk from short to medium to long term erosive trends, including areas vulnerable to erosion in the event that near shore seagrass meadows are damaged.]*

Protection Works Policy

One of the Board's duties, as set out in the *Coast Protection Act 1972*, is to protect the coast from erosion, damage, deterioration, pollution and misuse. If read out of context, this suggests a greater responsibility and funding role than in fact applies. These duties, and especially the coast protection one, are mostly carried out jointly with and through Local Councils, and the Act provides for the Board to make grants to assist Councils in this. It also provides for the Board to carry out works and recover a portion of the cost from a Council.

Protection against flooding and erosion is usually carried out to remedy the consequences of past planning, through the building of protective structures, such as seawalls, or through schemes of beach nourishment. It is also used to protect redevelopment where relinquishing a development site is impractical or uneconomical.

Most coast protection works are carried out by Councils or privately. With the exception of re-nourishing the Adelaide beaches, the Board provides Councils with grants of up to 80% of the cost of approved coast protection works and up to the same amount for storm damage repairs.
The State Government has assumed full responsibility for funding beach re-nourishment at Adelaide. This was necessary because several sea front Councils benefit to varying degrees, because the cost and benefits cannot be apportioned, and because of the large scale of the projects and the co-ordination required. Nourishment for purely recreational purposes attracts a lower grant level, if funded at all.

The Board's interpretation is that its funding is intended for situations that have arisen because of some previous mistake or lack of understanding about coastal processes. It does not consider that State Government funds should be available for protection of new development approved unwisely and against the Board or Department's advice. The Board considers it beneficial to retain the nexus between authority for approving coastal development (usually with Councils) and responsibility for the consequences of decisions made.

The Board requires that any protection works, towards which it provides a grant, have outcomes that benefit the general public, such as maintenance of public accesses along the coast.
The policy not to protect private property was affirmed by State Government in 1980, and has been applied since then. Although there will be exceptions, as noted in the policy, there can be little justification for the State to act as a free insurer of seafront property - to do so would encourage inappropriate development and unreasonable public expectations.

Policy 3.1

The Board will **encourage** the maintenance of adequate beach levels, both to prevent storm damage and to provide adequate beach recreation space.

Policy 3.2

The Coast Protection Board **will not oppose** the construction of beach and near-shore structures (such as seawalls, groynes and breakwaters) where:

(a) There is a demonstrated need in the public interest; and/or

(b) A comprehensive investigation to an appropriate standard has been carried out, and it can be demonstrated that on balance:
- There will be no unacceptable impacts on natural physical processes or ecosystems; and
- There will be no increase in coastal flooding or erosion hazard to neighbouring property or foreshore.

Policy 3.3

The Board **will provide grants** to Local Councils toward approved coast protection works in accordance with the *Coast Protection Act 1972*.

[In doing so, the Board will take into consideration state wide priorities and the availability of funds within the Coast Protection Fund. The grant shall not exceed 80% of the total cost of the works.]

Policy 3.4

The Board **will not provide funds** or grants for:

(a) The protection of private property unless;
- There is an associated public benefit;
- There is simultaneous protection of public property;
- A large number of separately owned properties are at risk, or
- Where the cause cannot be easily identified

(b) Outlets or other works associated with stormwater drainage.

(c) Protection of coastal property and installations owned by other Government agencies.
[Where Government installations (e.g. ports or drainage outlets) adversely affect the coast, such as by interrupting alongshore sediment movement, the agency responsible will be expected to arrange and fund remedial measures, such as sand bypassing.]

(d) Boat ramp facilities, including upgrades, maintenance, protection, removal and works such as sand bypassing.

Conservation Policy

South Australia's temperate seas and coastal environments contain many unique species of plants and animals on the land, within the ocean and the sheltered environments in the two gulfs. Further detailed knowledge of these environments is needed, but it is clear that marine biodiversity is an important heritage and resource for the state.

South Australia has few large rivers and estuaries. The distinctive environments of the estuaries make them significant, particularly to numbers of fish species. Important coastal wetlands are found within and adjacent to the estuaries, most notably the Murray Mouth and the Coorong. Pressures on the estuaries, particularly from land based discharges and water use, make the conservation of these areas a high priority.

The interface between sea and land is a very active area, rich in plants and animals, both marine and terrestrial and is an important breeding ground for many species. Such a biologically diverse environment is important in sustaining the biological resource base. Areas of conservation significance should be protected from development and zoned accordingly. If necessary, the conservation effectiveness of coastal areas can be enhanced by linking them to other natural environments with linear parks.

South Australia is fortunate that many significant terrestrial coastal areas and near-shore islands are within the state's Parks system or Crown reserves. Nevertheless work remains in ensuring that significant coastal heath, samphire (salt-flats) and mangroves are properly represented within the protected area system. While beaches and dunes are common in South Australia (59% of the shoreline length) their fragile nature makes them an issue of concern.

Within the terrestrial parts of the coastal zone, the area and shape of allotments can be important for facilitating the management of environmentally sensitive areas and minimising the impact of development on the coastal environment.

The coast is continually at risk of being damaged by pollution as it is at the receiving end of land drainage systems. Experience has shown that this poses a significant risk to estuarine and marine life and resources. Wetlands, which are often found behind sand dunes, and tidal flats not only provide a rich wildlife habitat, but are known to be a valuable natural treatment area for many pollutants carried by rivers. However, their capacity to treat pollutant loads is limited. Excess nutrient loads can damage or alter the ecosystem.

Coastal ecosystems are also important for mitigating the impacts of climate change. The carbon captured and stored in coastal ecosystems such as seagrass meadows, saltmarshes and mangroves is known as 'Blue Carbon'. Globally, blue carbon ecosystems play a key role in reducing greenhouse gas emissions, and are recognised as a nature-based solution for countries to help meet climate change commitments under the Paris Agreement. Blue carbon ecosystems can store up to four times as much carbon per area as land-based forests and, if undisturbed, can store carbon in soils over hundreds or thousands of years. The carbon stored within Australian blue carbon ecosystems constitutes around 11% of worldwide blue carbon stocks (Blue Carbon Strategy for South Australia 2020-2025).

Blue carbon ecosystems are being lost and degraded by human activities such as aquaculture, agriculture, recreational activities, pollution and industrial and urban development. As these areas are lost or degraded, the carbon stores are released as CO_2 into the atmosphere and/or ocean. Therefore, it is essential that the existing blue carbon ecosystems are protected, enhanced, conserved and restored where possible, or created in appropriate locations.

Policy 4.1

The Board will **instigate and/or participate** in the;

(a) Conservation of the diversity of plant, animal and marine species within coastal areas.

(b) Investigations into the impacts of development on coastal, marine and estuarine environments.
[In doing so the Board will seek to improve and build capacity for such investigations. But the Board's actions will not relieve the responsibility of developers in this regard.]

Policy 4.2 [vii]

The Board will **seek to**;

(a) Identify, protect and manage coastal environments with high conservation values.
[In doing so the Board will have regard to coastal environments including coastal dunes and heaths, samphires (salt-flats), mangroves, reefs, algal forests, seagrass meadows, estuaries, threatened and/or endangered native plants and animals and shore bird habitat.]

(b) Conserve and protect blue carbon ecosystems[6] and support the enhancement, restoration and creation of blue carbon ecosystems.
[In doing so the Board will have regard to the 'appropriateness' of restoration and creation projects, recognising that some stranded systems will have important ecological values that should not be disturbed and it is not always possible or appropriate to restore ecosystems to pre-existing conditions.]

(c) Acquire land, where it is necessary to ensure protection of areas of high conservation value.
[In doing so the Board will consider the land management actions necessary to protect and conserve the environmental values and will consider ongoing land management arrangements, which preferably will be undertaken by others.]

Policy 4.3

The Board will provide grants to Local Councils towards approved conservation projects that comply with these policies and the *Coast Protection Act 1972*.
[In doing so the Board shall have regard to overall state wide priorities and the availability of funds. The grant will not exceed 80% of the total cost of the project.]

[6] Blue carbon ecosystems are coastal ecosystems – mangroves, saltmarsh and seagrass meadows that capture and store carbon.

Heritage and Landscape Policy

The coastal areas of the State are important for their landscape and heritage values. Many significant landscapes and sites are recognised through reserve status; many others have less secure or specific recognition within the principles and objectives of the Development Plan or within the Register of the National Estate. The intrinsic attractions of coastal areas include aesthetic qualities, which are significant both to tourism and recreation, as well as providing a sense of identity and well-being for local people. The economic opportunities and the social values of South Australian coastal landscapes in part depend upon its diversity of natural and semi-natural landscapes.

Maintaining this richness of diversity poses a challenge in setting priorities for the development of the state's terrestrial, estuarine and marine coastal areas. For this reason, the Coast Protection Board seeks to establish a statewide assessment of coastal landscape quality. Marine and terrestrial coastal areas are rich in cultural and heritage significance and many groups are involved in identifying and protecting these sites. The Coast Protection Board has a role in working with groups to ensure that sites remain to be appreciated and understood by present and future generations.

Policy 5.1[viii]

The Board will **facilitate and support** the identification, recognition and protection of coastal areas with a:

- Significant landscape value;
- Marine archaeological heritage;
- Cultural significance; and
- Scientific significance.

[In doing so the Board will attempt to have such areas recognised in the Council's Development Plans and in other plans, where appropriate. In this process the Board will have regards to the standards and principles contained within "The "Natural heritage Charter" and "The Burra Charter".]

Policy 5.2

The Board **opposes** development that:

(a) Has a significant visual impact on coastlines with significant landscape value.

[In doing so the Board will have regard to both the visual impact from the land and the sea.]

(b) Results in the disturbance or devaluation of sites of:

- Marine archaeological heritage;
- Cultural significance; and
- Scientific significance.

Policy 5.3

The Board **recognises** the rights and needs of Aboriginal peoples and will encourage Aboriginal input into decisions affecting sites of Aboriginal significance and native title.
[In doing so the Board will have regard to the Commonwealth Native Title Act 1993.*]*

Policy 5.4

The Board will **seek to** acquire land, where it is necessary to ensure protection of areas of:

- Significant landscape value;
- Marine archaeological heritage;
- Cultural significance; and
- Scientific significance.

[In doing so the Board will consider actions necessary to protect and conserve the heritage and landscape values and will consider ongoing land management arrangements, which preferably will be undertaken by others.]

Policy 5.5[ix]

The Board will provide grants to Local Councils towards approved heritage and landscape projects that comply with these policies and the *Coast Protection Act 1972*.
[In doing so the Board shall have regard to overall state wide priorities and the availability of funds. The grant will not exceed 80% of the total cost of the project.]

Access Policy

South Australia is fortunate because early surveyors reserved much of the coastline for public use and the majority of these reserves remain today, despite ongoing coastal erosion.

Coastal visits for recreation far exceed the attendances at any other organised sporting activities. Coastal pedestrian and vehicular access is needed for a variety of reasons including walking, diving, swimming, recreational and commercial fishing, sightseeing, boating, aquaculture, and tourist ventures. In the past this demand was most evident near towns and cities, however, in later times with improved vehicles and increased leisure time, beach access demand has spread to the remotest parts of the coast.

It is important that the right of access is maintained, but it is also important that access is managed to minimise impact.

South Australia has some very sensitive portions of coast such as intertidal reefs, islands, estuaries, wetlands, dunes, and cliffs. Access management and/or control is one of the most important instruments for management of these areas. Uncontrolled pedestrian or vehicle access may not only physically degrade many landforms, but often results in the introduction of pest plants and animals.

Roads constructed along and parallel to the coast, to maximise access to coastal facilities, usually encourages ribbon development. Ribbon development tends to result in serious deterioration of the coastal reserve and detracts from the visual quality of the coast.

Access Policy

Policy 6.1

The Board will encourage and support:

(a) Environmentally sustainable access to the coast.

[In doing so the Board will take into consideration:

- *The ability of the particular landform to cater for uses without undue adverse environmental effects;*
- *Preference to public use over private use;*
- *Preference will be given to those uses which by their nature, need to be located close to the coast, and*
- *Public safety.]*

(b) Rationalisation of existing and planned roads that provides nodal access to the coast.

[In doing so the Board will discourage roads that run parallel to the coast.]

Policy 6.2

The Board opposes:

(a) Vehicular access to beaches.

[In doing so the Board acknowledges that vehicle access to the beach is required for certain recreational and commercial activities. Balancing public uses to ensure they are managed wisely, safely and in a manner that minimises environmental impacts to the beaches.]

(b) New development that restricts or limits existing public access to the coast.

[In doing so the Board acknowledges that certain developments by their very nature limit public access, in such circumstances attempts will be made to ensure the best outcomes for the public.]

Policy 6.3

The Board will provide grants to Local Councils towards approved access projects that comply with these policies and the *Coast Protection Act 1972*.

[In doing so the Board shall have regard to overall state wide priorities and the availability of funds. The grant will not exceed 80% of the total cost of the project.]

Appendix 1 - Standards Applying to New Development with Regard to Coastal Flooding and Erosion and Associated Protection Works[7]

Endorsed by the Coast Protection Board on 22 May 2012

[NOTE: Detailed standards on coastal erosion and flooding hazard follow below. Presently such standards are largely written into the Planning and Design Code under the Planning, Development and Infrastructure Act 2016. The Coast Protection Act 1972 does not directly provide for the enforcement of these or other standards within the coastal zone].

On the evidence, the Board is satisfied that global sea level is presently rising at a rate of approximately 3.4mm/year - local rates differ because of local land subsidence or uplift. It is accepting that there will be a global warming due to increases in greenhouse gases and that this will result in more rapid rise in sea level. On the basis of the IPCC projections the Board is recommending that a mid-range sea level rise of 0.3m by the year 2050 be adopted for most coastal planning and design. It should be noted that the 0.3m figure includes continuation of the present rate of rise and is not additional to it.

While sea level rise due to climate change is likely to continue beyond 2050, projections for the following 50 years to 2100 are less certain. The Board has adopted a 1m rise to 2100 for coastal policy, in the sense that this will only be applied for development, which could not reasonably be protected against this greater rise.

The Board is of the view that in most coastal flooding applications the 1% Annual Exceedance Probability (AEP)[8] standard, equivalent to the 100-year average recurrence interval (ARI), is appropriate.

Coastal flooding may be either directly due to a storm tide or by a combination of this with stormwater backed up by the tide. It will therefore sometimes be appropriate to consider the coincidence of tidal and rainfall events and to estimate the combined water level probability.

Coastal erosion around the South Australian coast is, in many places, quite significant in planning time frames resulting in significant coastal recession.

Accelerated sea level rise will generally cause an increase in the rate of recession, though would interact with local coastal processes in quite complex ways.

The recession/erosion standards are similar to the flooding ones in that they require development to be safe from the effects of a 0.3m sea level rise and to be capable of being protected against additional recession due to a further 0.7m of rise.

[7] This appendix is largely taken from the 'Hazard Risk' section of the previous policy document. These standards were the subject of considerable expert discussion and public consultation in the period 1991 – 2000 and revision was not seen as appropriate at this stage.
[8] The 1% AEP water level is a level with a 1% probability of being exceeded in a year.

The following standards apply:

S1 Site and Building Levels.

Except as set out in standard S2 and elsewhere in this document, development should not be approved where building sites are lower than a height determined by adding 0.3m to the 1% AEP water level and making a local adjustment (if appropriate) for land subsidence or uplift to the year 2050. For commercial or habitable buildings, floor levels should be no less than 0.25m above this minimum site level. Development should not be approved unless it is capable, by reasonably practical means, of being protected or raised to withstand a further 0.7m of sea level rise.

For residential development within existing low-lying vulnerable settlements, elevated floor levels may be considered as an alternative option to raising site levels provided adjacent land and buildings are uniformly low lying, and where the integrity of adjacent land and buildings will be not be compromised if the site of the development is inundated (e.g. by scouring as a result of site inundation). This may include such settlements as Cowleds Landing, Chinaman Wells, and Foul Bay.

Furthermore, elevated floor levels may be considered as an alternative to raising site levels provided the following criteria is met:

- The finished floor level is no lower than a height determined by adding 1.25m to the 1% AEP water level and making adjustment (if appropriate) for land subsidence or uplift to the year 2050;
- Underside areas are not enclosed (to allow for the potential flow through of water whilst supporting the house above); and
- Service facilities vulnerable to flooding are raised above the finished floor level (i.e. electrical power outlets, switchboards, hot water systems, air conditioning units, water pumps etc).

The application of this alternative option (i.e. raising floor levels only) recognises that such existing settlements are perhaps in inappropriate locations in regards to coastal hazards, and that elevated floor levels do not alleviate long term coastal hazard risks, nor does it lessen the requirement for whole of settlement coastal hazard adaptation strategies.

New settlement should either avoid such hazards or address the more substantial site and floor level protection requirements by the other standards.

The 1% AEP extreme water level should be based on the best information available, usually recorded extremes from the closest tide gauges. It should take into account site specific factors such as wave set-up and run-up and stormwater heights during extreme tides. Similarly the best available information should be used for predicting land subsidence or uplift.

S2 Flood Protected site and building levels.

Where flood protection measures exist or are to be provided as part of a development, building sites should be no lower than the design flood level within the development taking into account the mitigating effect of the protection measures. Floor levels should be at least 0.25m above this level. The design flood level is to be determined taking into account 0.3m of sea level rise and, depending on the situation, either the 1% AEP extreme tide in adjacent coastal waters together with stormwater and wave effects within the development or the 1% AEP stormwater event with due allowance for the effect of tidal surge on this.

Development which depends on measures such as levee banks, flood gates, valves, or stormwater pumping will need to demonstrate that there is a very low risk of failure of these devices and that they will be adequately maintained.

For residential development within existing low-lying flood protected settlements, where there is uncertainty about the adequacy of the existing protection, or it is known to be dilapidated, requiring upgrade, elevated floor levels may be considered as an alternative option to raising site levels provided adjacent land and buildings are uniformly low lying, and where the integrity of adjacent land and buildings will be not be compromised if the site of the development is inundated (e.g. by scouring as a result of site inundation).

Furthermore, elevated floor levels may be considered as an alternative to raising site levels provided the following criteria is met:

- The finished floor level is no lower than a height determined by adding 0.25m to the 1% AEP water level, making an allowance for 0.30m of sea level rise, and making adjustment (if appropriate) for land subsidence or uplift to the year 2050.
- Underside areas are not enclosed (to allow for the potential flow through of water whilst supporting the house above).
- Service facilities vulnerable to flooding are raised above the finished floor level (i.e. electrical power outlets, switchboards, hot water systems, air conditioning units, water pumps, etc.).

The application of this alternative option (i.e. raising floor levels only) recognises that elevated floor levels do not alleviate long term coastal hazard risks, nor less the requirement for urgent upgrade of existing flood protection works.

S3 Sea Level Rise for Major Developments.

For major coastal developments the Board recommends that in addition to standard 1 above, the full range of possible climate change and sea level effects be considered. The Board will encourage designs that enable later modification for further sea level rise. However it recognises that it may be appropriate in some instances not to provide these but rather to accept that there may be higher modification or rebuilding costs later.

S4 Setback for Erosion.

Development should generally not occur on sand dunes or close to soft, erodible coastal cliffs. Except where the development site is clearly safe against coastal recession and storm erosion, development should not be allowed unless appropriate studies have been carried out and demonstrate that the following criteria are satisfied. Alternatively the developer should include coast protection works and show that these would provide the required protection. In cases of doubt the Board will advise as to whether or not studies are required.

Development should be safe against coastal recession and storm erosion and the effect that a 0.3m rise in sea level would have on these. Also, development should not be approved unless it can be protected by practical measures against additional erosion that would be caused by a further 0.7m sea level rise.

Each situation will be different and will need to be considered on its separate merits. As a general guide, design and/or setbacks should take into account 100 years of erosion at a site (taking into account local coastal processes and assuming a sea level rise of 0.3m by the year 2050), and also taking account of storm erosion from a major storm or series of severe storms. For major developments, especially those establishing entire new

communities, 200 years of recession should be considered, and also the effect of sea level rise on this over the longer period. Consideration should also be given to whether an additional set-back is desirable to provide for public use after recession has occurred or to preserve the natural appearance of the coast.

S5 Impact of Protection Works.

Development should not be located where it will create or aggravate coastal erosion or if it will require coast protection works, which will cause or aggravate coastal erosion. The Board will not recommend approval of private coast protection works where these would be likely to cause loss of public beach amenity, erosion of adjacent land owned by others, or other adverse effects on the coastal environment.

S6 Responsibility accepted by owner.

The Board will not oppose isolated single owner developments where it is satisfied that adequate arrangements have been made to ensure that any erosion or flooding damage to the development, provision of future protection works, or relocation or demolition of threatened structures will be the sole responsibility of the developer or future owners. The Board may also seek assurance that funding for such measures is guaranteed or, alternatively, that agreements provide a mechanism for recovery of public costs that may be incurred. This would be subject to standard 5 above and that protection works would be likely to obtain approval at the appropriate time.

S7 Existing protection works.

The Board will not oppose development behind existing protection works where the Board's and the Local Council's intention is to maintain or upgrade these. The Board will recommend against approval where protection is provided by beach replenishment and the development would rely on continuation of this for its safety.

S8 Existing coast protection needs and infill development.

The Board will not oppose development where there is already a need for protection of existing development, where this is likely to be provided by Local or State Government and where the new proposal would not add to this need, nor to the cost. This would include development behind esplanade roads or other public property where these are likely to be protected in the future. However it will not always be practical or cost effective to protect public foreshore property and it may be undesirable to do so if this means losing the beach.

Each case will be considered on its merits and this policy may not apply where the new development represents a large increase in investment, or where protection may not be the optimum long-term strategy.

S9 Lesser criteria for some beach facilities.

Lesser engineering criteria may be applied, as appropriate, to public amenity structures such as beach shelters, toilets, change sheds and car parks, some of which may need to be considered expendable. Investment in such structures should be minimised, or they should be relocatable.

S10 Minor Structures.

Certain minor non-residential and non-commercial structures may not be required to meet the Board's coastal hazard standards. However the approving authority should ensure that the owners are aware of the risk of damage to the building and contents and accept all responsibility for loss, and that future owners would also be informed. Structures in this category might include garden sheds, boat sheds, carports, low cost swimming pools, and small jetties.

S11 Development advice.

The Board may make its own assessment of coastal hazards and coast protection proposed for a development and provide advice to the planning approval authority. For projects where the Minister has requested an Environmental Impact Statement, the Board will provide advice to the Minister.

Appendix 2 - Draft Development Guidelines and Risk Assessment Criteria for Coastal Acid Sulfate Soils in South Australia

Endorsed by the Coast Protection Board on 26 July 2002

Coastal Acid Sulfate Soils Strategy

A full description of the Coast Protection Board's Coastal Acid Sulfate Soils Strategy 2002 is detailed in three reports:

- Interim Strategy for Implementing CPB Policies on Coastal Acid Sulfate Soils in South Australia;
- Interim Development Guidelines and Risk Assessment Criteria for Coastal Acid Sulfate Soils in South Australia; and
- Interim Checklist for Development in Coastal Acid Sulfate Soils, South Australia. A Review of Existing State and Local Planning Approaches is also available.

Interim Strategy Statement

The Coast Protection Board will seek provision of the following for any proposed development in coastal acid sulfate soils areas before its advice will be provided to the Development Assessment Commission:

1. An assessment of the site including the natural ground surface relative to Australian Height Datum (AHD), and the amount of excavation or fill that is required;
2. Information on whether potential or actual coastal acid sulfate soils or ground-water are at risk of being disturbed as a result of the development;
3. Where there is a risk of acid sulfate soil disturbance:
   Consideration of mitigation strategies, and a standardised investigation of the soil, surface water and ground-water at the site; and
4. Where coastal acid sulfate soils are confirmed:
   A management plan of ongoing monitoring and best-practice management of the area so that coastal acid sulfate soil disturbance is minimised and remediated.

Interim Guidelines for Development Proposed in Coastal Acid Sulfate Soil Risk Areas

For proposed developments in South Australian coastal areas, elements of the NSW (Ahern *et al* 1998) and Queensland (Queensland Government 2002) acid sulfate soils approaches are utilised:

1. Any coastal region or subsoil <5 m AHD, where the natural ground level is <20 m AHD, will be subject to coastal acid sulfate soil risk assessment.
2. If acid sulfate soils (either potential or actual acid sulfate soils) are present, then acid sulfate soils provisions will apply to developments involving:
   a. Extraction or removal of >100 m^3 material, or
   b. Filling of >500 m^3 of material at >0.5 m average depth.

3. Any building, plumbing, drainage or operational works involving less than the relevant amount of excavation or filling is not assessable by the Coast Protection Board. However, in acid sulfate soils risk areas, standard building or works assessment criteria should be devised.
4. ASS risk maps for South Australia will need to be consulted to determine the probability of acid sulfate soils occurrence and potential disturbance at the proposed development site. These will be available through the South Australian Coastal Atlas: www.atlas.sa.gov.au.

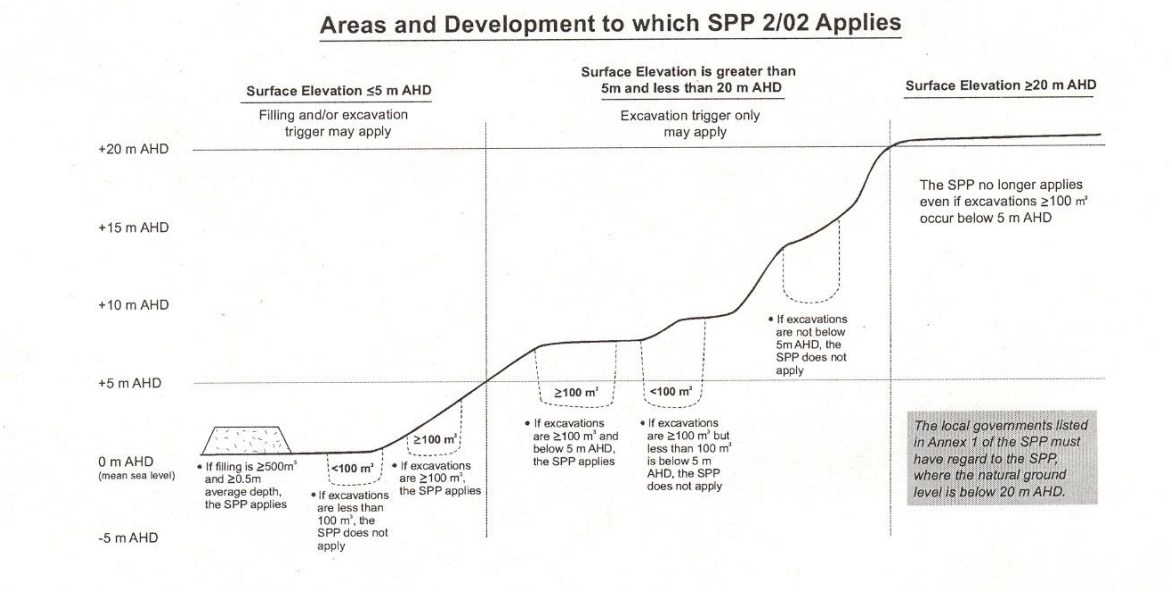


Figure 1. Elevations and amount of excavation or fill in the *Queensland State Planning Policy 02/2*

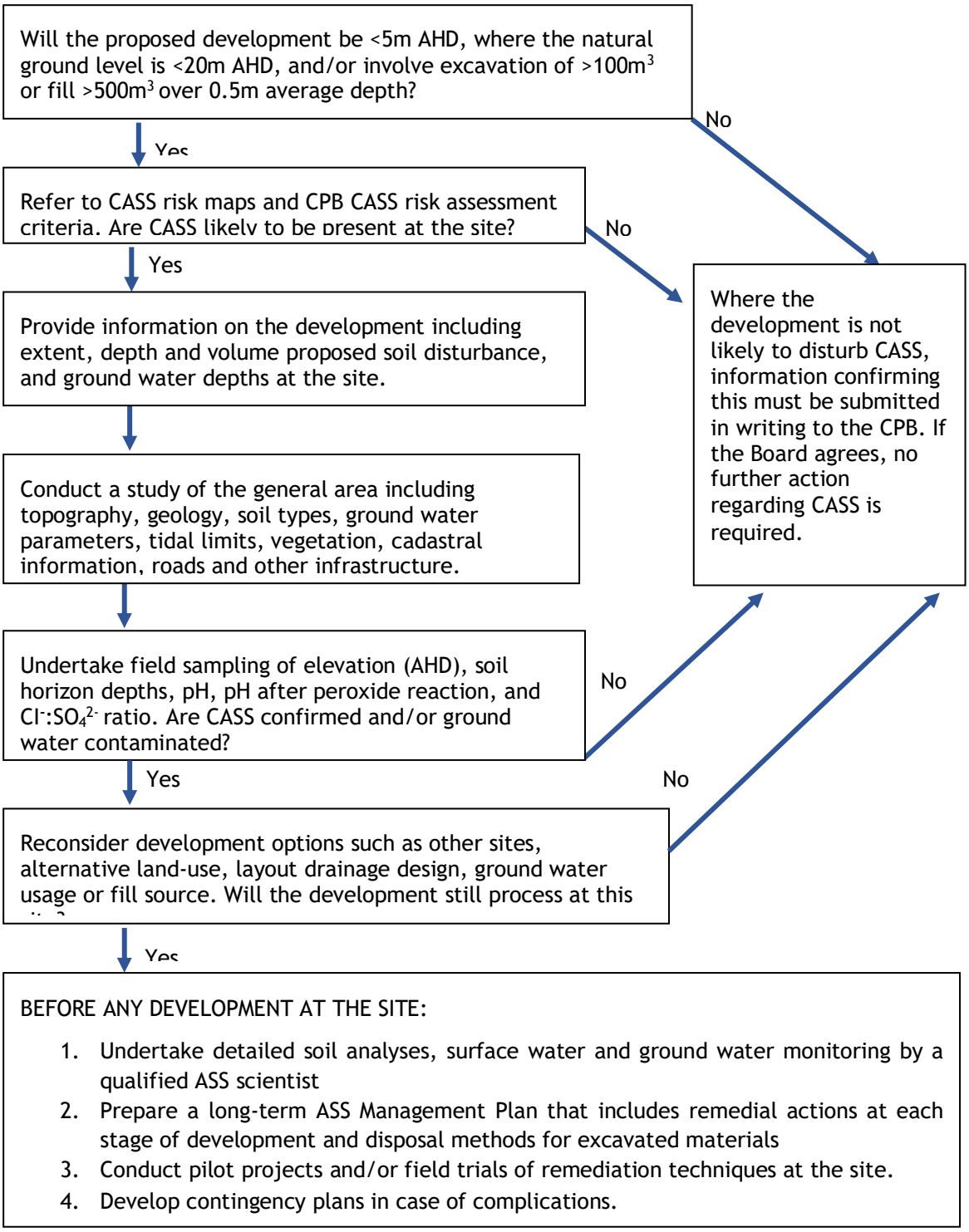
Developments can be defined as any material change intrinsic to the proposed use that involves excavation, filling, drainage, dewatering or other modification. Such uses include agriculture, aquaculture, infrastructure, industrial, urban and tourism developments. Activities[9] in coastal regions where acid sulfate soils or ground-water are likely to be disturbed include:

- **Excavation, filling and acid sulfate soils disturbance** - construction of roads, foundations, drainage works, laser levelling, land-forming works, flood mitigation works, dams and aquaculture ponds, sand or gravel extraction, dredging, and where excavated material is placed or used;
- **Drainage, de-watering and lowering the watertable** - new drainage works or deepening or existing drains, use of ground water, de-watering of dams, wetlands or quarries, and dredging works lowering riverbeds;
- **Use of acid sulfate soils** - aquaculture pond walls, dams, flood mitigation works, imported fill material, reclamation or foreshore works;

[9] Activities listed in the *Environment Protection Act 1993* as Prescribed Activities of Environmental Significance include any activities producing listed waste (Part B of the Schedule), such as acids or acidic solutions, other than any activities including building, plumbing or gas fitting and agriculture or horticulture. In these circumstances, where significant risk to the environment can be identified, provisions need to be considered to limit these activities or provide alternative options.

- **Habitat modification for mosquito control** - runnelling, drainage and selective ditching for water removal or to allow access for predatory fish (Ahern *et al* 1998).

Acid Sulphate Soils Decision Tree for Proposed Coastal Development



Information Required for Proposed Developments in Coastal Acid Sulphate Soil Risk Areas of South Australia

Will any part of the proposed development be less than 5 m Australian Height Datum, where the natural ground level is less than 20 m AHD?

This applies to ground surfaces and subsoils below 5 m AHD in coastal areas where the natural ground is less than 20 m AHD. Coastal acid sulfate soils form mostly in low-lying coastal regions that have been subject to seawater inundation. In the Recent geologic history of South Australia, this inundation does not appear to have exceeded 5 m AHD. Even so, acid sulfate soils may also occur at some distance from the existing coastline in low-lying coastal sediments covered by younger geologic material. For this reason, coastal areas with elevations up to 20 m AHD natural ground surface are included in the CPB strategy.

Will the proposed development involve excavation greater than 100 m^3 or fill greater than 500 m^3 over a 0.5 m depth?

Only developments of this size or greater are covered by the CPB coastal acid sulfate soils strategy. Smaller developments, e.g. building or operational works in individual premises, are not assessable under the strategy. However, a duty of care should be carried out for any developments in coastal acid sulfate soil risk areas, and standard building or development assessment criteria should be devised to address smaller developments.

For proposed developments in the coastal zone:

If all of the proposed development is to occur in soils *above* 5 m AHD and/or *does not* involve excavation of more than 100m^3 or fill of more than 500m^3 over an average 0.5m depth, written information confirming this should be provided to the CPB and no further action regarding the coastal acid sulfate soils strategy will be required.

If any part of the proposed development is to occur in soils *less than* 5 m AHD and/or *will* involve excavation of more than 100 m^3 or fill of more than 500 m^3 over an average 0.5 m depth, it will be necessary to consult the coastal acid sulfate soil risk maps and the CPB risk assessment criteria to determine if coastal acid sulfate soils are likely to be present in the region.

Coastal Acid Sulfate Soil Risk Mapping and Risk Assessment Criteria

Coastal acid sulfate soils risk mapping has been undertaken to assess the probability of acid sulfate soils occurrence in coastal regions of South Australia. The South Australian Coastal Atlas GIS maps (http://www.atlas.sa.gov.au) were used as base maps and ten classes of acid sulfate soils risk probability were assigned to them (Table 1). These coastal acid sulfate soils risk maps can be used for planning purposes and to guide development by merging the ten classes into three main risk assessment categories depending on the probability of coastal acid sulfate soils occurrence (Table 2).

Table 1. CSIRO CASS Map Classes for South Australia (Fitzpatrick *et al* in press)

Map Legend		Class Description
1	a) Actual Acid Sulfate Soils (AASS) (disturbed) b) Potential Acid Sulfate Soils (PASS) (disturbed)	**Existing AASS** Very high risk. Only found in this mapping unit in the Port-Adelaide – Gillman, Barker Inlet area and in the adjacent "Other Soils" mapping unit. **PASS in subsoil below 20 cm (up to 1 metre thick with surface monosulfidic black ooze (MBO), intertidal** (mainly in samphire). Moderate risk because carbonate layers usually occur above and below.
2	PASS (mangrove)	**Thick PASS - mangrove soil** (potential acid sulfate soils) Mainly in mangroves with high risk.
3	PASS (tidal stream)	**PASS of tidal streams** (PASS underlying tidal streams, not extensive laterally). Moderate risk.
4	PASS (intertidal)	**PASS in subsoil below 20 cm (up to 1 metre thick) with surface monosulfidic black ooze (MBO), intertidal** (mainly in samphire). Moderate risk because carbonate layers usually occur above and below.
5	PASS (supratidal)	**PASS in subsoil below 50 cm (up to 1 metre thick) with some surface MBO - supratidal** (Mainly in samphire, salt bush, blue bush, or saltpan associated with hyper saline soils where there is less frequent tidal inundation). Moderate to low risk.
6	Sand	**Soils of sand dunes, ridges** (No PASS and ASS within 1 metre of surface). Low risk of PASS below watertable.
7	Calcarenite	**Calcareous soils and hardpans** (No PASS, high neutralising). No or very low risk.
8	Marine Soils	**Marine soils - subtidal and intertidal marine** (PASS may be present; ASS neutralised by tides and carbonates) No or very low risk.
9	Other Soils	**Soils associated with other land uses within coastal landforms.** Risk requires individual investigation; guided by adjacent mapped units.
10	Soils Not Classified	**Soils outside area of mapped coastal landforms.**

Table 2. CASS Risk Assessment Criteria for South Australia (adapted from Stone and Hopkins 1998 – Appendix 1: Acid Sulfate Soil Model LEP)

CSIRO Acid Sulfate Soil Map Class	Risk Assessment Categories	Risk Assessment Criteria
1-3	1	Strategy applies to all developments.
4-6	2	Strategy applies to developments that involve excavation or filling beyond 1 metre below natural ground surface or affect the water table.
7-10	3	Strategy applies to developments within 500 metres of adjacent Category 1or 2 land or which are likely to affect the water table on adjacent Category 1 or 2 land.

Any proposed development in the acid sulfate soils risk assessment categories will require CPB approval. In areas mapped as Risk Assessment Category 1 or 2, where there is a probability of acid sulfate soils disturbance by the proposed development, it will be necessary to identify the areas at greatest risk. In areas mapped as Category 3 and within 500 m of adjacent Category 1 or 2 areas, verification will be necessary as to whether acid sulfate soils are present or ground water is likely to be affected. If so, the actions to be taken will be similar to those for Category 1 or 2 areas. In areas where it is assessed accurately that the proposed development will not disturb acid sulfate soils or ground water, no further action relating to acid sulfate soils management will be required.

Where a Risk of Coastal Acid Sulfate Soil Disturbance is Identified

Provide general parameters of the proposed development

Describe the nature of the development to determine whether acid sulfate soils would be disturbed. Are earthworks to be undertaken? If so:

- What is the depth of soil disturbance?
- What is the volume of soil to be disturbed?
- Can exposure to air of disturbed soil be minimal?
- Is the ground water level likely to be lowered?
- Is the ground water drawdown rate or flow direction likely to be altered?
- Is the soil or ground water disturbance likely to be short or long term?

Conduct a study of the area

A site description can be compiled from topographic maps/aerial photographs to include:

- Delineation of the area to be disturbed on an appropriately scaled map;
- Physical and biological nature of the area – topography, geology, soils, hydrogeology/ground water, tidal limits, and vegetation communities; and
- Human infrastructure in the area – land zoning, roads, population density, associated activities.

If acid sulfate soils (Table 3) are likely to be present in the area of the proposed development and are at risk of being disturbed, soil and/or ground water sampling at the site will be necessary.

Table 3. Acid Sulfate Soils Site Characteristics (sourced from Ahern *et al* 1998)

Soil Type	Soil Characteristics	Water Characteristics	Other Characteristics
Actual Acid Sulfate Soil	• Field pH ≤4; • Jarositic horizons (pale yellow mineral deposits). Where the water table fluctuates, jarosite may precipitate along cracks or root fissures in the soil); • Iron oxide mottling in soil left exposed to air (e.g. excavated or dredged material); • Presence of shell.	• pH <5.5 in surface ponding, drains, ground water or adjacent streams; • Clear or milky blue-green water flowing within or from the site (aluminium released from acid sulfate soils can act as a flocculating agent); • Iron stains on drain or pond surfaces, or iron-stained water deposits.	• Scalded or bare low-lying areas; • Corrosion of concrete and/or steel structures.
Potential Acid Sulfate Soil	• pH usually neutral but may be acidic – positive peroxide test; • Waterlogged soils –blue-grey or dark greenish grey unripe muds, mid to dark grey estuarine silty sands or sands or dark grey estuarine/tidal lake bottom sediments; • Presence of shell.	• pH usually neutral but may be acidic.	

Field sampling

Field investigations for coastal acid sulfate soils and associated ground water will be required in areas where it is assessed there is a risk of disturbance. An experienced and accredited soil consultant should be engaged when undertaking any acid sulfate soils investigation program.

a) *Sampling sites*

The number of sampling sites to be chosen will vary depending on the type of disturbance proposed, site variability, soil characteristics and the sensitivity of surrounding areas. The *Australian Soil and Land Survey Field Handbook* (McDonald *et al* 1990) should be consulted when planning site locations. As a guide, sites should be located every 0.25 ha for areas up to 4 ha, and every 0.5 ha thereafter. Down the soil profile, samples equal to 0.5 kg or more should be collected at intervals of 0.25 m depth or minimally every 0.5 m or different horizon. The upper and lower depth of each horizon should be recorded and samples should not be taken across horizon boundaries. The depth of sampling should continue to either at least one metre below the proposed excavation depth or estimated reduction in watertable height, or a minimum of two metres below the land surface whichever is greater. Where the site characteristics indicate that CASS may be present, the number of sampling sites and intervals down the soil profile should be increased in those areas.

b) *Sample layout*

Extensive projects:
For extensive projects, e.g. housing developments, highway construction or agriculture, large areas of coastal acid sulfate soils may be disturbed. For these types of projects, sampling should generally cover the whole area of the proposed development on a grid of every 0.25 ha or less. More intensive sampling of every 50-75 m should be undertaken in areas of potentially greater coastal acid sulfate soils disturbance. Where the likelihood of coastal acid sulfate soils is reduced e.g. above 5 m AHD, this sampling intensity is not necessarily expected although some confirmatory sampling and analysis will be required.

Linear projects:
Linear development, e.g. drains, service trenches or narrow roads, will require sampling along the proposed line of disturbance every 50 to 100 m, or at lesser intervals in areas where the risk of coastal acid sulfate soils disturbance is greatest.

Dredging projects:
For projects involving dredging of material from estuaries, coastal lakes and wetlands, samples should be taken along transects every 50 to 100 m (or lesser where appropriate) and collected to at least one metre below the expected depth of extraction. Care must be taken to collect all of the sediment sample as the fine fractions may drain away during retrieval or, in some wet dredging operations, separate from the bulk material during stockpiling. Seawater or shells in the sample may complicate the analysis of the dredged material by neutralising any acids present.

c) *Sampling equipment*

The choice of soil equipment will depend on site access, soil texture and wetness, and sample depths. As a general rule, core or sample diameters should be greater than 50 mm to allow for representative soil sampling. Manual sampling equipment types include tapered-tip push tubes, tapered gouge augers, jarret augers or piston samplers, whereas mechanical equipment and techniques include hydraulic push

tubes, hollow flight screw augers, vibrocorers or wash bore drilling combined with driven Standard Penetration Test spilt tube sampling. Some types of equipment are more suitable than others for different soil types. Further information on sampling equipment suitability is given in the NSW ASS Manual Assessment Guidelines (Ahern et al 1998). A record of the type of sampling or drilling equipment together with the drilling operator's contact details should be kept. An acid sulfate soils-trained soil consultant must be present to supervise drilling and handling of samples. Between each sample, equipment should be washed to avoid contamination of samples.

d) *Soil field pH*

Soil field pH gives a quick indication of the likely presence and severity of actual acid sulfate soils. pH readings should be taken from each horizon of the soil profile. Readings of pH ¤4 generally indicate actual acid sulfate soils (and acid pore water) are present. Readings of pH >4 may indicate actual acid sulfate soils are absent although potential acid sulfate soils may still be present. pH values >4 and <5.5 may be the result of previous or limited oxidation of sulfides. Other factors such as organic acids, leaching or strong overuse of fertiliser can also cause pH >4 and <5.5. At these pH values, substantial exchangeable/soluble aluminium and hydrogen ions are usually present.

Field pH equipment
Field pH can be measured by a battery-powered field pH meter with a spear-point double reference pH electrode probe. The probe should be inserted directly into either soft wet soils or soil mixed into a paste with deionised water. It should be standardised prior to and regularly during use against standard solutions according to the manufacturer's instructions. Similarly, a 1:5 ratio of soil:de-ionised water suspension can be mixed in a small tube, hand shaken and the pH of the solution measured using pH test strips. These will give an approximate pH value ±0.25.

Field peroxide test
To test for unoxidised sulfides and therefore potential acid sulfate soils, place a small amount of soil into a clean glass container and drop a small volume of 30 % hydrogen peroxide onto the soil. 30 % hydrogen peroxide is a strong oxidising agent and it should be handled carefully using eye and skin protection. The test should only be undertaken by a trained operator. In some cases the reaction may be instantaneous but in others it may take 10 minutes or more. Heating over hot water may be necessary to start the reaction on cool days. Following a reaction, allow time for the solution to cool as pH probes will only measure to 60 ˚C.
The pH of the peroxide should be between 4.5 and 5.5. Analytical grade peroxide can be as low as 3 as manufacturers stabilise technical grade peroxide with acid. Therefore, first determine the pH of the peroxide and if necessary adjust it with a few drops of 0.1 M NaOH before taking it into the field and undertaking a field peroxide test (sourced from Ahern *et al* 1998).

Field pH alone cannot indicate potential acid sulfate soils as they may be neutral to slightly alkaline when unoxidised. For potential acid sulfate soils that contain unoxidised sulfides, a peroxide test – 30 % (100 volume) hydrogen peroxide - can be used to rapidly oxidise the iron sulfides, resulting in the production of acid with a corresponding drop in pH. Indicators of a positive reaction include:

- Effervescence;
- A change in soil colour from grey to brown tones;
- Sulfurous odours;
- A lowering in pH below pH_F (field pH); and
- pH <3.5.

The peroxide test is most reliable on clays and loams with low levels of organic matter and least useful on sands and gravels with low levels of sulfidic material (e.g. <0.05 % S). Care must be taken when interpreting the results since soils containing a high level of organic matter or other constituents such as manganese oxides can also cause a reaction (Ahern *et al* 1998).

Microscopic soil analysis

Soil samples can be examined microscopically to provide evidence of sulfide framboids (small nodules) or individual crystals. A small amount of soil should be mixed into a paste with deionised water, placed on a glass slide, and viewed under a microscope. Where framboids or crystals are observed, 30 % hydrogen peroxide can be dropped onto the slide. An effervescence reaction would indicate sulfidic matter. If no framboids or crystals are observed, this does not necessarily suggest their absence as sulfidic particles may have been lost during preparation or may not represented in such a small sample.

Ground water analysis

The pH and EC (electrical conductivity) of ground water should be recorded at each borehole or sample site. Samples may also need to be submitted for laboratory analysis. Each sample should be labelled and coded, and its depth and location of the site marked on a map with grid references.
In general, seawater has a Cl^- concentration of approximately 19,400 mg/L and a SO_4^{2-} concentration of approximately 2,700 mg/L, giving a $Cl^-:SO_4^{2-}$ ratio of 7.2:1. As the ratio of the dominant ions in saline waters remains approximately the same even when diluted with freshwater, estuaries, coastal saline creeks and associated ground water should have similar ratios to that of seawater. Thus, any elevated levels of sulfate ions relative to chloride ions can indicate the presence of acid sulfate soils in the region. A $Cl^-:SO_4^{2-}$ ratio <4:1 and particularly <2:1 provides a strong indication of additional sulfate from previous sulfide oxidation. However, the $Cl^-:SO_4^{2-}$ ratio is less predictive when waters become predominantly fresher, and care must be taken when interpreting results from areas where large freshwater inputs can occur (Ahern *et al* 1998).

Piezometers

A properly installed piezometer assists in accurately determining ground water depth and monitoring water quality. A simple piezometer can be constructed from a 3 m length of 40 mm diameter PVC pipe that has had thin slots cut into and around the lower 1m of the pipe. A filter sock can be secured to the pipe at its base by a PVC end cap and with duct tape above the slots so these do not become clogged with soil or other material. To position the piezometer, a hole should be dug about 100 mm in diameter to about 2.8 m, and sand poured into the bottom of it so that the top 0.2 m is protruding. The hole should be back-filled with coarse sand or gravel and packed tightly using a dowel rod until all the slots are covered. Backfill the hole a further 0.2 m with betonite or dry clay to deter surface water from draining down; follow that with the excavated material until 0.2 m from the surface, and then use betonite or concrete to the surface. The height of the piezometer should be determined relative to AHD using nearby survey benchmarks.

Ground water depth can be measured from the top of the piezometer using a measuring stick with a tape and plopper device attached to record when it hits the ground water. An alternative is to install an electronic water-level recorder to record depths at regular intervals. Water quality monitoring in the field usually involves pH and electrical conductivity, which can be undertaken using electronic probes calibrated for each set of measurements. Samples can also be collected for dissolved iron, aluminium, chloride and sulfate, and sent to a water-quality testing laboratory (adapted from Schmidt *et al* 1998).

Table 4. Summary of Field Analyses (adapted from Ahern *et al* 1998)

Characteristics	Sample no	Sample no	Sample no	Sample no	Sample no
Field sample number					
Location/site number					
Map reference and grid					
Elevation/ Depth (m AHD)					
Site observations					
Soil horizon type & depths					
Field pH					
Peroxide reaction					
pH after peroxide					
Microscopic identification					
Cl^-:SO_4^{2-} ratio					

Interpretation of results

Following the field investigation, where there is a strong likelihood of coastal acid sulfate soils disturbance in the region, alternative sites and/or mitigation strategies will need to be considered. In addition, detailed sampling and chemical analyses will be required, particularly in those areas found to have the highest probability of coastal acid sulfate soils (i.e. hot spots) being present. Depending on the results of these analyses, a management plan for the site may be necessary.

In cases where the investigation concludes that coastal acid sulfate soils are not likely to be disturbed, the proponent will be required to submit the results of the analyses to the Coast Protection Board. If the Board responds in writing that it is satisfied that coastal acid sulfate soils will not be disturbed as a result of the proposed development, no further actions will be required.

Mitigation Strategies

Major developments should not proceed in areas of high coastal acid sulfate soil risk. The cost to the surrounding environment and inevitably to the development itself of releasing acid and metal ions in the soil and ground water outweighs any short-term gain. Where acid sulfate soils have been disturbed in the past, structures have subsided, building materials have been corroded or agricultural/aquaculture productivity has been markedly reduced (NWPASS 2000).

To avoid disturbing coastal acid sulfate soils, and therefore the need for subsequent remedial works or rehabilitation, alternative approaches should be considered before any earthworks are undertaken (Table 5). The mitigation strategy that is chosen should represent the lowest risk to the environment. Not all strategies will succeed in some regions or under certain conditions. In such cases, site-specific pilot projects will need to be set up and monitored over the long term to determine the suitability of the mitigation strategy and allow for any design improvements.

If all of the alternative options have been considered carefully and the proposed development is still to proceed, the proponent will need to submit standardised soil, surface water and ground water analyses to the CPB, as well as a proposed development management plan. This is so that: 1) minimal soil disturbance will occur during and after completion of the development, 2) excavated materials will be disposed of or neutralised correctly, and 3) remedial strategies will be implemented.

Table 5. Alternatives before undertaking development in Coastal Acid Sulfate Soils Risk Areas (sourced from Ahern *et al* 1998)

Mitigation Strategies	Examples and Benefits
Alternative low risk sites	Agriculture/aquaculture venture – avoid loss of product yield and ongoing acid sulfate soil management costs.
Alternative uses of land	Urban subdivision – reserve areas of high acid sulfate soil risk for environmental protection.
Alternative site layouts	Construction of roads or pipelines – redesign routes to avoid acid sulfate soil hot spot areas.
Alternative drainage designs	Drains, levees or floodgates – consider wider, shallower drainage options or floodgate operations that suit variable flow conditions to reduce the likelihood of acid sulfate soil disturbance.
Alternative ground water usage	Ground water discharge and recharge – consider using alternative water supplies; avoid decreases in ground water levels associated with the use of levees or floodgates.
Alternative sources of fill	Do not use fill sourced from acid sulfate soil areas –consider using clean imported fill to avoid remedial works.

Detailed Soil, Surface Water and Ground water Analyses

For areas where there is a high risk of coastal acid sulfate soils disturbance, detailed soil and water sampling and analyses are required; the higher the level of risk, the greater the sampling and analysis program. A qualified acid sulfate soils consultant will be required to conduct a well-planned approach to the investigation and qualified laboratories will need to be used for the soil analyses. In situations where samples exceed acceptable sulfur or carbon results, a management plan will be required.

Soil Analysis Program

Analytical procedures are currently being developed by CSIRO for temperate acid sulfate soils in South Australia. These include:

- Total soil carbon and total sulfur by LECO furnace;

- Carbonate carbon – to determine the neutralising capacity, i.e. there is sufficient capacity to neutralise all the potential acid if the $CaCO_3$ content is 3 times that of total sulfur;
- Sulfide sulfur – to determine how much reduced sulfur is present;
- Total sulfur/sulfide sulfur – to indicate the amount of sulfate sulfur present;
- Total carbon/carbonate carbon – to estimate the amount of organic carbon present applicable as food for bacteria; and
- Bulk density of soil samples from below the water table - to calculate values in tonnes/ha.

The two main methods used to analyse soil samples in NSW and Queensland are:

- Total oxidisable sulfur – TOS; and
- Peroxide oxidation combined acidity and sulfate – POCAS.

The TOS procedure is a low-cost screening tool used to determine sulfide levels but does not account for acidity. This method is generally unsuitable for soils containing sands and gravels with low levels of sulfidic material.

TOS results can be complemented with the POCAS procedure to determine the oxidisable sulfur content of soils, particularly those with pH less than 4.5. POCAS analyses provide an indication of the 'sulfur trail' and 'acid trail' of soils. Where a clear relationship between the acid and sulfur trails can be established for a number of samples, only the POCAS acid trail need be used for the analyses. This allows for a quicker turn-around time of samples and therefore earlier liming calculations and management of any disturbed acid sulfate material.

Table 6 outlines action criteria based on the percentage of oxidisable sulfur (TOS) or equivalent total potential acidity (TPA) or total actual or existing acidity (TAA). For any proposed development where the action criteria values are exceeded, a management plan will be needed for the site.

Table 6. Action Criteria Based on Acid Sulfate Soils Analyses (from Ahern *et al* 1998)

Type of Material		**Action Criteria for ≤1000 tonnes disturbed**		**Action Criteria for >1000 tonnes disturbed**	
Textural Range (McDonald *et al* 1990)	**Approx. clay content (% <0.002 mm)**	**Sulfur Trail % S oxidisable (oven-dry basis) e.g. S_{TOS} or S_{POS}**	**Acid Trail Mol H^+/tonne (oven-dry basis) e.g. TPA or TAA**	**Sulfur Trail % S oxidisable (oven-dry basis) e.g. S_{TOS} or S_{POS}**	**Acid Trail Mol H^+/tonne (oven-dry basis) e.g. TPA or TAA**
Coarse - sands to loamy sands	≤ 5	0.03	18	0.03	18
Medium - sandy loams to light clays	5 - 40	0.06	36	0.03	18
Fine Medium to heavy clays and silty clays	≥ 40	0.1	62	0.03	18

S_{TOS} - sulfur as total oxidisable sulfur; S_{POS} - sulfur as potential oxidisable sulfur; TPA – total potential acidity; TAA – total actual or existing acidity.

Treatment categories have been devised for NSW and QLD that indicate the amount of pure lime that would be required to treat different weights of disturbed acid sulfate soils if the percentage oxidisable sulfur is known. The quantity of lime recommended is that required to neutralise the acid that could potentially be produced and includes the minimum industry safety factor of 1.5. An adequate amount of neutralising material such as pure lime should be used to neutralise any acid that may be produced and to bring the pH of the soil above 5.5. In regard to the leachate, its pH of should ideally be between 6.5 and 8.5 to remove toxic forms of aluminium and other heavy metals (Ahern *et al* 1998).

Water Analysis Program

Surface water sampling requirements

Where coastal acid sulfate soils are at risk of being disturbed, a water-sampling program should be devised that takes into account the scale of development proposed, the characteristics of the river or drainage system, and the nature of the potential impacts. The data should give an indication of the current health of the system, whether it is already impacted from acid sulfate soil disturbance, and also provide a benchmark to access any changes that may occur as a result of the development.

Water samples need to be taken both upstream and downstream of the development site, from different depths within the water column, and during different seasons in the year, particularly the wettest and driest periods. Further information in regard to rainfall patterns and flow characteristics should also be obtained. Samples should be collected in containers of at least 0.5 litres and filled to the top to exclude air. They should also be kept cool to minimise chemical activity.

In regard to acid sulfate soils, the main water quality issues are those of acidity, soluble iron, aluminium and heavy metal concentrations, and changes in dissolved oxygen, carbonate and bicarbonate levels. Water quality measurements should routinely include:

- pH;
- Total dissolved solids or electrical conductivity (EC); and
- Soluble Cl^- and SO_4^{2-} concentrations (for Cl^-: SO_4^{2-} ratio for ground water or drain water).

pH and EC should be measured in the field as soon as the sample is collected. Samples can also be analysed for soluble iron, aluminium, dissolved oxygen, carbonate and bicarbonate. However, the results of soluble iron and aluminium analyses are often difficult to interpret and these analyses need only be undertaken in circumstances where large volumes of material containing sulfide are to be disturbed or if drainage from the development site directly affects river or drainage systems or natural wetlands. If iron analyses are to be performed, a separate water sample should be collected and acidified with nitric acid to prevent iron precipitation due to oxidation of the sample.

Table 7. Water Quality Criteria for Aquatic Ecosystems Protection (ANZECC 1992).

Indicator	Freshwater	Marine Water
pH	6.5-9.0	< 0.2 unit change
Fe (total)	500 µg/L	NA
Total Dissolved Solids (TDS)	0-15,00 mg/L	> 1,500 mg/L
Al (total)	5 µg/L for pH < 6.5; 100 µg/L for pH > 6.5	NA

The pH of most natural freshwater is usually 6–7 and for marine water is close to 8.2 (Table 7). The ANZECC Guidelines (1992) recommend that changes of more than 0.5 units from seasonal maximum or minimum should be investigated. In marine waters, the pH should not vary by more than 0.2 units as these waters are strongly buffered and even small changes in pH indicate a major change to the system. The total alkalinity of seawater is 115-120 mg/L as $CACO_3$. The chemistry of aluminium in natural waters is complex and the solubility of aluminium is pH dependent. If pH is <5.2, total soluble aluminium increases with an increase in the range of dissolved ionic species present. Very low dissolved oxygen levels may result where iron precipitates from acidic water. Dissolved oxygen should not fall below 6 mg/L or 80-90 % saturation, having been determined over at least one diurnal cycle (ANZECC 1992).

Where polluted water is evident at a site, it should be contained and managed within the site boundary. Bunds or levees should be constructed of non-acid sulfate soil material and water should be treated to an acceptable pH level. This is usually in the range of 6.5-8.5 to ensure a reduction in total soluble aluminium and other toxic ion species (Ahern *et al* 1998).

Ground water

Ground water analyses are similar to those for surface water (pH, EC, Cl^-: SO_4^{2-} ratio). The number of sampling locations and frequency of sampling will be influenced by the scale of the proposed development, and the nature of the ground water resource. Where there is a risk that ground water will be disturbed, appropriate piezometers will need to be installed to monitor its movement and chemistry. Water samples of at least 0.5 litres should be collected from each strata in the water column, and their containers filled to the top and chilled immediately to reduce any chemical activity. If iron analysis is required, a separate sample should be collected and acidified with nitric acid to prevent oxidation and iron precipitation.

Table 8. Site Specific Investigations (sourced from Ahern *et al* 1998)

Type of investigation	Rationale
Water table depth and seasonal variations	The greater the ground water depth, the less likely ground water levels will change or water quality will be impacted as a result of the proposal.
Aquifer characteristics	e.g. hydraulic conductivity (thickness, porosity and transmissibility), ground-water gradient and flow direction, soil permeability and attenuation/sorption. High permeability increases ground-water infiltration.
Adjoining ground water related environments	e.g. wetlands, springs, rivers, creeks or recharge areas. The likelihood of ground water being affected increases at sites with surface water linkages.
Existing ground water users	e.g. density of bores, uses of ground water, the impact of the proposal on existing ground water supply and quality.

Developments have the potential to substantially affect ground-water by impacting on the generation and export of sulfuric acid. Depending on the characteristics of the aquifer and its interaction with the surrounding environment, a lowering of ground-water levels can lead to oxidation of coastal acid sulfate soils and degradation of ground-water quality.

Activities that cause ground-water levels to decline include ground-water extraction, excavation to or below the water table, construction of deep drains, dewatering of quarries or construction sites, dredging of river beds, and growing trees on cleared land. Alternatively, raising ground-water levels can also result in waterlogging and changes to the hydrology and ecology the area.

Proposed Development Management Plan

Where coastal acid sulfate soils are confirmed in an area, a management plan of the site should be prepared for ongoing monitoring and best-practice management to minimise soil and ground water disturbance. It should include an outline of any earthworks and their operational phases to reduce the impacts during any particular stage, and it should also include measures that protect the soil, surface water, ground water, environment and the community in the area.

Table 9. Proposed Development Management Plan Outline (sourced from Ahern *et al* 1998)

An overview of the proposed development and an environmental description of the site and its surroundings.
Consideration of mitigation strategies: • Alternative sites for the proposed development and/or land use changes of the site; and • Strategies to minimise any impacts during each phase of the construction schedule.
A soil, surface water and ground water monitoring and analysis program: • Parameters to be monitored, their location and sampling frequency; • Analyses to be conducted and laboratories involved; • Actions to be taken where thresholds for acid sulfate soils disturbance are exceeded; and • Reporting procedures to relevant organisations.
Pilot projects or field trials for managing acid sulfate soils disturbances: • Trialling of new technologies and management procedures; and • Compliance with agreed standards and effective implementation.
A contingency plan: • In case of unexpected events, failure to implement a management strategy or ineffective management options.

More detailed management plans for coastal acid sulfate soils risk areas are provided in 3. *Draft Checklist for Development in Coastal Acid Sulfate Soils, South Australia* (2002c).

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Appendix 3 - Guidelines for Proposed Coastal Development Outside of Urban Areas

Endorsed by the Coast Protection Board on 29 July 2016

General Siting and Design Parameters

The Board's Policies address regular siting and design objectives. In addition, coastal development outside of urban areas should demonstrate measures to conserve and preferably enhance the coastal values of the site, for *example* through:

- Closure of unnecessary tracks and access points, and discouraging access to sensitive areas;
- Being sited to avoid or minimise the clearance of native vegetation including for vehicle and/or pedestrian access;
- Avoiding impact to threatened fauna and flora species and their habitat;
- Being sited to avoid impacting on highly valued, undeveloped coastal vistas;
- Being a type of development which will not impact on environmental water resources (including aquifers) to the detriment of wetlands, watercourses and other water-dependant ecosystems;
- Being designed so that it is responsive to the landform and natural environment;
- Implementation of a native flora revegetation program;
- Implementation of a pest species management program; and/or
- Establishment of a Heritage Agreement or Land Management Agreement, over all or part of the allotment, to protect it from further development or ensure ongoing conservation management.

Standard of Information Accompanying Development Applications

Proposals for coastal development outside of urban areas should meet a high standard of design and assessment to ensure that impacts on coastal values are avoided or minimised. It *may* be necessary to provide the following information:

- Any native vegetation clearance (species and location of plants), including that required by the Country Fire Service;
- An assessment of impacts on sensitive coastal features, threatened species or ecological communities provided by a suitably qualified person, and measures to mitigate detrimental impacts;
- A visual impact assessment provided by a suitably qualified person which outlines the building design concept in relation to its surroundings and addresses building visibility (including use of surveyed sightlines where necessary and photomontages), and measures to mitigate visual impact issues;
- A landscaping and/or conservation management plan which describes how the development will mitigate environmental impacts, and/or any conservation initiatives to be undertaken;
- Information with regards to coastal hazards potentially impacting on the development (flooding, erosion, sand dune drift, acid sulfate soils) and mitigation strategies;

- Proponents of development are encouraged to contact Department staff supporting the Coast Protection Board to establish the requirements for particular proposals prior to lodging an application.

Threatened and sensitive coastal species, communities and habitats

Development should be sited and designed to avoid harm or disturbance to threatened coastal species and habitats. Impacts will vary and assessment is on a case by case basis. The guidelines below are provided for particularly sensitive species and habitats that are especially susceptible to coastal development.

Coastal Raptors

White bellied Sea Eagle and Osprey

White-bellied Sea Eagles (*Haliaeetus leucogaster*) and Ospreys (*Pandion haliaetus*) are generally located along the coast away from developed areas in South Australia.

These species are sensitive to human disturbance, particularly when established in remote locations and/or there is a change to the landscape through new building or human activity. They are particularly vulnerable to disturbance during the breeding season, which may result in desertion of the nest or young, or reduced productivity.

South Australia has a small and somewhat isolated population of these species, with evidence of significant declines in some regions. It is important to minimise disturbance to this species to conserve their small population.

On the basis of scientific reports, the Coast Protection Board has established a *default* spatial buffer for development from the *breeding territories (*which includes nests and guard roost*)* of these birds, being 2 kilometres for the White-bellied Sea Eagle and 1 kilometre for Osprey.

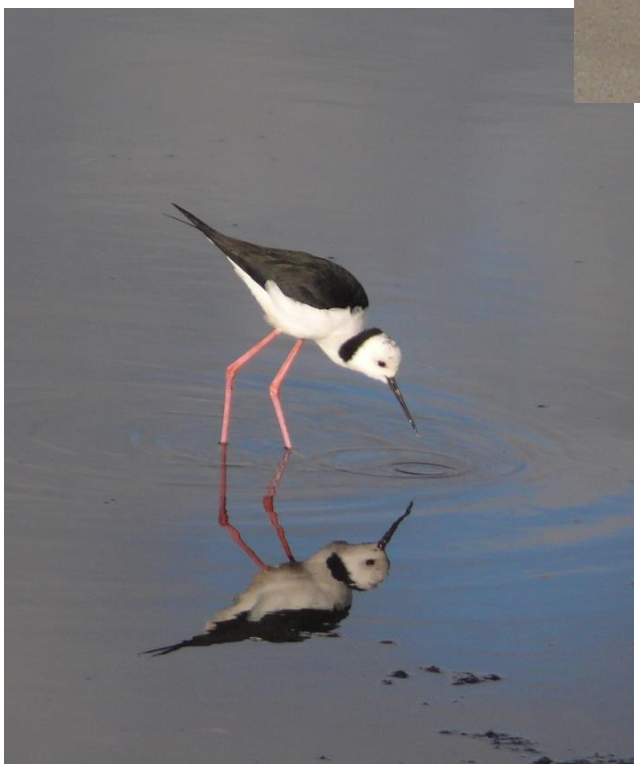
A lesser buffer distance may be supported where there is specific, independent advice provided by a suitably qualified person to demonstrate a lesser distance is acceptable with regards to the proposed development.

Resident and migratory shorebirds

Beach nesting birds in South Australia include the Hooded Plover (*Thinornis rubricollis rubricollis), the Red-Capped Plover (Charadrius ruficapillus), the* Australian Pied Oystercatcher (*Haematopus longirostris),* and the Sooty Oystercatcher (*Haematopus fulinginosus*).

Hooded Plovers are particularly threatened, with only a small population remaining in South Australia. Populations of all four species are in serious decline on many of the State's beaches, including remote beaches and particularly those accessible to off-road vehicles and people.

The South Australian coastline also includes many areas that are critical habitat to migratory shorebirds that travel to Austral along the East Asian – Australasian Flyway from breeding ground in the northern hemisphere.



The populations of many of these species are in serious decline due to loss of habitat throughout the flyway. Incremental loss of habitat in South Australia and disturbance of shorebirds on our coast is contributing to these declines.

Resident and migratory shorebirds are particularly vulnerable to disruption by coastal development and associated human activity, including visitation and recreation, dogs off-leash, and off-road vehicle driving.

Development adjacent to a coastline used by shorebirds, including migratory and resident species, should be sited, designed and managed to minimise disturbance to these important areas.

This may include restricting vehicle and/or pedestrian access to the shoreline by the rationalisation of existing walking and vehicle tracks, fencing and signage to discourage access to nesting or feeding areas, interpretive signage, and information for guests for tourist accommodation to raise awareness.

Saltmarsh and *Tecticornia flabelliformis*

Sub-tropical and temperate coastal saltmarsh is a threatened ecological community in South Australia. Saltmarshes are tidal wetlands that filter land-sourced runoff and are productive contributors to marine fisheries.

Samphires are dominant plant species in South Australia's coastal saltmarshes. Fan or Beach Samphire (*Tecticornia flabelliformis*) is a samphire that has been identified for additional protection.

Threats to saltmarshes include alterations to hydrology by development, dredging, water extraction, sea level rise, off-road vehicles, grazing, dumping and trampling by foot traffic.

Appendix 4 - Assessment Guidelines for Proposed Boat Ramp Developments

Endorsed by the Coast Protection Board on 5 February 2021

Proposals for new boat ramp facilities or modifications to existing facilities need to be accompanied by appropriate information and investigations, to enable the Board's assessment. A preliminary assessment by the Board can help determine the extent of information required, which may vary depending on the scale of the works and location. Information may include:

- Assessment of potential impacts of the boat ramp facility on coastal processes, including longshore sediment movement (e.g. causing updrift accretion and downdrift erosion) and beach-cast wrack movement;
- Assessment of potential whole-of-life impacts of the boat ramp facility on environmental features and values (terrestrial and marine habitats), undertaken by suitably qualified person, including measures to avoid, minimise and/or monitor and assess the impacts;
- Depending on the location and site characteristics, other assessments by suitably qualified persons such as cultural, heritage, amenity and or visual impact;
- Design information that demonstrates the boat ramp facility can withstand coastal processes, potential storm events and sea level rise;
- Evidence that alternative site and design options have been considered;
- Provision of a sand/beach-cast wrack monitoring & management plan;
- Assessment of whole-of-life maintenance requirements, costs and funding responsibilities; and
- Information on associated works such as roads, car parking facilities and pedestrian access points.

[Appropriate feasibility studies ensure that proponents/owners and other stakeholders fully understand the potential impacts, including those that require ongoing management and funding, prior to construction. Note, the Board will not assess boat ramp safety and serviceability for boat users.]

Appendix 5 - Policy Amendment Record

[i] Policy amended, meeting 20/12/02, Item 12.

[ii] Policy amended, meeting 29/07/16, Item 10.

[iii] Policy amended, meeting 30/08/02, Item 11.

[iv] New policy, meeting 29/07/16, Item 10.

[v] New policy, meeting 5/02/21, Item 7.3.

[vi] Policy amended, meeting 20/12/02, Item 12.

[vii] New policy, meeting 5/02/21 Item 7.3.

[viii] Policy amended, meeting 20/12/02, Item 8.

[ix] New policy, meeting 20/12/02, Item 10.