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PER

ASSESSMENT

OF THE

PUBLIC ENVIRONMENTAL

REPORT

ON THE

WITTON BLUFF PROTECTION STRATEGY

Assessments Branch
Department of Environment & Planning
South Australia

1. INTRODUCTION

Noarlunga City Council proposes to protect development in the vicinity of Witton Bluff, which is an exposed headland situated between Christies Beach and Port Noarlunga on Adelaide's southern coast, from erosion.

Two basic alternative approaches could be taken to alleviate this problem.

a) to permit erosion to continue largely unconstrained and take measures to protect public safety and property by acquiring a few of the Explanade properties and relocating the road away from the cliff edge

b) to take measures to halt erosion, by constructing a rock revetement at the base of the cliff and placing fill against the cliff

The latter option is the one proposed by Noarlunga Council and supported by the Coast Protection Board which will provide eighty per cent of the funds required.

The Environmental Impact Assessment procedure has become a part of the planning process and is designed to ensure that environmental factors are recognised and given appropriate consideration in the planning, design and implementation stages of development proposals. The Public Environmental Report (PER) is a recent addition to the various forms of documentation used for Environmental Impact Assessment, which provides the developer and Government instrumentalities with an opportunity to reach the community with details of studies, amendments, monitoring, or intermediate level proposals, for new or existing developments.

The role of a Public Environmental Report is to make information available to the public on matters which are not appropriately dealt with as a complete Environmental Impact Statement (EIS) or as a document that is submitted for internal review by the Government. The public review period for a PER is six weeks, following which time and Assessment Report on the PER is prepared. Any comment received during the public exhibition of the PER is considered in the Assessment.

The Public Environmental Report for the Witton Bluff Protection Strategy was advertised on 21 December, 1983 and the public invited to examine the report and comment in writing to the Minister for Environment and Planning. During that period the development application was advertised by the Planning Commission. All public submissions directed to the Planning Commission and the Minister for Environment and Planning have been considered in the following Assessment Report.

2. ADEQUACY OF THE PER

In accordance with guidelines issued by the Department, the following aspects were required to be considered.

- The broad objectives of the proposal
- Substantiation of the proposal including analysis of alternatives considered, the environmental impact and costs and benefits of each alternative, and the reasons why the alternatives were rejected in favour of the preferred option.
- Description of the proposed development
- Environmental impact of the proposed development
- Environmental safeguards and standards
- Public involvement

2.1 The Council has presented the objectives of the proposal as

"to make safe a section of coastline ... so that the risk of structural failure of the cliff and surrounding area will be eliminated."

and

"to safeguard those surrounding cliffs not subject to imminent collapse from the worst effects of erosion ..."

However, the erosion of the cliff would not be of concern if it were not for the intensive use of the area by people for living and recreation. The main objectives are therefore to safeguard people using the area from hazard arising from cliff collapse, and property and development in the area from damage and loss due to cliff recession.

2.2 Substantiation of the Proposal

Council considered 13 different options to minimise the problems associated with coastal erosion. They are basically variations on 3 alternatives plus the do nothing option. They are :

a) to place revetement at the base of the cliff and to fill against the cliff face

b) to place revetement at the base of the cliff but allow the slower erosion process at the top of the cliff to continue and remove development in the path of erosion by acquisition

c) to permit erosion at the base and top of the cliff to continue largely unconstrained and remove development in the path of erosion by acquisition

The two options of a) revetement and fill, and b) no revetement but acquisition of 6 houses on the Esplanade and relocation of the road eastward are considered in detail by Council. The option of revetement plus acquisition was not considered in any detail.

Although, as will be discussed in Section 3 of this report, the findings of the PER are not supported, this section was covered adequately.

2.3 Description of Existing Environment

The PER adequately covered the scenic, geological, geomorphological, hydrological, erosive processes, terrestial biology and land use and social aspects, the description of the marine environment was extremely brief and would have been more valuable if expanded further. This is not however a serious oversight as neither option will have a major impact on the marine environment.

2. 4 Description of the Proposed Option

The proposal is generally adeuately described although no detail on the number of trucks and routes to be used during construction phase is provided.

2.5 Environmental Effects

The section on environmental impact of the proposed option to the alternative option covers the marine environment, biotic effects, landscaping, land use, housing, tourism, features of cultural and scientific interest, property values and visual appearance, safety and amenity and impact during construction. The impact of the options is adequately described except for the construction impact which is likely to have a potential impact through noise, dust, traffic and sedimentation.

2.6 Monitoring

There is no discussion of monitoring in the PER. It is however stated on page 42 that turbidity in the sea will be minimised with no description of how this will be achieved.

2.7 Public Involvement

There has been no public involvement in discussions of proposed options for the area prior to release of the PER.

3. EVALUATION OF ALTERNATIVES

3.1 Introduction

There are three points around Witton Bluff where active erosion is giving rise to some concern about the long term ability of the Esplanade Road. (see Map 1). The area of immediate concern is the section between Fenton

and Benny Roads where the cliff top is very close to the edge of the road. The proximity of the road to the cliff in this location warrants prompt action to protect public safety.

A number of alternative proposals to protect property and the public from the coastal erosion were considered in the PER. They are variations on two basic options which are :

a) take measures to halt erosion

b) to permit erosion to continue largely unconstrained and to remove development in the path of the erosion.

Consideration of the various options reduced the list to two alternatives which were investigated more fully. a third option warrants more detailed consideration following a review of the PER and the response in the public submissions. The options are described below.

3.2 Revetment and Fill

The option selected by Noarlunga Council and supported by the Coast Protection Board is that of constructing a rock revetment around the base of the cliff extending from the existing revetment at the southern end of Christies Beach to the natural limestone platform on the southern side of Witton Bluff. The revetment would stand off from the base of the cliff so that an overall slope of 37° could be drawn from the 30 metre contour at the top of the cliff. The cliff face would then be blanketed with fill similar to the protective works immediately north of the site which were carried out in 1973. The cliff between Benny and Fenton Streets would be covered with fill once the revetment is constructed while the cliff between Benny and Anderson Streets may need to be filled in the long term.

As will be argued in section 4 of this report, it is considered that the extent of the proposed revetment is excessive. A more appropriate location would be to butt the revetment against the northern side of the bluff rather than extend it around the point.

3.3 Acquisition Option

The acquisition option would allow the natural erosion processes to continue and would remove development in the path of that erosion. The seven properties with six residences on them between Fenton and Benny Streets would be acquired and the Esplanade Road in this area would be moved eastward. This would create an area of land at the top of the cliff which could be landscaped and used as a reserve and carparking. It will be argued in the next section that a modification of this proposal which would only involve the acquisition of four properties (3 houses) immediately north of Benny Avenue, and relocation of the

Esplanade would provide adequate protection of the public from the coastal erosion.

3.4 Revetment plus Acquisition

This is option (2) in the list of alternatives presented on page 4 of the PER. Rock revetment would be placed at the toe of the cliff between Fenton and Benny Avenues and the four properties (3 houses) on the Esplanade immediately north of Benny Avenue would be acquired. The Esplanade Road would then be deviated further east.

4. ENVIRONMENTAL IMPACT

This section will evaluate the environmental impact of the three basic options described in the previous chapter.

4.1 Terrain

Witton Bluff is a prominent and scenic headland separating the beach side surburbs of Port Noarlunga and Christies Beach south of Adelaide.

It is one of the major coastal features of the metropolitan coastline having good access and in reasonable proximity to the main metropolitan area. Its attraction arises from the height of nature and colour of sheer cliff in contrast with the long stretches of white beach to the north and south. The whole area is one of high amenity which is perennially popular with tourists and residents.

Option 1, that of revetment and fill would cover the natural cliff, initially on the northern side, and in the long term, on both sides of the bluff. Only the tip of the bluff would remain uncovered. This would significantly alter the landscape of the area.

It is intended to landscape the fill with hardy coastal species. However as will be discussed in the Flora section in this chapter the combination of steep slopes and coastal location will make it difficult to establish plantings. The artist's conception of the completed project therefore is misleading as the filled area is likely to be much more sparsely planted with active erosion still continuing.

The acquisition option will retain the present character of the cliffs and the Bluff. Erosion will continue slowly and imperceptibly and the sea/land interface will shift progressively landward.

Realignment of the Esplanade will provide a significant cliff top area which could be developed as a landscaped park, and provide some car parking. This would improve the present rather barren and weedy nature of the area and provide a pleasant spot to enjoy the coastal views.

This cliff top park would be subject to gradual erosion until in an estimated 200 years the cliff edge would have reached the realigned Esplanade Road.

Option 3, that of revetement plus acquisition would alter the existing character of the area by the loss of the beach at the base of the cliff under revetement and fill. The character of the cliff would still be retained although it would gradually erode to a gentler slope. This erosion process would be so slow that it would only be over significant time periods e.g. 25 - 50 years that any change would be perceived.

This option would also enable creation of a cliff top park which would be a permanent feature.

4.2 Erosion Processes and Stability

The primary objectives of the proposal are to minimise damage to public and private property and to reduce the risk of personal injury resulting from collapse of the cliff. This has been perceived in the PER (page 2) as the objective "to make safe a section of coastline ... so that the risk of structural failure of the cliff and surrounding areas will be eliminated;". In assessing the proposed action it is necessary to examine the relationship between the risk and consequences of damage or injury and the mechanisms of erosion perceived to be the cause of the problem. There is little doubt that the cliff is eroding and that structural failure is and will continue to occur if no action is taken. However, an examination of the erosion processes should provide a better perception of the risks involved and will assist in selecting the most appropriate means of minimising the risks in the most effective way.

For a cliff to form and be maintained in any location, three processes must take place. The base of the slope must be undercut by some process. This must be followed by collapse of the slope above the undercut section, and the remaining material must be strong enough to stand in near vertical sections. Except in some unusual circumstances, the debris from the collapse must be removed from the toe of the cliff, for the profile to be maintained.

There are two main mechanisms of erosion that are producing cliff forms at Witton Bluff: erosion by rainfall and runoff from the cliff face, and erosion by the sea near the base of the cliff. Cliff forms caused by rainfall and runoff are present in the top section of the slope in the younger, generally unconsolidated Pleistocene sediments, while the marine processes are more active in the Tertiary sediments lower in the sequence.

The ~~rainfall/runoff~~ erosion acts over the entire face of the cliff, and at Witton Bluff is most effective on the clays and silts of the Pleistocene sediments and the

non-silicified marl comprising the upper part of the Blanche Point ~~Marl~~. The overall tendency of this type of erosion is to reduce the slope, although undercutting of more resistant bands by small waterfalls can produce local steep sections.

On the other hand marine erosion occurs largely at the base of the cliff, and is dependent on many factors including interalia, the wave climate of the area, tidal range and rock type. Detailed examination of the lower part of the cliff and the adjacent shore platform revealed extensive examples of intricate solution features and microphysical weathering, with little evidence of abrasion, as suggested on page 3 of the PER. The Tortachilla Limestone at the base of the cliff is rapidly being undercut by weathering and the products removed each time the tide and other phenomena allow wave action to reach the cliff base.

Large scale failure of the cliff face could occur during storm events when waves breaking against the cliff can exert sufficient hydraulic pressure to open up the well defined joints present in the Tortachilla Limestone and the Blanche Point ~~Marls~~ Formation.

The consultants also identify another mechanism of failure. During rainfall events with high infiltration, sufficient water may enter a section of undercut material to increase its weight above that necessary for failure along water lubricated joint planes.

Any debris that falls from the cliff face is being regularly removed by wave action. The finer grained material up to small boulders would be removed by normal wave action whereas the larger blocks would remain until they weathered in situ, or were broken up and carried away by storm waves. This removal of debris would enable fresh material to be weathered at the base of the cliff and permit further undercutting.

There are four important aspects of the erosion at Witton Bluff that must be taken into consideration when planning remedial action.

a. Failure and continued recession of the cliff is dependent on the preconditioning of the sediments at the cliff toe by weathering and their subsequent removal by normal wave action which act to undercut the cliff. Thus if a remedy is to be effective in slowing marine erosion, it must either stop weathering occuring, or ~~if not~~, ~~it must~~ stop the removal of the weathering products. Further, it suggests that the rate of recession is not ~~necessarily~~ dependent ~~solely~~ on the storm intensity. ~~Storm frequency is important as well in that further failure~~ is unlikely to occur at a particular point during a second storm closely following an event which ~~resulted in~~ failure of the cliff face.

b. Failure of large slabs of material is ~~only~~ more likely to occur during a storm event when waves are acting at the cliff base and the area is unaccessible, or during a rainfall event. While it cannot be stated that failure of the cliff will not occur outside of these events, the public risk is extremely low and can, with some foresight and suitable planning, be reduced even further. Dangerous slabs of rock about to fall can be brought down by various means, and the location of sites likely to fail can be identified and access limited.

c. Failure is likely to occur in those areas where joints in the Tortachilla Limestone and the Blanche Point ~~marl~~ formation are closely spaced or are approximately parallel to the cliff face. Joint plane directions of 355°, 320° and 285° were identified in the shore platform, and the areas where recent rock falls have occurred are all where the line of the cliffs approximates 320° (south of the Bluff) or 360° (in the bays immediately to the north and south of the Bluff).

d. The data and arguments presented in the PER suggest that rotational failure in ~~saturated~~ unconsolidated sediments is unlikely to be a major cause of concern unless there is a dramatic change in the hydrological regime which resulted in saturation of the fine grained sediments in the cliff face.

The rates of erosion have a bearing on the optional solution, and the estimate of 5m/100 years appears to be a reasonable maximum. This rate is relatively low by world standards (average rates of 1-2m/year in England have been cited in the literature, King 1972) and has been estimated from photographic evidence. Some support for this rate comes from considering the cliffs in relation to the younger feature of the Port Noarlunga Reef, some 300m offshore. Assuming that the Tertiary sediments extended out to the reef and have subsequently been eroded back from there over the last 6,000 years since sealevel has approximated its current level, the rate of erosion would be 5m/100 years. This confirms the consultant's estimate as being of the correct order of magnitude.

Traffic vibration has not been considered in the report, and in view of the frequency of pounding by waves, is unlikely to be a trigger for failure at current rates of usage. Nevertheless, greatly increased heavy traffic could cause problems, particularly in the section between Fenton and Benny Avenues and it would be desirable to restrict traffic at Fenton Avenue ~~regardless of~~ the options ~~selected~~.

While large scale failure has been adequately addressed in the report, injury to a member of the public from pebbles and small boulders should be considered. Birds and other animals can and do dislodge small pebbles and stones, particularly from the honeycomb weathered Pliocene

sandstone. However, the risk of injury from such sources is considered to be very low and this is supported by the lack of any records of injury from falling debris at Witton Bluff.

It is established that there are erosion problems at some locations near Witton Bluff; and the consequences of the various courses of action can be examined.

In terms of environmental impact there are four options :

a) do nothing
b) acquire land and relocate the Esplanade
c) construct a revetement
d) construct a revetement and fill against the cliff slope

In the do nothing and acquisition options, the cliff will recede at its current rate, and at the section just north of Benny Avenue, failure close to or under the road is quite possible during a major storm event. If the road has not been relocated as in the acquisition option, this would lead to considerable problems for services and traffic. Failures at other sites, such as in the bay immediately to the south and at the gap in the bench could occur, but would be of little consequence as there is adequate room for erosion for many years, without endangering property. The risk of injury from falling rock will remain unaltered for both options.

A revetement at the base of the cliff that prevents the sea from reaching the cliff toe will halt undercutting of the cliff by slowing weathering rates dramatically and stopping the removal of weathering products. Further, hydraulic pressure effects would be eliminated and this would greatly reduce the risk of rock fall. However, slow subaerial processes will continue to lower the cliff slope and slabs of rock that are preconditioned already are likely to fall. The road north of the Bluff at Benny Avenue would still be at risk of failure, but without waves acting at the base, the risk would be greatly reduced compared with the natural situation.

As with all options, the rate of erosion of the cliff top is dependent on the measures for rerouting any runoff away from the cliff face, and stabilising the unconsolidated sediments with vegetation and other measures.

The additional measure of filling behind the revetement would eliminate the risk of natural rock fall from the covered slopes and would shift the subaerial erosion seawards onto the fill. This erosion would continue as it has done on the existing fill unless it is checked by stabilising the slope with vegetation and other measures.

The proposal for revetement and fill is to extend the revetement from the existing protection works around the Bluff and southwards to the bench in the Blanche Point Marl. Considering the current erosion rate and the area of land before property is endangered, it is hardly necessary to place revetement south of the Bluff. In fact, adequate protection of the cliff toe can be achieved by terminating the revetement about the ~~two~~ northern ~~caves in the bay north~~ east of the Bluff, a distance of approximately 100m instead of 220m. A small section of revetement just north of Murray Street may be considered desirable to reduce the risk of rock fall to the public but it is not necessary for protection of public property and has not been included in the consultant's report.

4.3 Scientific Impact

The geological sections exposed at Witton Bluff have been designated a geological monument by the Geological Society of Australia and the area is a well recognised site for teaching purposes. The section includes Tertiary and Pleistocene to Recent sediments in the Noarlunga Embagment of the St. Vincent Basin and is recognised as one of the two good exposures of these sediments in the area. It is stated in the PER that the section of the Bluff is not unique, with the implication that the section to the south of the Onkaparinga Estuary is the same. While it is recognised that the sediments exposed are indeed similar, there are some significant differences in the ages of the various sedimentary horizons. At Witton Bluff, the basal sediments were deposited earlier than at the Onkaparinga Estuary. Deposition of the upper part of the Section (above the Blanche Point Formation) resumed at an earlier time.

The value of the section would not be diminished by the do nothing or acquisition options, and there would only be minimal disturbance with the revetement option, particularly if it is restricted to north of the Bluff. Some exposure of the Tortachilla Limestone would be lost and erosion of the material above would eventually mask part of the Blanche Point Formation.

If the option of revetement and fill is adopted, all sections north of the Bluff would be lost, and most exposure of the Tortachilla Limestone south of the Bluff would be covered. From a teaching viewpoint, the sections south of the Bluff are most useful, and if the revetement stopped at the Bluff, the geological usefulness would be retained.

Some features of geomorphic interest would be lost, particularly to two caves north of the Bluff, if any of the revetement with or without fill options are adopted. These caves would be the most accessible active sea caves close to Adelaide and the site as a whole is an excellent example of coastal cliff erosion demonstrating several important points.

4.4 Marine Environment

There are two aspects of the marine environment that require discussion; the wave climate, and the marine biota in the vicinity of the Bluff.

The wave climate is adequately described in the PER, in that most of the energy at the coastline at Witton Bluff is derived from locally generated waves with only a minor swell contribution. It should be noted that the degree of protection offered by the reef may not be very high because swell waves from the south west would reform between the reef and the shore to a certain extent.

The effect of this proposal on the wave regime is likely to be minimal for all options. The proposed revetement would be constructed to absorb energy rather than reflect it, and rather than an increase in turbulence off shore from the interaction of incoming and reflected wave fronts, there is likely to be a slight reduction in turbulence.

It is mentioned in the PER that the area from the end of the revetement to 1 km off shore southwards is an aquatic reserve. This reserve was proclaimed to protect the varied fauna and flora of the Noarlunga Reef and foreshore. While it is unlikely that there are any "unique marine species" inhabiting the area, the area is a well preserved habitat that is not protected where it occurs at other locations in the Gulf. Hence every effort should be made to minimise damage to the marine life.

Fortunately none of the proposals is likely to cause any significant long lasting change to the area other than a minor loss of area of the shore platform habitat. Temporary increases in turbidity during construction may occur if the revetement and fill option is selected and care is not taken to keep the fill material from eroding away; particularly during placement. It is noted that considerable turbidity resulted from unsuitable construction techniques and materials during the construction of the existing revetement but these effects are no longer evident. This would need to be monitored carefully during construction. The recent construction of the marina at O'Sullivans Beach to the north is an excellent example of good construction practices.

4.5 Fauna

The cliffs at Witton Bluff retain very little of the original fauna and flora. The steepest parts of the cliffs do provide nesting areas for birds, mainly introduced species such as pigeons and starlings. It is unlikely that a wide range of the common reptiles inhabit the area, contrary to the statement in the PER.

The revetement and fill option would remove these nesting sites although it may attract other birds, depending on the species planted and the success of the plantings. The acquisition option would retain the status quo while the revetement plus acquisition option would gradually change the habitat from the existing to a parkland area depending on long term landscaping plans. As the fauna of the area has been so depleted the impact of the project on the fauna of the area is not significant.

4.6 Flora and Landscaping Proposals

The flora on the cliff face and top at Witton Bluff is similar to that on other coastal cliffs in the vicinity, being influenced by its proximity to the sea and the substrate. The discussion of the flora in the PER mentions a number of species that are present on the slopes at Witton Bluff, but is not exhaustive, and includes some species that are not present, but might be expected to grow in thaet environment. A list of species observed on site and their substrate is included as Table 1 as a guide to appropriate species for stabilisation.

As observed in the PER, the vegetation is suffering from pedestrian traffic and rapid subaerial erosion in some places.

All options require some stabilisation of the upper slopes in order to reduce the rate of recession of the cliff top by subaerial erosion. This has been demonstrated in the revetement and fill option where revegetation of the existing fill south of Christies Beach has patchy vegetation and has eroded badly in some places. It is equally important to stabilise the upper slopes in the other options. As the principles of landscaping are similar for all three options, the landscaping proposal for the filled slope as described in the PER can be discussed as representative.

The PER lists three principles for landscaping aimed at stabilising the slopes, providing cover and shelter and finally providing visual interest and scale. While the first two principles noted are appropriate for the area, the general opinion from the public submissions was that the cliff profile was more desirable than a landscaped garden. Consequently, the third principle is not supported.

The landscaping and stabilisation programme involves construction of a spoon drain to divert run off from the cliff top, sealing the cliff top area in order to prevent infiltration and protecting large gullies with rock fill and smaller gullies with bitumenous spray or sprayed concrete/ cement. Planting of a range of species on the filled slope is to be undertaken, together with some trial planting on the unfilled areas.

For long term protection and minimisation of erosion, vegetating the filled and unfilled slopes is probably the most cost effective and efficient, as other techniques are generally

temporary and may exacerbate the problem in the long term. For example, the bitumenous spray will last only a few years at best and will promote erosion where the spraying is stopped. The gunite (concrete) would be more durable, but it does not permit germination and growth of plants, and will accelerate erosion greatly off the sprayed area, with the probable result of severe undermining of the cliff sediments. It is interesting to note that one of the public submissions considered rockfill in gullies to be undesirable, as it can promote expansion of gullies, rather than reduce erosion.

More appropriate measures for stabilisation of either filled or unfilled surfaces might be the use of a latex spray that permits germination and establishment of seelings or better still, mulching with a natural material such as brush, chips or washed seaweed held in place with coarse wire mesh. This latter method has the advantage of allowing some infiltration, reducing moisture loss from the soil and slowing any runoff that may occur. It could not be placed on the steepest slopes, but would be very suitable in fully bottoms, ridges and other more gentle slopes. This would provide a much more suitable environment for germination and establishment of plants.

Treatment of the cliff top should be similar rather than sealing the surface. However, the concept of the spoon drain is seen as necessary for minimisation of runoff reaching the cliff face and its construction is strongly supported.

The list of suggested species for planting is somewhat surprising, and general objective of the plantings appears to be to provide a landscaped garden behind the promenade along the cliff bottom with little regard for the environment of the area or the aesthetic attraction of the cliff faces. Of the twenty species suggested, nine are introduced from overseas (this includes New Zealand and Norfold Island) and at least three Australian species are inappropriate for this environment with two others doubtful, as they express a preference for sandy soils which are present only in limited areas at the Bluff. It is the policy of this Department to use species local to the area in planting programmes (e.g. "Coastal Vegetation in South Australia" Coastline No. 11 published by the Coast Protection Division of the Department for the Environment) and this is strongly supported by most of the public submissions. Accordingly, a revised planting list is suggested including the suitable local species noted in the list in the PER, other species already present on site with some additions. The substrate preference for each species is noted.

The slope treatment and suggested planting guide would be applicable for both filled and unfilled surfaces, provided the plant preferences are matched to the substrate, and it would be desirable if this treatment be extended to the existing filled area, where vegetation establishment has been patchy in the 10 years since the material was emplaced.

TABLE 1

SPECIES	HABIT	LOCATION
Sarcocornia sp.	Low shrub	Clayey area on low beaches
Maireana oppositifolia	Low shrub	Clayey areas close to sea
Scaevola crassifolia	Low spreading shrub	Clayey and sandy areas
Pimelea serphyliifolia	Low shrub	Clayey and Sandy areas
Nitraria billardierii	Low to high spreading shrub	Clayey and sandy soils
Myoporum insulare	Medium to high spreading shrub	All areas
Rhagodia baccata	Low shrub	Lighter soils, some on clay
Calocephalus brownii	Low shrub	Doing poorly on sandy soils
Scirpus nodosus	Reed	Sandy soils
Gazania sp.	Herb	Sand and clay areas
Dianella revoluta	Reed	Sandy soil
Carpobrotus aequilaterus	Succulent ground cover	Sand and clay areas
Muehlenbeckia gunnii	Creeper	Sandy area, cliff top
Pinus sp.	Low shrub	Clayey area
Tamaris aphytla	Small tree	Clayey area, high on cliff
Lycium ferocissimum	Shrub	Noxious weed, high on cliff
Artemesia sp.	Shrub	Protected locality, light soil
Grasses		Sheltered localities

TABLE 2

SPECIES	HABIT	LOCATION
Carpobrotus aequilaterus	Ground cover	Sand or clay
Frankenia paucifolia	Ground cover	Sand or clay
Scaevola crassifolia	Ground cover	Sand or clay
Myoporum insulare	Bush	Sand or clay
Nitraria billadieri	Bush	Sand or clay
Rhagodia baccata	Bush	Sand or clay
Calocephalus brownii	Bush	Sandy
Goodenia varia	Ground cover	Sand or clay
Melaleuca lanceolata	Bush	Sand or clay
Casuarina stricta	Low tree	Sand or clay

NOTE: Many of the bushy species will adapt a low habit as a result of the effects of wind and spray.

4.7 Social Impact

The area around Witton Bluff has mainly been developed since 1945. Adjacent to the Bluff is the Esplanade Road and frontage houses, which are in fair to good condition. Further southward are the RSL Hall, Caravan park and bowling club which are on Council owned land. They are likely to be relocated elsewhere some time in the future, thus releasing a large area for potential public benefit.

The revetement and fill option will have little impact on local residents except in the short term during construction. The options involving acquisition will have an impact on the local residents. The acquisition option considered in detail in the PER involves acquiring seven properties (six house and one vacant block). As was argued in the section on erosion and stability above, this would be greater than is needed to give long-term protection to the area.

If the amended option is considered acquisition will disturb three home owners. The residents will have their properties acquired at fair market value and will be paid an allowance for disturbance. Although the impact on the affected residents is significant the loss of the housing stock and coastal properties is not significant in community terms, there being an estimated 200 coastal properties within the Noarlunga Council area alone, let alone the wider Metropolitan area. There are also significant areas of undeveloped residential land within the Noarlunga Council area.

Relocation of the Esplanade Road and the services such as electricity and water will involve a loss of this community asset. However, as this area was developed in the 1950's and 60's portion of the economic life of these services has already passed. It is, however, significantly cheaper to realign the road and acquire the properties than it is to construct the revetement option.

The acquisition option will enable the development of a landscaped park at the top of the cliff, with space for car parking. This will enhance the local area and ease the pressure on parking in the area during the summer peak.

A number of the public submissions suggested that the Esplanade road should be closed as a through road, and traffic diverted on to Witton Road. This would reduce vibration to the top of the cliff and thus minimise this contribution to erosion. In actual fact traffic does not contribute significantly to erosion of the cliff as there is limited use of the road by heavy trucks. Although it would be advantageous to close the road in planning terms as it would reduce the conflict between through traffic and people recreating in the area and it would reduce traffic and noise to local residents, the Department

of Tourism considers that it is a major attraction and is opposed to any road closure. Closure of the Esplanade is not a feature of any of the major options for coastal protection and is a matter for Council decision.

4.8 Recreational Use

The Witton Bluff area has many attractions including the wide sandy beaches, the scenery, jetty, aquatic reserve and boat ramp and the geological features in the cliff. All these combine to attract a large number of visitors all year round but particularly in the summer. The cliffs although the main point of interest for those interested in the geology of the area are a pleasant backdrop and a feature which gives the character to the area.

The revetement option with the fill against the cliff on the northern side and fill on the southern side in the long term, will remove the natural character of the area and replace it with a man-made landscape. This will affect those visiting the area for the geological features but will not significantly affect visitors attracted by the other recreational features.

4.9 Construction Impacts

All options will have some short term impacts during the construction phase. The revetement and fill option is likely to have a short term impact through traffic, noise and dust. Work is planned to commence in April 1984 with the revetement from Fenton to Benny Avenues completed by mid-May, and level fill to the top of the revetement completed by the end of June. The actual construction time will depend on the weather. It is intended to complete the second phase of construction, the revetement construction from Benny to Anderson Streets and the fill to the cliff face from Fenton to Benny Avenues, during the next financial year.

Revetement construction will be carried out by extending the existing revetement. If the amended revetement scheme, which only extends the revetement to the northern side of the Bluff, is adopted, disturbance during construction would be reduced.

This area of construction would need to be carefully timed so that the minimum disturbance to beach users is caused. The fill against the cliff will be mainly placed from below and only the final portion will be dropped from the top of the cliff. Thus there is likely to be little truck traffic on the cliff top.

Dust during transportation can be minimised by watering or covering the truck loads. If dust arises from use of the unsealed areas around the Bluff then they should be watered as a dust suppressor.

Care should be taken to avoid transfer of fill material onto the sealed roadways where it can be raised as dust by passing traffic. This can be minimised by use of hard gravel at the entrance to help clean the truck tyres, and by ensuring that there is a smooth entrance with no pot holes or ditches to dislodge the load.

Noise will arise from trucks visiting the site and earth-moving equipment working on site. Work at the base of the cliff should not unduly disturb nearby residents particularly if restricted to normal working hours. Work near the top of the cliff will have a greater noise impact but will occur for only a short period of time.

As the source of supply for the rock and the fill has not been decided the route for the trucks can not be finalized.

The revetement option is also likely to increase turbidity of the sea in the immediate vicinity of the revetement. This aspect has been discussed in 4.4 above and is not expected to have a significant impact.

The impact from the options involving acquisition will arise from demolition of the houses and realignment of the Esplanade road. The activities are likely to give rise to noise and dust and can only be minimised by restricting such activities to normal working hours where possible and using dust suppressants where appropriate. These impacts will however only occur over a short period.

4.10 Cost

The cost of the various options are as follows :

a)	Revetement & fill	Establishment	$ 15,000.00
		Rock revetement	$384,250.00
		Random filling	$390,000.00
		TOTAL	$789,250.00
b)	Acquisition of properties	Acquire 7 properties	$405,000.00
		Relocate Esplanade Road	$ 85,000.00
		Relocate services	$ 5,000.00
		Recreational facilities	$ 40,000.00
		TOTAL	$535,000.00
c)	Amended acquisition option	Acquire 4 properties	$260.000.00
		Relocate Esplanade Road	$ 85,000.00
		Relocate services	$ 5,000.00
		Recreational facilities	$ 40,000.00
		TOTAL	$390,000.00
d)	Amended Revetement plus acquisition	Rock revetement	$192,250.00
		Acquire 4 properties	$260,000.00
		Relocate Esplanade Road	$ 85,000.00
		Relocate services	$ 5,000.00
		Recreational facilities	$ 40,000.00
		TOTAL	$572,250.00
e)	Amended Revetement and fill	Rock revetement	$192,000.00
		Establishment	$ 15,000.00
		Random filling	$390,000.00
		TOTAL	$597,000.00

It can be seen that the amended acquisition option involving acquisition of 4 properties and realignment of the Esplanade Road eastward is significantly cheaper at $390,000.00 than the other options. The other options come in the following order of expense :

Acquisition of seven properties	$535,000.00
Amended Revetement plus acquisition	$572,250.00
Amended Revetement	$597,000.00
Revetement and fill	$789,250.00

The proposed option is the most expensive option and even then does not include any estimate for landscaping the area and establishing plants on the slope. It is estimated that this would cost in the order of $ although as acknowledged in the PER, it will be difficult to establish plants in this area which may increase the cost of this aspect.

At a time when Government places a high priority on cost savings it would indicate that the cheapest option should be adopted where it achieves the objective of protecting property as effectively as the other options and it has an acceptable level of impact.

5. PUBLIC SUBMISSIONS

Public comment on any PER is welcome and is considered during the assessment period. Four submissions were received, and they are summarised below.

Southern Districts Environment Group

- Opposed to the proposed fill and covering of the cliff face, on the grounds that :

  a) erosion of the cliff top could be kept under control without such a measure, and by that it was a feature of outstanding morphology and beauty and of geological interest.

  - the report disregarded the effect of traffic vibration on the Esplanade road. Closure of the Esplanade to through traffic is suggested.
  - Construction of the revetement was supported.
  - Concern was expressed at possible sedimentation of fill material through the revetement.
  - Plant lists to assist in rehabilitation of the area were submitted.

Conservation Council of S.A.

- The proposed revetement is supported.
- Loss of the natural cliff face is deplored and should be protected because of its importance geologically and as a landscape feature of the area.
- Landscaping should use endemic native plants as much as possible.
- No mention is made of the effects of traffic on erosion of the Esplanade.
- Consideration should be given to diverting through traffic to Witton Road.

Field Geology club of S. A.

- Support the proposed revetement.
- Concerned at the proposal to cover the cliff and request reconsideration of the proposal to retain as much as possible of the exposed natural cliff.
- The problem at Witton Bluff is that development is too close to the coast. It is hoped that this situation is not repeated in the developing areas of the coastline.

Geological Society of South Australia

- The Public Environmental rEport does not acknowledge that Witton Bluff is designated a Geological Monument.
- Particularly dissappointed that the proposed protection strategy would destroy it under fill.
- Disagree that the artificial landscaping of the cliffs will compensate for the loss of its special character and landscape appeal
- Rock fill of gullies may cause increased erosion unless properly designed
- Request a re-examination of the proposal to determine whether there can be a better balance of the conflicting interests.

CONCLUSIONS

REVETEMENT AND FILL

For	Against
. Long term solution	. Proposed revetement excessive
. Eliminates danger to public at base of cliff	. Removes a natural feature and attractive landscape - replaced with man-made feature
. Eliminates uncertainty of damage to property in long term	. Removes site of geological significance
	. Short term impact of construction - Noise, dust, traffic to residents, turbidity in marine environment
	. Most expensive option

ACQUISITION OF 7 PROPERTIES

For	Against
. Sufficiently long term solution 200-500 years	. Danger to public at base of cliff remains but controlled through blasting dangerous sections
. Retains natural landscape, and a metropolitan feature	. Short term impact of construction of roadworks for realigned Esplanade Road and demolition of houses
. Retains site geological significance	. Social impact - removal of housing stock
. Retains comparative seclusion of bays at Bluff	. Impact on residents
. Creates attractive park at top pf Bluff	
. Creates space for car parking at top of Bluff	
. Retains habitat for bird-life (nests)	
. Cheaper	

AMENDED REVETEMENT AND FILL

For

- Long term solution
- Eliminates danger to public on northern side of Bluff
- Retains site geological significance on southern side

Against

- Removes a natural feature on northern side
- Removes site geological significance on northern side
- Short term impact of construction, turbidity in marine environment
- public hazard on southern side remains same as present

AMENDED ACQUISITION - 4 PROPERTIES

For

- Long term solution 50-100 years
- Retains site geological significance
- Retains natural character of area
- Creates attractive park at top of Bluff
- Creates space for car parking at top of Bluff
- Retains habitat for bird-life
- Cheapest option

Against

- Danger to public remains
- Short term impact of construction
- Social impact - removal of 3 houses
- Impact on residents

AMENDED REVETEMENT PLUS ACQUISITION

For

- Long term solution
- Retains natural cliff in short term, long term erosion make slope more gentle
- Retains geological feature in short term
- Sufficient space for cliff top park

Against

- Social impact - loss of housing stock and impact on residents
- Loss of geological feature in long term

RECOMMENDATIONS AND CONCLUSIONS

A number of potential enviornmental impacts have been identified in this report and summarised above.

In the two extreme options of engineered total protection against acquisition and relocation of the road, the risk of damage to public (and private) property is minimised for a period of at least 100-200 years, and therefore that part of the objective can be fulfilled by either option. However, the public safety issue still remains as a significant negative environmental impact that must be weighed against the loss of aesthetic quality of the landscape and the loss of scientific value.

It is the view of the Assessments Branch, that the public risk of injury from falling debris does not outweigh the aesthetic and scientific value of the area in its natural state.

Accordingly, it is considered that the environmental impacts of the revetment and fill option are unacceptable in view of :

1. loss of aesthetic quality of the area
2. loss of scientifically value of the site
3. the ability to protect public and private property from unplanned damage and to reduce public risk of injury by the acquisition and relocation option at a lower economic and environmental cost.

It is recommended that :

1. The document entitled "Witton Bluff Protection Strategy Public Environmental Report" prepared by Pak Poy & Kneebone for the Corporation of the City of Noarlunga be accepted and forwarded with this Assessment Report to the Planning Commission in order to assist in their deliberations.

2. In view of the additional information presented in this report and the potential enviornmental impact of the proposed action, the Coast Portection Board may desire to change their advice forwarded to Council.

3. If the acquisition option is adopted, the extent of acquisition should be determined by the period of protection of public property required and by the need for sound road engineering practices.

4. If public safety and the social disruption of acquisition is considered paramount, and the revetment and fill option is retained, the revetment should extend only to the northern side of Witton Bluff as this would retain visual amenity from the south, retain most of the geological significance of the site and public risk would be relatively low.