This is the third part of a three part report. Continued from part 2

Appendix E

Definition of Options

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1 Introduction

A number of options were identified for each section of Buffalo Beach by the initial screening assessment as being technically or practically viable. These options were then carried through to the next stage to be assessed more thoroughly for social, economic and environmental impacts. The following describes each of these options in full.

Included in the definition of options is a statement on which tier of the hierarchy of responses the option would fall to be considered. National policy and best practice directs any assessment of options for managing coastal erosion to this hierarchy of responses, described as follows:

- Tier 1: Non-Structural Options, e.g. do nothing, management (protection) of natural systems and natural defences.
- Tier 2: Soft Structural Options, e.g. beach dewatering.
- Tier 3: Hard Structural Options, e.g.: seawalls, groynes and offshore breakwaters.

This hierarchy of responses directs those assessing coastal management options to Tier 1 as the most preferred option and Tier 3 as the least preferred option. (this hierarchy is also defined in the Glossary, Appendix J).

2 Buffalo Beach Southern Section

2.1 Status Quo

2.1.1 Description

This option essentially involves protection of the foreshore roads and properties by ongoing maintenance of the existing protection works.

Key elements of this option are:

- **Maintenance of existing rock protection works** extending over a total length of about 750-800m, from the toilet block on the foreshore (opposite the former hospital) south to the wharf.

These works are largely composed of dumped rock of various sizes and have not been properly engineered and require maintenance to maintain protection. A recent engineering report prepared by Tonkin and Taylor Ltd highlights severe deficiencies with the most critical area of protection (foreshore area north of Albert Street). Therefore, these works may need very high levels of maintenance in the future.

The works on the foreshore from Albert Street north over about 420m extend well forward onto the active beach on most occasions and there is only rarely a high tide beach along the face of this area.

- **Existing development controls**, including a 30m setback and a relocatability requirement for all new dwellings, additions and extensive renovations.

This area is under enormous development pressure and it is not clear if the 30m setback is still applied. The existence of important roads along the foreshore (including the former State Highway north of Albert Street) has tended to give rise to an assumption that the area will always need to be protected. There was also a period where this end of the beach was designated as a defended shoreline – because of previously proposed groyne and nourishment works.

Status quo is a tier 3 option in the hierarchy of response options promoted by the NZCPS and national climate change guidelines as the existing situation consists of hard engineering structures.

2.1.2 Estimated Costs

The major costs of this option will be associated with ongoing maintenance of the existing rock protection works.

In view of the deteriorated condition of the most exposed area of the works, it is anticipated that a high level of maintenance will be required – estimated at about $120,000 per annum.

2.2 Purchase of Beachfront Properties and Rezone as Open Space Policy Area

2.2.1 Description

This option would involve purchase of the most significantly affected properties and dwellings at current market value and designation of the area as reserve. Actions required include:

- **Purchase of relevant properties at market price**

There are at least 17 properties that would have to be purchased – being the foreshore properties within the area about 400m immediately north of Albert Street.

The properties along The Esplanade are insufficiently threatened by erosion to justify the cost of the purchase option in this area. It is also unlikely that the option would be practical in this area for various reasons. For instance, not only are the properties extremely expensive but the area is also fronted by Phoenix Palms that have significant local heritage value and protection. Continuation of the status quo has been assumed in this area.

- **Removal of existing dwellings from purchased properties** – sale of houses that are relocatable, demolition and removal of those that are not

It is probable that the toilet block on the foreshore would also have to be relocated to the new reserve.

- **Closure of the foreshore road over a distance of about 420m north of Albert Street**
- **Removal of existing coastal structures along the foreshore north of Albert Street (over a distance of 420m) and restoration of a natural foredune along the seaward margin of this area, estimated cost of $42,000**

- **Designation of the area as recreational or esplanade reserve**

As this option involves the removing of hard engineering structures and properties most at risk from coastal erosion then it would be classed as a tier 1 option in the hierarchy of options promoted in the NZCPS and national climate change guidance documents.

2.2.2 Estimated Costs

The cost of this option would be extremely high.

For instance, purchase of the most affected beachfront properties (1 to 18 Buffalo Beach Road) is likely to cost at least $18 million (based on most recent capital valuations) and possibly much more.

Removal of the existing dwellings, structures, roads, relocation of the toilet block, and dune restoration works would probably add a further $1.5 million.

Therefore, the total capital cost is likely to exceed $19.5 Million

2.3 Frontal Seawall

2.3.1 Description

This option involves the protection of foreshore roads and the private properties further landward through the replacement of the existing foreshore structures with a properly engineered rock wall - located along the alignment of the existing structures. Key elements of the option are:

- **Construction of a new rock seawall**

This structure would probably extend over the foreshore area from north of the wharf to the existing toilet block, a distance of about 800m. However, the wall might also be limited to the area north of Albert Street - as the existing structures along The Esplanade may be adequate for the erosion in this area with ongoing maintenance. The wall may need to extend slightly further north to protect the Buffalo Monument area and to enable the northern end of the wall to be located and designed to mitigate end effects.

The most appropriate length for the wall would need to be assessed during detailed design.

Apart from length, the details and dimensions of the structure would be similar to the frontal wall option for Buffalo north.

The wall would be entirely located on Council reserve land.

The portion of the wall north of Albert Street would be permanently exposed along the back of the beach and a high tide beach would rarely occur along the first 400-420m of this area.

Existing development controls would be maintained - to minimise complication of existing hazard should the wall need to be removed at some future date.

A rock seawall is a hard engineering structure and is therefore considered as a less favourable tier 3 option in the hierarchy mentioned in the NZCPS and national climate change guidance documents.

2.3.2 Estimated Costs

The capital cost of the wall is estimated at up to $3.2 million and maintenance costs are estimated at 2% per annum. Capital costs may be slightly reduced by recovery of usable rock from the existing walls.

2.4 Frontal Seawall and Rezoning of Beachfront Properties to Town Centre

2.4.1 Description

This option involves the rezoning of the existing beachfront residential areas to Town Centre. It also involves the protection of foreshore roads and the private properties further landward through the replacement of the existing foreshore structures with a properly engineered rock wall - located along the alignment of the existing structures. Key elements of the option are:

- Rezoning of properties from Housing Zone to Town Centre Zone through a Variation to the TCDP

The Variation would require a Section 32 assessment under the RMA, a publicly notified Variation with Council Hearing that could potentially be appealed by any affected parties. This would then mean that any properties located within this zone could undertake commercial activities.

- Construction of a new rock seawall (or similar)

This structure would probably extend over the foreshore area from north of the wharf to the existing toilet block, a distance of about 800m. However, the wall might also be limited to the area north of Albert Street - as the existing structures along The Esplanade may be adequate for the erosion in this area with ongoing maintenance. The wall may need to extend slightly further north to protect the Buffalo Monument area and to enable the northern end of the wall to be located and designed to mitigate end effects. The most appropriate length for the wall would need to be assessed during detailed design. Apart from length, the details and dimensions of the structure would be similar to the frontal wall option for Buffalo north. The wall would be entirely located on TCDC reserve land. The portion of the wall north of Albert Street would be permanently exposed along the back of the beach and a high tide beach would rarely occur along the first 400-420m of this area.

The key to this option is integrated redeveloped of the southern section of Buffalo Beach to reflect a truly commercial area that will draw tourism activity to the area.

A rock seawall is a hard engineering structure and is therefore considered as a less favourable tier 3 option in the hierarchy mentioned in the NZCPS and national climate change guidance documents.

2.4.2 Estimated Costs

It is difficult to estimate costs for this option, as it will depend on the final commercial development concept for the redevelopment of the southern section of Buffalo Beach. However, the capital cost of the wall is estimated at $4-5 million and maintenance costs are estimated at 2% per annum. Capital costs may be slightly reduced by recovery of usable rock from the existing walls.

Costs involved with a Variation to the TCDP to change the zoning of the properties from Residential to Town Centre could be in the vicinity of $600,000.

2.5 Realign Existing Frontal Seawall and One-Laning of Road

2.5.1 Description

This option involves the use of an engineered seawall to protect foreshore roads and the private properties further landward in the area at highest risk from erosion – i.e. the section of foreshore from Albert Street to about 420m north. However, the wall would be located as far landward as practical to mitigate adverse effects on the beach. The width of the foreshore road would be reduced to allow for the wall to be set back

This option only addresses the area of most severe erosion hazard, the 420m length of shoreline immediately north of Albert Street, as the Phoenix Palms prevent landward relocation of the rock wall in areas further south. The costs of protecting any additional areas would be similar to the frontal wall option. Therefore, in other foreshore areas, the status quo would be maintained.

The key elements of the option are:

- **Narrowing of existing foreshore road north of Albert Street**

The road in this area would be reduced either to a one-way road, (i.e. width of 4 metres) or closed and reduced to an access lane for foreshore properties. The area would also be managed to make it more pedestrian friendly to take advantage of the improved beach amenity - close to the centre of town and local motels. Therefore, even if a one-way road were maintained, this would probably involve speed humps. A pedestrian walkway would also be placed on the immediate landward side of the wall.

- **Removal of existing seawalls and construction of properly engineered frontal seawall further landward.**

The seawall will lie at least 7-9m landward of the existing seawall (the least setback occurring in the centre of the affected area) and further landward where practical (e.g. northern and southern ends of the area.

The seawall would not extend to the toilet block on the foreshore just south of Halligan Road or south of the The Esplanade – as these areas provide little to no opportunity for the new wall to be located further landward. In these areas, the existing works would either be maintained or replaced with a frontal wall in similar location – depending on a risk assessment during detailed design. Consideration could also be given during detailed design to the potential to relocate the toilet block to a suitable site behind the wall – though

there are major difficulties with moving or replacing foreshore toilet blocks due to objections from adjacent landowners.

Consideration would need to be given to relocating this toilet block to a suitable area existing protection works would be maintained in this area (or replaced if judged to be necessary).

Apart from length, the wall would be similar in design and dimensions to the frontal wall option.

The beach value benefits able to be achieved over the existing frontal seawall will depend on location of the wall. However, it is probable that a high tide beach would be restored along the full length of the structure on most occasions.

A rock seawall is a hard engineering structure and is therefore considered as a less favourable tier 3 option in the hierarchy mentioned in the NZCPS and national climate change guidance documents.

2.5.2 Estimated Costs

The capital cost of the 420m realigned seawall is estimated at up to $1.8 million (including excavation) with maintenance costs estimated at 2% per annum. As with the frontal wall, capital costs may be slightly reduced by recovery of usable rock from the existing walls.

The narrowing of the road over the 420m is estimated at $0.5 million.

Therefore, total capital costs are estimated at $1.9 million.

2.6 Groyne(s) plus Nourishment

2.6.1 Description

This option involves the use of a groyne and beach nourishment to retain a beach along the frontage of the affected roads and properties. This option has previously been investigated and modelled by Raudkivi (1986) who concluded that the option could be used to maintain a protective beach in this area.

There is net southward longshore transport along the Buffalo Breach foreshore - associated with the pattern of net sediment recirculation over the ebb tide delta. Therefore, any groynes placed in this area will trap longshore moving sand and a beach will be formed on the northern (i.e. updrift) side. This option involves locating a groyne at the southern end of the affected shoreline, designed to form and hold a protective beach along the front of the properties. Nourishment will be used to initiate a protective beach on the updrift side, so as to enhance the amenity of the area. As the groyne(s) at this site would be used to retain beach nourishment material then the groyne(s) could effectively be considered an artificial headland(s).

The key elements of the option would be:

- **Construction of the retaining groyne**

Detailed design would be required to establish the details of the groyne, including the length, orientation and location required to retain a beach over the length of the affected shoreline. However, it is probable that a hook groyne could be used similar to the design advocated by Raudkivi (1981; 1986). Similar features have worked reasonably well to date at Omaha Beach.

Based on Raudkivi's conceptual sketch the total length of the proposed groyne appears to be approximately 225m in length. Additional physical model results from University of Auckland also indicate that an additional 30m of scour protection would be required around the head of the groyne and along the southern flank to prevent scour due to the high current velocity concentrations through the Whitianga Harbour Inlet[1]. However, it is possible that the location and other details of the groyne may need to vary from the proposal modelled by Raudkivi – to ensure an adequate width of protective beach is established and to ensure the groyne is sufficiently removed from the entrance to avoid scour and other problems during periods of extreme entrance flow (e.g. during tsunami such as that experienced in May 1960).

- **Placement of beach nourishment**

Beach nourishment would be required to fill the groyne on the updrift side to provide an initial beach.

- **Other possible requirements**

It is unclear whether or not shoreline armouring would be required along the back of the beach with this option. This will depend to a large extent on whether or not an adequate width of protective beach and dune could be established along the affected shoreline to protect this area from erosion during severe storms. We have assumed that armouring will not be necessary but this is a matter that will require further consideration during specific design.

Issues that will need careful consideration in the detailed design of any groyne and nourishment option at the southern end of the beach include the length and shape of the groyne required to form a protective beach against this shoreline and the level of maintenance likely to be required to maintain this protective beach. These aspects can be particularly complex to resolve in near-entrance areas such as this - where high velocity tidal flows occur along the face of the beach fill, imparting the potential for significant removal of beach fill during periods of active wave stirring. It will be important to carefully review previous work and further detailed investigation and modelling may well be required.

A groyne is a hard engineering structure and is therefore considered as a less favourable tier 3 option in the hierarchy mentioned in the NZCPS and national climate change guidance documents. However, beach nourishment associated with the groyne is considered a soft tier 1 option in the hierarchy of responses.

[1] Tonkin & Taylor, 1998.

2.6.2 Estimated Costs

The cost of a 250m groyne is estimated as approximately $1.5 million with annual maintenance costs of 3-5%.

Beach nourishment to fill the groyne is likely to cost less than $0.2 million assuming the sand is available from the Waterways project. However, ongoing maintenance of the nourishment will eventually require sand from other sources. Maintenance costs could be in the order of $20,000 per year if sands have to be accessed from areas of the Coromandel inner continental shelf beyond Mercury Bay.

Therefore, total costs are estimated at $1.7 million and longer-term maintenance costs may average $80,000 per year.

3 Buffalo Beach Mid Section

3.1 Status Quo

3.1.1 Description

This option is essentially a continuation of the existing situation.

The area is dominated by wide reserves – largely grassed in the area south of Taputapuatea Stream and with rough vegetation (exotic grasses and various native species) in the area north of the stream. There is a low dune fronting the reserves to the north of Taputapuatea Stream but the areas south of the stream generally lack a dune.

The seaward margins of the reserves are well vegetated and there are no serious problems with wind blown sand spreading onto the reserves. Exotic grasses and weeds dominate the vegetation along the seaward margin both north and south of the stream and there is a general lack or paucity of native sand binding vegetation such as spinifex and pingao - except in a limited area immediately south of the stream. Therefore, natural dune building and repair is slow following periods of erosion.

The development in this area is well setback from the sea and neither erosion nor sea flooding pose any serious risk to Buffalo Beach Road behind the reserves or to private property and development further landward.

The reserve areas have generally been kept relatively barren of trees and shrubs apart from occasional Norfolk Pines, Phoenix Palms and pohutukawa. However, in recent years the local Beachcare group has been re-establishing a small area of native trees and shrubs in backdune areas immediately south of the Boat Club and the local Reserves Group has established pohutukawa along the foreshore and margins of the reserve to the south of the Taputapuatea Stream. Status quo is a tier 1 option in the hierarchy of response options promoted by the NZCPS and national climate change guidelines.

3.1.2 Estimated Costs

The continuation of the present option will involve limited ongoing cost – associated with ongoing plantings of trees by the Beachcare programme and maintenance of the pohutukawa south of the stream by the Reserves Group. These costs have typically averaged less than $2000 per year in recent years.

3.2 Dune Restoration

3.2.1 Description

This option essentially maintains the status quo but also involves the restoration of a naturally-vegetated dune along the seaward margin of the reserves.

This work would involve the removal of exotic vegetation over the most seaward 10-20m (variable) of the reserve – with re-establishment of spinifex and pingao along the seaward face and native ground covers further landward. Access management measures would be introduced to facilitate access to and from the beach and protect the sensitive native sand binders from trampling. Limited reshaping work would probably also be required in some areas prior to planting.

Over time, the plants would re-establish a low dune along the seaward margin. The native sand binders would also ensure the dune was self-repairing after periods of beach and dune erosion. The major aim of the work in terms of coastal hazard management I to facilitate natural dune repair following periods of erosion and to minimise wind blown sand losses over time. The work would also have benefits in terms of natural character, biodiversity and visual amenity.

Dune restoration is a tier 1 option in the hierarchy of response options promoted by the NZCPS and national climate change guidelines as it does not involve any engineered structures.

3.2.2 Estimated Costs

The dune restoration work would be progressively undertaken over a number of years (probably 12-15 years) using a community-based Beachcare approach. Experience at other eastern Coromandel sites suggests that a budget of $10000 per year would be adequate to progressively implement and maintain the dune restoration work. However, once the basic accessways and planting had been completed (probably 10—15 years), funding requirements would probably reduce – possibly to less than $5000 per year. However, to be precautionary, a figure of $10,000 per annum has been assumed. These costs would also incorporate the limited ongoing planting work presently being undertaken by the Beachcare and Reserves Groups.

4 Buffalo Beach Northern Section

4.1 Status Quo

4.1.1 Description

This option is essentially a continuation of the existing situation, i.e.:

- **Various seawalls**, including:
    - A 325 metre long mass bloc seawall reinforced with rock riprap along the seaward face extending along the frontage of 17 beachfront properties (105-137 Buffalo Beach Road), recently granted short-term consent (the period of consent still subject to appeal)
    - Un-consented rock walls extending along the face of 139 Buffalo Beach Road and the council reserve immediately north
    - An un-consented rock wall along the seaward face of 141 Buffalo Beach Road, located between the streams at the northern end of the study area. This wall is composed of relatively small rock and is in a degraded condition.

The seawalls are largely, though not entirely, located on reserve land managed by TCDC. The seawalls fronting the private properties from 105-139 Buffalo Beach Road are relatively robust structures but are not designed or constructed to normal engineering standards and the likely performance of these structures under serious erosion is unknown. The remaining seawalls are relatively ineffective and have been badly damaged in past storms.

- **Unprotected foreshore** south of 105 Buffalo Beach wall, subject to end effects erosion over a distance of 100-120m (though most markedly over about 50-60m) immediately south of the seawalls.
- **Placement of beach nourishment** to mitigate adverse effects of the seawalls on the adjacent beach.

This is an existing condition imposed on the consented portion of the present seawalls. It is anticipated the condition will also be imposed on the other seawall structures, if these are granted consent.

Over the term next few years, sands for nourishment will become available from the Whitianga Waterways development – with up to 110,000 cubic metres of sand likely to become available over time and to be delivered to the beach for free as part of the Waterways consent. However, there will be additional costs – such as those associated with levelling or shaping of the placed sand.

The costing of the status quo option assumes that the need for nourishment will have ceased by the time the available Waterways sand is exhausted, due to commencement of the next period of natural beach and dune recovery. However, there is considerable uncertainty around this aspect.

If significant ongoing nourishment is still required to mitigate the adverse effects of the seawalls once the Waterways sand is exhausted, the cost of the status quo option is likely to increase considerably. The sands within Mercury Bay are either finer than the beach sediments or (in limited areas) much coarser (see Figure 3.3 of Cooper, 2003); and therefore unsuitable for nourishment of the beach. The only alternative sources of suitable sand, if any, are likely to be areas of the inner continental shelf beyond the confines of Mercury Bay, several kilometres from Buffalo Beach and in depths of 8-15m. It is likely to cost at least $25 per cubic metre to excavate and transport sediment from these sources – assuming the sand is suitable.

Status quo is a tier 3 option in the hierarchy of response options promoted by the NZCPS and national climate change guidelines as the existing situation consists of hard engineering structures.

4.1.2 Estimated Costs

Given the limitations and uncertainties surrounding the existing structures, a moderate level of maintenance is anticipated – estimated at $70,000 per annum.

This costing excludes the structure along the frontage of 141 Buffalo Beach Road, which is judged to be ineffective. This seawall would need to be totally replaced. However, such work is outside the scope of the status quo and is addressed in the frontal seawall option.

The cost of beach nourishment (assuming 10,000 cubic metres per year – the maximum allowable with existing consents) is estimated as either:

- $30,000 per year – if obtained from the Waterways (assuming costs of up to $3 per cubic metre for shaping and other associated work). The Waterways consent provides for up to 110,000 cubic metres of suitable sand to be supplied to the beach and therefore could provide sand for up to 11 years. However, much of this sand may also be required at other Buffalo Beach sites.
- $250,000 per year if sands have to be sourced from offshore.

Costing has assumed that nourishment could be required for the first 12 of the next 50 years – with half this sand coming from the Waterways source (years 1-6) and the other half having to be sourced offshore (years 7-12).

4.2 Living with Coastal Erosion

4.2.1 Description

This option involves living with coastal erosion, while managing use and development of the properties to avoid or minimise risk to dwellings.

Key elements of the option would include:

- **Landward relocation or replacement of existing dwellings assessed to be at high risk from erosion in the absence of existing protection works**.

There are about five houses that would probably need to be relocated before existing protection works could be removed. On many sections, particularly towards the northern end there is only limited space for landward relocation. Moreover, while some of these houses could be relocated, there is at least one dwelling that would have to be demolished and replaced.

Even with this action, existing hazard setbacks (Environment Waikato, 2002) suggest there would be residual risk to most dwellings. In the event of severe erosion, up to 15 houses might need to be relocated – with 14 of these potentially having to be temporarily relocated offsite until the shoreline recovered. Therefore, while further investigations would be required to confirm the maximum likely erosion, the option involves considerable uncertainty in terms of the level of protection that can be provided to dwellings.

- **Removal of existing seawalls**

Ideally, a natural frontal dune would also be re-established along the landward margin to encourage natural dune recovery between storm events. However, on many sections this would tie up most of the remaining land seaward of the dwellings – especially towards the northern end.

As this option involves the removing of hard engineering structures and properties most at risk from coastal erosion then it would be classed as a tier 1 option in the hierarchy of options promoted in the NZCPS and national climate change guidance documents.

4.2.2 Estimated Costs

The costs associated with this option depend on the maximum erosion likely to occur in the absence of protection works and this is presently subject to uncertainty.

However, at the very least, the option is likely to require costs associated with:

- Landward relocation of about five dwellings, at least one of which would have to be demolished and replaced. These costs could be up to up to $400,000 (assuming $50k each for four relocations and $200k to demolish, remove and replace one dwelling).
- Removal of existing seawalls (total length of about 500m). These costs are assessed at approximately $100 per linear metre or $50,000 in total – though it is possible that the cost could be totally or substantially offset by sale of the large rocks and concrete massblocks fronting the properties from 105-139 Buffalo Beach Road.
- The removal of existing seawalls would also involve losses for the owners of 105-137 Buffalo Beach Road who have spent about $30,000 per property on the wall in this area.

There are various other costs and losses that may be incurred depending on the maximum extent of future erosion, including:

- Loss of capital value due to uncertainties in regard to future erosion,
- Potential costs of having to relocate up to 14 dwellings in the event of severe erosion,

- In the longer-term, with erosion aggravated by projected sea level rise, up to 14 properties may be rendered unusable by 2100 – these properties having a combined current capital valuation of approximately $11.5 million.

4.3 TCDC Purchase Properties, Relocate Buildings and Rezone as Open Space

4.3.1 Description

This option involves:

- Purchase of affected properties and dwellings at current market value
- Removal of existing dwellings of the properties – sale of houses that are relocatable, demolition and removal of those that are not
- Removal of existing coastal structures
- Restoration of a natural foredune along the seaward margin of the area
- Designation of the area as recreational or esplanade reserve

As this option involves the removing of hard engineering structures and properties most at risk from coastal erosion then it would be classed as a tier 1 option in the hierarchy of options promoted in the NZCPS and national climate change guidance documents.

4.3.2 Estimated Costs

The purchase of the 17 most affected beachfront properties (109B to 141 Buffalo Beach Road) is likely to cost at least $12 million (based on most recent capital valuations) but more probably about $15 million. Removal of the structures and dune restoration may cost up to $100,000 but will probably be significantly offset by recovery of rocks and concrete massblocks. Therefore, estimated capital costs are $15 million.

4.4 Frontal Seawall

4.4.1 Description

This option involves the protection of properties and dwellings by an engineered rock wall located seaward of property boundaries. Key elements of the option are:

- **A rock seawall** located along the seaward margin of the properties.

The total length of the seawall would be approximately 520m long, though in 2 distinct sections (north and south of Te Weiti Stream). The wall would be approximately 4-5m high (possibly only 3.5-4m north of Te Weiti Stream), have a seaward slope of 1V:2H, a D50 rock size of approximately 0.9m, and an armour layer thickness of about 2.0m The structure would be underlain by an appropriate geotextile filter.

The wall would primarily be located on Council reserve to the south of Te Weiti Stream, though this may not be the case to the north of the stream.

Existing structures would only be removed to the extent required to construct the new wall and it is probable that much of the rock recovered from the front of 109B to 137 Buffalo Beach Road could be used in the new structure.

The portion of the wall above prevailing beach levels would probably be exposed during erosive periods (as have prevailed since about the mid-late 1990's), though the section of wall south of Te Weiti Stream would be buried when the beach and dune are in a prograded state. The structure south of Te Weiti Stream would probably eliminate a high tide beach for most of the time during erosive periods, though the section north of Te Weiti Stream could have a less severe effect on most occasions – depending on location of the wall.

A rock seawall is a hard engineering structure and is therefore considered as a less favourable tier 3 option in the hierarchy mentioned in the NZCPS and national climate change guidance documents.

4.4.2 Estimated Costs

The capital cost of the wall is estimated at $2 million, with average annual maintenance costs estimated at $40,000 per year.

The costs of the wall would be largely (probably entirely) covered by the benefiting properties - as there is little benefit for the wider community and even some disbenefits.

4.5 Relocate Dwellings and Redevelopment with Backstop Wall.

4.5.1 Description

This option involves the use of an engineered seawall to protect property and dwellings – but with the structure located as far towards the landward edge of the dynamic envelope as reasonably practical, to minimise adverse on the beach and to be buried on most occasions.

The key elements of the option are:

- **Relocation or replacement of up to five existing houses** further landward (on the existing sections) to create room for wall.
- **Removal of existing seawalls** – together with excavation and construction of the replacement backstop seawall.

The wall will largely be located on private land. However, the section of wall to the south of Te Weiti Stream would be tied into public reserve at either end.

The maximum landward extension of the wall into private property would involve a balance between minimising adverse effects on the beach and minimising loss of private property. The ideal would be to place the wall where it would only be exposed by erosion very infrequently and for relatively short periods of time (say for a few weeks every 20 years). However, the maximum intrusion reasonably practical will probably be in the order of 10-12m from front section boundaries – possibly less from 125-139 Buffalo Beach Road where beachfront boundaries are further landward and properties have a lesser depth. The

best practicable location and the frequency of exposure (and other effects on the beach) will require detailed design and consultation.

The wall would be similar in design and dimensions to the frontal wall but would probably involve a lesser total height because of the lesser depth of embedment required to avoid undermining. As with the frontal wall, the top elevation would be designed to minimise or avoid wave overtopping, while minimising any impacts on views from adjacent properties and dwellings. The land behind the wall would be contoured according to landowner wishes, while the area in front of the wall would be maintained in a natural state (i.e. dune vegetated in natural sand grasses or, during periods of erosion, a beach).

The beach value benefits able to be achieved over a frontal wall will depend on location of the wall. However, in the longer-term, there is potential for the benefits to be lost due to the aggravation of beach erosion by projected sea level rise.

- **Ideally, the private land in front of the wall would be taken partly or wholly into public ownership** to eliminate potential legal issues in respect of access when the beach lies within the front edge of existing boundaries.

Provided an appropriate setback could be achieved for the wall, a vegetated natural dune would be maintained on the seaward side of the wall (except immediately after severe erosion) to assist in natural dune building and recovery, enhance natural character and to maintain a barrier between the public beach and adjacent private land.

4.5.2 Estimated Costs

The cost of the wall is estimated at $1.2 million. Removal (and also recovering suitable rock) from the existing seawalls could cost up to $50,000. Landward relocation of up to five existing houses is estimated at $400,000. Therefore, total capital cost is estimated at $1.55 million.

Maintenance costs are estimated at $20,000 or less per annum – provided the wall can be located sufficiently far landward to avoid frequent wave exposure.

If a sufficient setback can be achieved to keep adverse effects on the beach to a minimum (i.e. very infrequent exposure), there will be significant benefits for both property owners (see Cost Benefit Analysis in Appendix F) and the wider community, and therefore costs would probably be shared between these parties. The community share may also be further increased to purchase the land in front of the wall. Relative benefits can only be assessed once likely wall location is known.

4.6 Groyne(s) plus Nourishment

4.6.1 Description

This option involves the use of nourishment to widen the beach and dune sufficiently to protect properties from erosion. Nourishment would only be conducted adjacent to the affected properties and a groyne or groynes would be used to retain the placed sand in the

affected area. The existing seawalls would be retained but the option would be designed to ensure sufficient sand was placed to permanently bury these walls.

There is net southward longshore transport along the Buffalo Breach foreshore - associated with the pattern of net sediment recirculation over the ebb tide delta. Therefore, any groynes placed in this area will trap longshore moving sand and a beach will be formed on the northern (i.e. updrift) side. This option involves a groyne placed at the southern end of the affected shoreline, designed to form and hold a protective beach along the front of the properties. Nourishment will be used to form the protective beach so that the shoreline on the southern (i.e. downdrift) side of the groyne is not starved of sediment, which could otherwise aggravate erosion in that area. As the groyne(s) at this site would be used to retain beach nourishment material then, in the true sense, the groyne(s) would be considered an artificial headland(s).

The key elements of the option would be:

- **Construction of the retaining groyne(s)**

Detailed design would be required to establish groyne details; as design of these features is complex as the response of shorelines to groynes is a function of at least 27 different parameters (Kraus et al., 1994).

However, the groynes could involve either:

- **A single shore-perpendicular groyne located at the southern end of the affected area.** This groyne would probably need to extend to depths of about 2m below low water, requiring a length of about 200-220m, to contain most sand moving alongshore. Otherwise, high levels of maintenance may be required for the beach nourishment. However, a complication is that longer groynes require larger volumes of sand to fill them.
- **Two or three shorter groynes** extending to about low water – requiring less sand to fill and extending to lesser depths.

Detailed design will be required to estimate the right balance between numbers of groynes, groyne length, nourishment volumes and nourishment maintenance.

However, as a precaution, a groyne of 220m length and extending to 2m below low tide has been assumed for preliminary costing.

- **Placement of beach nourishment**

The volume of beach nourishment required is that necessary to both fill the groyne (to avoid downdrift erosion effects) and to maintain an adequate width of protective beach along the front of the properties. The volumes required to meet both these objectives would need to be assessed by detailed design.

However, preliminary estimates suggest that a volume of 100,000 cubic metres would be adequate to form a 30m wide protective beach along the 500m of affected shoreline. This should provide an adequate width of protective beach to protect the properties and ensure the existing seawalls remain buried under a dune system.

A groyne is a hard engineering structure and is therefore considered as a less favourable tier 3 option in the hierarchy mentioned in the NZCPS and national climate change guidance documents. However beach nourishment is considered a tier 1 option in the hierarchy, but only in isolation of any structures.

4.6.2 Estimated Costs

The cost will depend on the number and length of the groynes required – which will need to be assessed by detailed design and modelling. However, if a single groyne was used it would probably need to extend to depths of 2m below low water to adequately trap longshore moving sediment – requiring a groyne of about 220m length. A structure of this length is likely to cost about $1.2 million. If 2 shorter groynes were used, costs would probably be similar.

The cost of the beach nourishment will depend on the source. If the volume were taken from the quota (110,000 cubic metres) to be supplied from the Waterways site at no charge over the next few years – total costs would probably be less than $0.3 million (assuming $3 per cubic metre for levelling/shaping sands and other associated costs).

However, if the sand could be obtained locally but required purchasing, costs could be $10-15 per cubic metre including placement, giving total capital cost of $1-1.5 million. If the sands could not be obtained from local barrier deposits, the nearest likely source would be depths of 8-15m on the inner continental shelf – but well beyond the confines of Mercury Bay (sand within the bay is generally too fine to be used for nourishment at this site). Extracting and barging sand distances of 10-20 km could cost $25 per cubic metre or more – with a total capital cost of $2.5 million.

Therefore, lower limit capital costs for this option will probably be in the range of $1.5 million, while the upper limit costs could be as high as $3.2 million. An average figure of $2.35 million has been adopted for assessment.

The maintenance of the groyne and beach nourishment is difficult to estimate without more detailed design but could easily be 5% of capital cost, especially if the sand for nourishment had to be obtained from continental shelf areas beyond Mercury Bay.

4.7 Offshore Breakwater plus Nourishment

4.7.1 Description

This option involves the placement of a breakwater offshore from the beach – designed to create a seaward bulge in the shoreline (technically known as a salient) along the 500m frontage of the affected properties – of sufficient width to protect properties from erosion.

The option, if practicable at this site, would also restore a high tide beach backed by a natural dune. The existing consented seawall structures would probably be left in place but the design would ensure burial of these works.

The key elements of the option are:

- **Construction of an offshore breakwater** in appropriate location offshore from the affected area.

The breakwater is designed to refract waves and dissipate wave energy by breaking – creating a salient in the "wave shadow" of the breakwater.

The wave, current and sediment dynamics associated with the ebb tide delta could be a complication – though probably not as significant as sites close to the entrance of the harbour. However, given the extensive boating activities in Mercury Bay off Buffalo Beach (see background summary in Appendix B), navigation concerns will inevitably be a significant complication.

If the various design complications could be overcome, the required breakwater would probably need to be located in depths of 3m about 50 m offshore (assuming an emerging breakwater). The breakwater would probably extend over a total length of nearly 500m, but with breaks would have a net length of about 300m.

If an offshore surfing reef (fully submerged) type structure was used, it would probably be located further offshore.

- **Placement of sufficient beach nourishment to form the expected shoreline bulge (i.e. salient)**.

Ideally, beach nourishment is required so that formation of the salient does not draw sand from adjacent beach areas, thereby risking aggravation of erosion in these areas.

A breakwater is a hard engineering structure and is therefore considered as a less favourable tier 3 option in the hierarchy mentioned in the NZCPS and national climate change guidance documents.

4.7.2 Estimated Costs

It is difficult to estimate the costs of the breakwater and nourishment without detailed design. However, preliminary estimates suggest total capital costs are likely to be in the order of at least $4.3 million with maintenance costs averaging about 1% per annum.

Appendix F

Economic Analysis

Table of Contents

1 Economic Analysis

The economic analysis evaluates the options for management of the coast in terms of the overall impacts on society, including beachfront dwellers and the wider community.

2 Cost-Benefit Analysis Methodology

2.1 Objective of Analysis

Economics uses the term economic efficiency to define the optimal outcome for society. Options which are more efficient move society closer to an optimal outcome. The definition of optimality is based on the original definition posed by Italian economist Vilfredo Pareto as a point at which no other distribution of goods could be achieved that would make someone in society better off without making someone else worse off. But this pareto optimality criterion is difficult to achieve—changes usually make some people better off while making others worse off, e.g. protecting beach-front properties with a seawall reduces the naturalness of the beach as enjoyed by others. The criterion is modified by an additional test—can the winners compensate the losers? From the perspective of society as a whole, it does not matter if there are losers, so long as the benefits to the winners are, in aggregate, greater than the costs faced by the losers.

Under this definition[1], it does not matter if compensation is not actually paid to the losers. What is important is that it could have been paid. This then makes society as a whole better off and better able to tackle any distributional issues, such as occur when certain communities bear greater proportions of environmental damage. In contexts where these redistributions are never actually made, policy makers have sometimes concerned themselves with the distributional impacts of environmental policy.

In analysis here we are concerned with the aggregate position of the community; we use a national approach to the definition of costs and benefits. We will also comment on the distributional impacts of the effects.

2.2 Monetary Values and the Sustainable Development Framework

The analysis of impacts on economic efficiency is not an input to the economic section of a triple or quadruple bottom-line analysis. Economic analysis is measuring overall well-being impacts; it uses monetary values to rank people's preferences for different options. To understand differences in preferences, we use data available including:

- **revealed preferences** such as the time and effort that people spend in going to a beach, and the price premium on houses by the beach; and
- **stated preferences** in response to surveys.

Preferences for the outcomes of different management options will depend on environmental factors (naturalness of the setting), social factors (how good the recreational

[1] know as Kaldor-Hicks efficiency

experience is) and potentially cultural factors (their historical attachment to the beach). We do not separate these out; we seek only to measure how preferences change, regardless of the underlying reason.

2.3 Marginal Versus Average Effects

The primary interest in analysis is in the effects of changes—how will the different management options for the coast change the total well-being of the community. This is an analysis at the margin. However, measuring only marginal effects can lead to perverse results.

For example, the different management options will have different impacts on the attractiveness of the beaches to visitors and therefore on their enjoyment of the visit, and on the numbers of visitors or the duration of their stays. For many visitors, individual beaches are substitutable—if one beach is less attractive they can always go to another, possibly at a small additional cost or with a small reduction in quality of experience. When there are substitutes, the impact on visitor well-being of reducing the value of one individual beach, e.g. through construction of a seawall to protect properties, might be small. Despite the fact that people obtain considerable pleasure (well-being) from going to a beach, the value of an individual beach is limited by its substitutability. Figures 1a and 1b illustrate.

Figure 1a: Value of Beaches

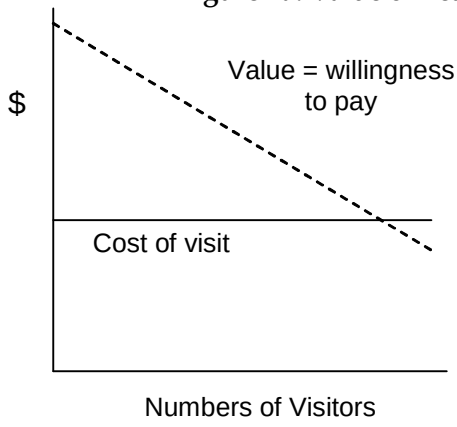


Figure 1b: Value of One Beach

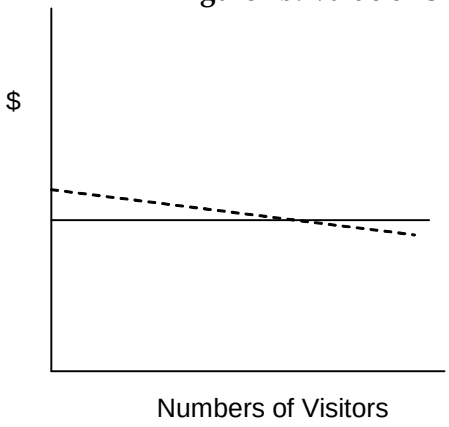


Figure 1a pictures the value that people obtain from beaches in general. It assumes that all visitors face the same costs to travel to a beach. To the left of the diagram the first visitors obtain a considerable benefit from the visit; they value beaches highly and gain a significant surplus from a visit—the difference between the costs of visiting and how much they would have been willing to pay to visit. As we move to the right, we find visitors for whom the value of the visit is close to the costs of getting there; they would be reasonably indifferent as to whether or not they went to the beach. Figure 1b shows the relationship when there are many substitutes. Here the willingness to pay to visit an individual beach is limited because any visitor can easily go to another beach and obtain a similar amount of pleasure.

The consequence for analysis of using this marginal approach is that an individual beach is measured as having a low value to visitors and there is little cost to beach damage via a reduction in its qualities. This can be appropriate if the policy choice will only ever relate to one beach.

If one beach is reduced in quality, the demand for other beaches increases; this is equivalent to an increase in value. Damage to the quality of the next beach will lead to further increases in demand and thus value of the remaining beaches, to a point where the costs of additional damage will be greater than the benefits. But such an approach leads to a distribution of damage that reflects the order in which the beaches are analysed, rather than it reflecting an optimal level of damage or beach value protection.

An analysis using average costs, using the demand curve for beaches in general (Figure 1a) is more appropriate for analysis of a policy type decision that will apply to numerous beaches. The analysis here has elements of both; it is intended to be an analysis of a single beach but using an approach that might be applied elsewhere. We have adopted the average approach to analysis.

2.4 Cost Definitions

The analysis measures the changes in real resource costs at the appropriate level. At the national level, taxes for example, are not costs but they are transfers between consumers and the government. These transfers are separated out in our assessment.

2.5 Counter-factual Assumptions

For analysis we evaluate all options against the status quo. This assumes that the current situation continues, i.e. there is some protection of existing houses via sea walls, but it is not reliable, whereby there is some discounting of current house values.

3 Well-being and Beaches

Beaches contribute to community well-being. We know this because:

- people choose to visit beaches at some cost, including those who choose to live at the beach at some price premium over alternative places to live; and
- surveys have recorded community interest in beach environments.

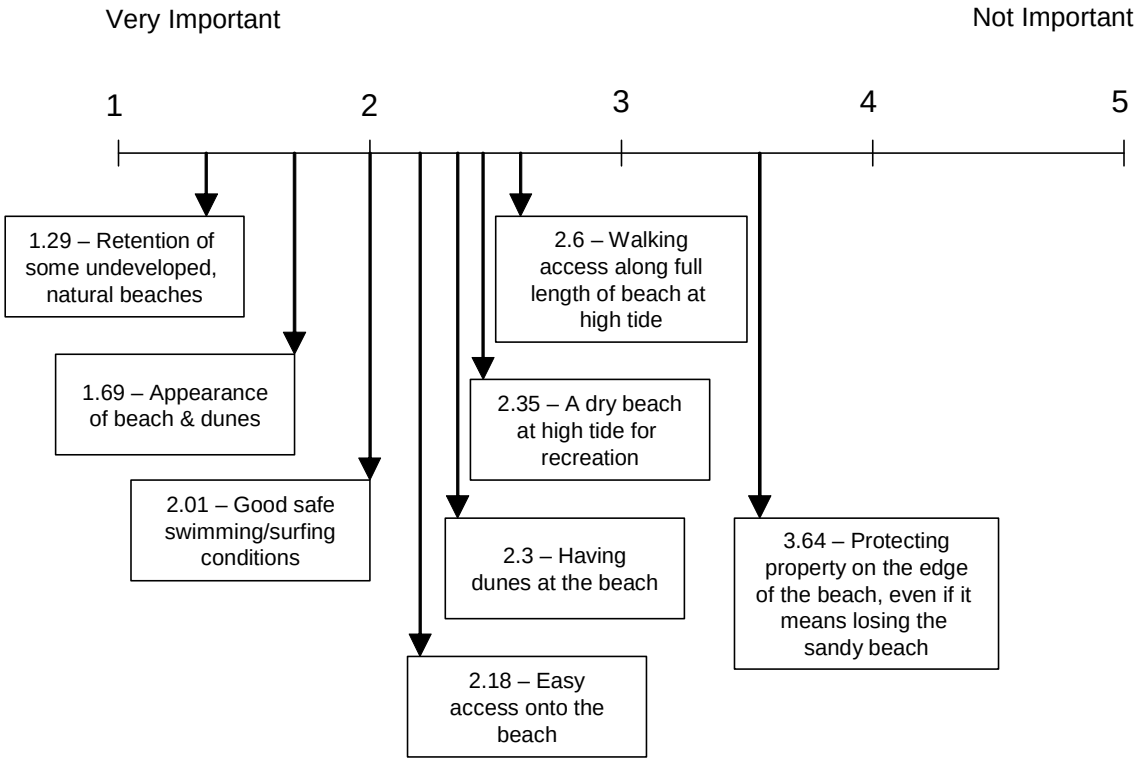
A recent survey for Environment Waikato reviewed available research, both from New Zealand and other countries, on beach use, beach values and perceptions of coastal erosion[2]. It identified a number of factors that contributed to beach value. Additional

[2] Dahm C (2002) Beach User Values and Perceptions of Coastal Erosion. Final. Environment Waikato.

research used the specification of the values to derive a weighting of preferences for beach values[3]. These are illustrated in Figure 2.

The main impacts of the management options we are assessing are on some of these valued parameters: the naturalness of the beach, its appearance and availability of beach at high tide for walking and recreation.

Figure 2: Average Rating of Beaches on 5-Point Scale



Source: Thomson J (2003) Coastal Values and Beach Use Report. Prepared by Jill Thomson Eclectic Energy for: Community, Economy and Environment Programme, Environment Waikato

These different elements make up the value of the beach from the perspective of those who live there and those who visit.

Below we analyse a number of individual impacts that result from the management options.

[3] Thomson J (2003) Coastal Values and Beach Use Report. Prepared by Jill Thomson Eclectic Energy for: Community, Economy and Environment Programme, Environment Waikato.

4 Impacts of Loss of Property

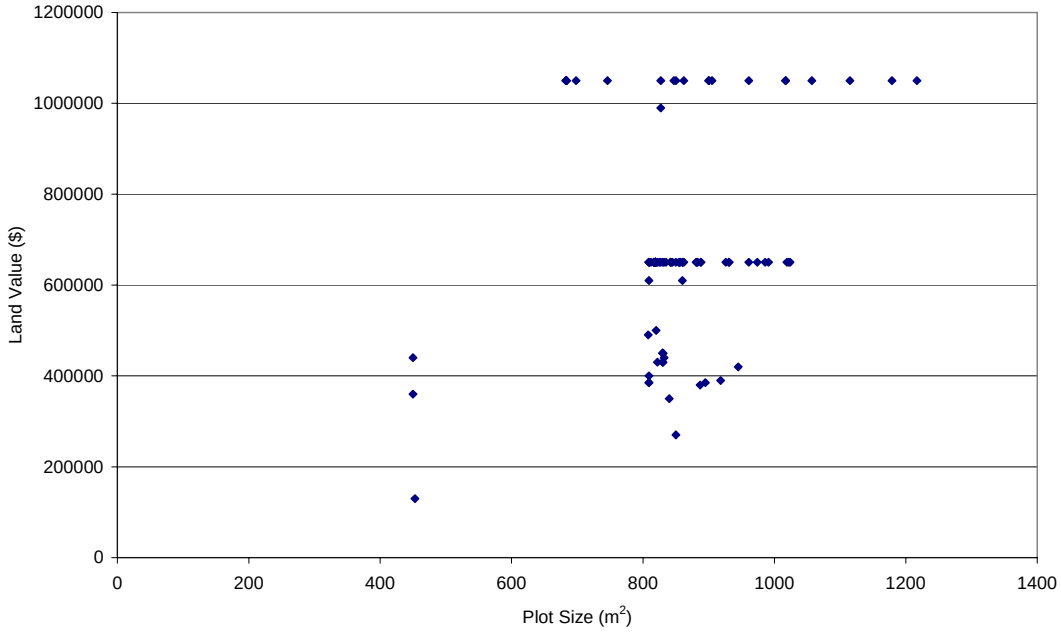
Property loss as a result of coastal erosion has two effects. There is a reduction in the land area of properties and, in extreme cases, loss of houses or the need to shift them. We examine both effects.

The analysis at Buffalo Beach has concentrated on the strip of beachfront properties at most risk from coastal erosion. Losses of land and houses are real resource costs. Their capital values represent the willingness of pay of residents to live at Buffalo Beach. We use quoted values from Environment Waikato's property database as our basis for estimating the impacts of property values.

4.1 Loss of Land

To understand the cost of a reduction in property size, we examined the current relationship between land value and property size, using the Regional Council's property database. An analysis of property values for Cooks Beach beachfront properties[4] (Figure3) suggested that there is no meaningful relationship between plot size and land value; regression analysis of these data failed to produce any statistically significant relationship.

Figure 3: Relationship between Plot Size and Land Value—Cooks Beach



Our assumption is therefore that marginal reductions in plot size will have no measurable effect on land and thus property value. If losses of plot size became significant it is likely that the perceived risk of losing the house itself affects the property value, rather than the loss of land. This conclusion is confirmed from discussions with local real estate agents.

[4] Cooks Beach figures were used as there was no data available for Buffalo Beach and Cooks Beach is considered to be similar.

4.2 Loss of Houses

The loss of houses could have a significant cost. At some point the level of encroachment is such that the house is either moved or demolished. Alternatively, a management choice might be made to force houses to be moved or demolished. The costs of house removal are estimated to include the costs of land elsewhere to accommodate the people shifted, the reduction in consumer surplus (well-being) associated with a lesser quality plot of land plus either the costs of shifting the house and connecting it to networks, or the costs of demolishing the house plus the costs of building a new one.

The cost of a property elsewhere, plus the reduction in consumer surplus, is equivalent in value to the current land value of the properties. For the house-related costs, we assume the loss of current improved value of the at-risk properties plus $10,000[5] for the costs of demolition; the assumption here is that the current occupiers purchase a property elsewhere and there is an additional cost of demolition and removal.

The total cost is therefore estimated as equal to the current capital value of the at-risk properties plus $10,000 per property. From the property database, the average capital value of the at-risk properties is approximately $820,000.

Where houses are simply shifted within their current plots, we have assumed a cost of $50,000 per house to move the house and reconnect with services.

4.3 Compensating Value Improvements

If beachfront property is lost, a new set of houses become the beachfront properties and increase in value. For this analysis we use land values to ensure that we are not taking account of differences in the value of the houses themselves. The difference in land value between beach-front and second-row properties is approximately $311,000. We use this as the value of compensating improvement for houses that become beachfront properties.

5 Value of Property Protection

Some risk of property loss is built into the current property value. The arrangement of properties at Buffalo Beach is such that there is no simple comparison of properties at-risk and similar properties not at risk of erosion. We therefore use values derived for Cooks Beach and estimate that, in the absence of the risk of erosion, beachfront properties would have an average capital value of $1.12 million, i.e. a difference of approximately $300,000 per property[6]. And for analysis, we assume that the protection of the at-risk properties would have a benefit of $300,000 per property.

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[5] As advised by demolition company, Winston Jacob Ltd

[6] We have used the current value of properties at Buffalo Beach alongside data on the value of properties, not at risk from erosion, taken from Cooks Beach. This approach was adopted because of the absence of data on suitable properties at Buffalo Beach. Therefore the assumption is that, given adequate protection from erosion, beachfront properties at Buffalo Beach would be valued at $1.12 million.

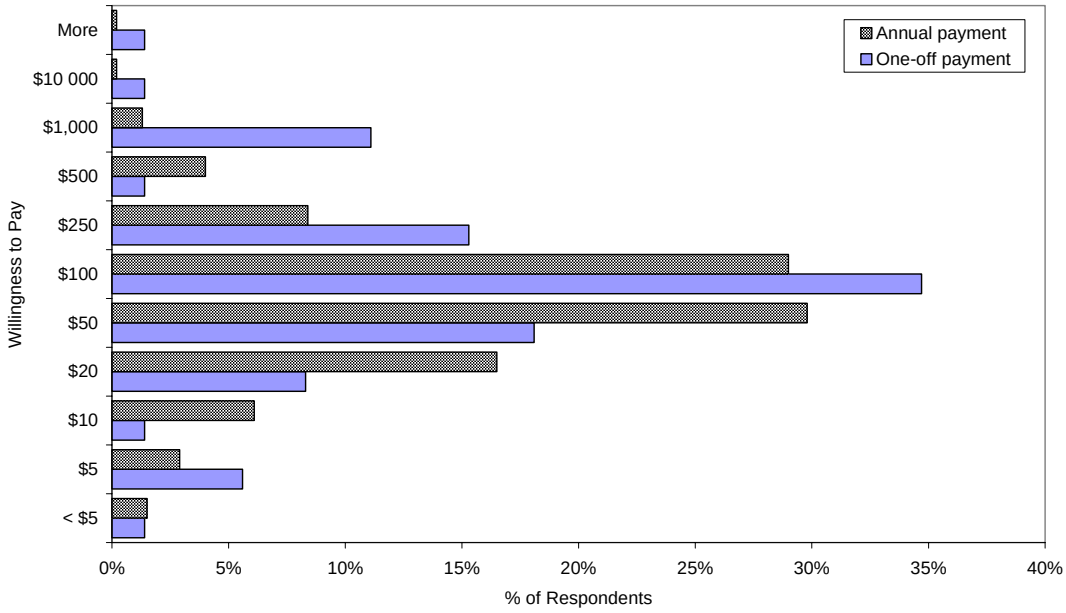
6 Impacts of Reductions in Natural Values

The management options differ in their impacts on beach user values, i.e. the overall value of a visit to the beach. The factors that determine the visit value include the naturalness of the setting, the beach aesthetics and the ability to walk along the beach or otherwise use it for recreational activities at both low and high tides.

A national coastal survey was used to estimate the public's willingness to pay for improvements in the natural character of beaches. Respondents resident at beaches were asked their willingness to pay, via their rates, for "new dune care and planting, including the replacement of current hard defences"[7].

Because of the small sample sizes for individual beaches, we have analysed a wider set of data for a number of North Island beaches[8]. The survey included results of those specifying a willingness to pay to improve natural character as a one-off payment and as an annual payment. The results are shown in Figure 4. As might be expected, the higher stated willingness to pay is for one-off payments.

Figure 4: Willingness to Pay of Residents for Improvements in Natural Character



Source: D Johnston, Institute of Geological and Nuclear Sciences Ltd, personal communication

The weighted average willingness to pay specified as a one-off payment is $1677 (at a 5% discount rate) or $913 at a 10% rate. As an annual payment the weighted averages are $91 and $92 at 5% and 10% discount rates respectively.

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[7] Johnston D, Leonard G, Bell R, Stewart C, Hickman M, Thompson J, Kerr J and Glassey P (undated) 2003 National Coastal Survey. Institute of Geological & Nuclear Sciences Limited

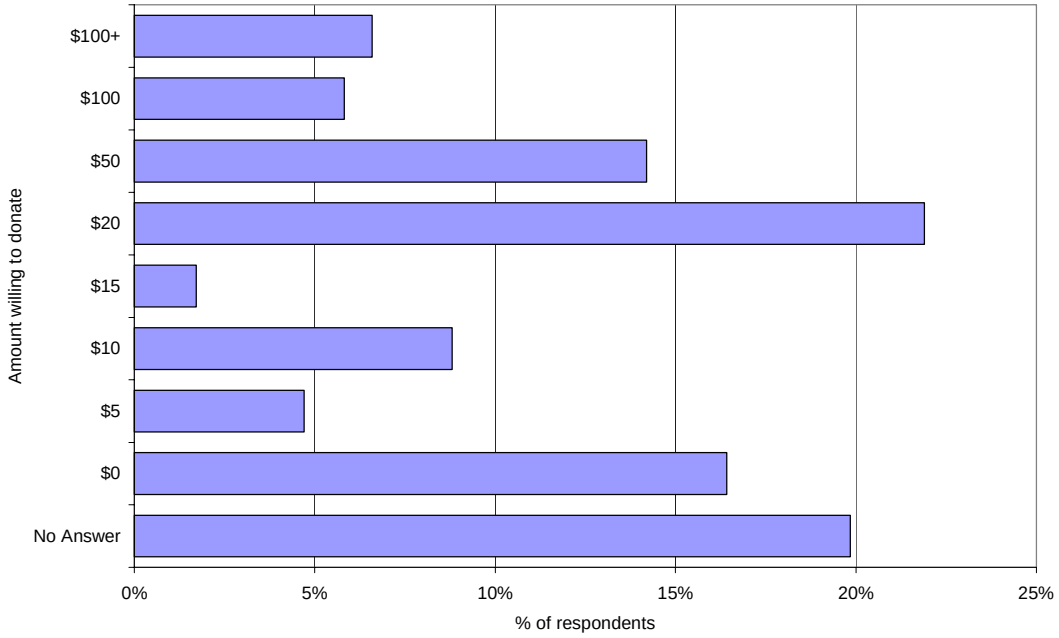
[8] Coastlands, Cooks Beach, Langs Beach, Maketu, Mount Maunganui, Ohope, Omaha, Papamoa, Pukehina, Waihi Beach, Whangamata, Whitianga

We use these figures in analysis[9].

Another study asked Waikato region residents their willingness to pay to protect beaches in their natural state. This was a more generalised survey to a wider cross section of people, not necessarily residents nor visitors to a beach, and the answers apply to all beaches not to an individual beach. The question asked was "how much would you donate to protect our beaches in a healthy, natural state?" The results are shown in Figure 5.

The weighted average value depends on what is assumed by a stated willingness to pay of more than $100[10]. If we assume $250, the weighted average willingness to pay is $35/person; at $500, the weighted average is $52. In contrast to the data above, when the same question was asked to people that owned beach property, the weighted average donation that owners were willing to give was $42 (assuming $250 for the over $100 category, or $65 assuming $500).

Figure 5: Willingness to Pay to Protect All Beaches in their Natural State



To compare with these values, Table 1 presents the results of a series of studies in New Zealand on the value of recreational visits to natural areas, taken from a database maintained by Geoff Kerr (Lincoln University). We have converted all figures to 2004 dollar values[11].

It includes results from studies using two methods:

[9] We use a one-off payment, although in practice it does not matter which approach is used.

[10] Following the conclusions in the study, we assume that those stating no answer were unwilling to donate anything.

[11] Using the Reserve Bank of New Zealand's CPI Inflation calculator www.rbnz.govt.nz/statistics/0135595.html

- Travel Cost (TC), which analyses how much people spent in travelling to a recreational site, used as a proxy for willingness to pay—it is a minimum willingness to pay; people must be willing to pay at least that amount as they already have;
- Contingent Valuation (CV) which uses surveys to ask people directly, how much they would be willing to pay. It results in higher values as it measures the additional surplus that visitors enjoy over and above their costs of visiting.

The contingent valuation studies provide potentially higher values because they incorporate people's willingness to pay, beyond what they might actually have to pay. Thus Bottle Lake Forest recreation has an average visitor value of $2/visit using travel costs but $36/visit using contingent valuation; the difference represents an estimate of the visitor surplus enjoyed.

The research suggests that recreational values for day visits range widely, from $2 to over $100, but that the highest value recreation visits are for specialist activities, eg canoeing ($81-$109/person/visit), skiing ($175/person) and fishing ($76/person/visit), or for visiting unique sites, such as Mt Cook ($83). More general recreation is valued at approximately $10/person/visit, with a maximum value of $56 for Hanmer Forest Park. This latter site has a high estimated travel cost and therefore a low surplus (contingent valuations are actually lower than the travel cost estimate but suggest that there is little additional value above the costs of getting there). This is similar to the results of assessments of the value of visits to Auckland regional parks (Table 2).

Table 1: Results from NZ Non-Market Valuation Studies

	Year		Methodology[1]
Hanmer Forest Park	1985	$56/person/visit	TC
Hanmer Forest Park	1986	$5.03 - $54.40/person/visit	CV
Wanganui River recreational canoeing	1986	$80.66-$109.41/person/visit	CV
Visitors to Mount Cook	1986	$83/person/visit	TC
National Park visitor centres	1988	$3.84/person/visit	CV
Camping, Tararua Forest Park	1988	$7.53/person/night	CV
Whangamarino wetland preservation	1988	$9.68-$18.64/household/year	CV
Whakapapa skifield recreation	1989	$93/person/year (summer) $175/person/year (winter)	TC
Wanganui River recreation	1989	$147/person/visit	TC
Reduction in flood risk Waimakariri river	1989	$65-$748/ratepayer/year	CV
Climbers at Mt Cook	1989	$226-$282	TC
Kaitoke Regional Park recreation	1990	$8.44/visit	TC
Recreational hunting	1990	$18/hunter/day	TC
Hollyford Valley walking track	1991	$121-$173/year	CV
Kauaeranga Valley recreation	1991	$5-$10/person/year	CV
Preservation of Aorangi Awarua forest block	1992	$10.92/household/year	CV
Bottle Lake Forest recreation	1992	$2.03/visit	TC
Bottle Lake Forest recreation	1992	$36/visit	CV
Ashburton river water instream values	1991/ 92	$63-$201/angler household/year $35-$119/non-angler household/year	CV
Improved water quality, Lower Waimakariri River	1993	$115-$165/household/year	CV
New recreational lake	1994	$45-$98/household/year	CV
Greenstone & Caples Valleys recreation	1996	$32/tramper/visit; $68/hunter/visit; $45/angler/visit	CV
Wellington Regional Council parks	1996	$12.08/person/visit	CV
Fishing Tongariro river	1997	$76/person/visit	CV
Orakei basin water quality	1997	$11.39-$12.30/household/year	CV
Rangitata River salmon angling	2001	$43-$110/angler/visit	TC

[1] TC = Travel Cost method; CV = Contingent Valuation

Source: New Zealand Non-Market Valuation Database (http://learn.lincoln.ac.nz/markval/)

Table 2: Values of Visits to Auckland Regional Parks

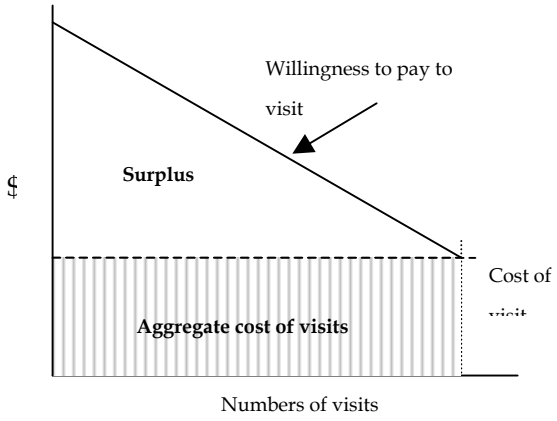
Activity	Unit Day Values ($)
General recreation	11.00
Specialised recreation	26.00
Camping	9.00
Education	11.00
Special Event	30.00

Source: Ball RJ, Saunders CM and Cullen R (1997) Auckland Regional Parks Network: Assessment of Benefits & Expenditure Recovery Options. Lincoln University, Canterbury, NZ

The highest values recorded in Table 1 are for reductions in threats to property—reduction in flood risk at the Waimakariri River.

Our interest in these analyses is in the surplus obtained per visit (see Figure 6). Thus higher surpluses can be obtainable for recreational sites closer to population centres.

Figure 6: Visitor Surpluses



This simple picture shows many visitors, all with the same cost of travel to the park. The aggregate cost of visits (visits x costs) is the area under the cost of visit line. This is the total private cost of recreational visits. Some people would have been willing to pay (WTP) a lot for their visit; they are at the left hand side of the graph—for them there is a large surplus. In theory, the last person to visit the park will be the one whose cost of visit is exactly equal to WTP. The total surplus is the difference between aggregate WTP and aggregate private costs.
Under a cost-benefit framework, the surplus represents the net benefits of the visits to the site.

If we use travel costs to analyse the willingness to pay to visit Buffalo Beach, the suggested values are approximately $330/person (see Annex A). This is significantly above the values presented above, and reflects the fact that the Coromandel is a holiday destination, rather than a day trip destination.

There is a possible additional surplus relating to the costs of travel. Private costs of travel include a tax element—duties and GST on petrol. This is a transfer payment to government and not a cost to society. However, there are external costs of transport that include pollution (air pollutants, greenhouse gases and road run-off) and road damage effects that are not explicitly priced. It is possible that, for rural travel, the level of these external costs is less than the amount of tax paid on petrol, and therefore there is an additional social surplus when people make private choices to visit Coromandel beaches. The tax on petrol element of the total estimated travel cost is approximately 5% or $15 per person. However, we have no information on whether or how much of this is an additional social surplus. We have not included this in analysis.

Surpluses can be enhanced by the quality of the site. A survey in South Africa[12] estimated the current travel costs to visit selected beaches in the Cape Peninsula; the mean trip cost was R4.90 for residents and R4.20 for tourists. The researchers subsequently asked what people would be willing to pay to visit a clean beach. On the basis of a photograph, 43.5% of residents stated that they would be willing to travel 50 km or more to visit a clean beach; this had an estimated minimum trip cost of R35.50. The difference between this willingness to pay and the current travel costs was the researchers' estimate of the surplus that would be received by visitors to the current beaches if made clean.

We use the New Zealand data above to identify two values for analysis:

[12] Balance A, Turpie J and Ryan P (In draft) The recreational demand for clean beaches and economic impacts of pollution: a case study from the Cape Peninsula, South Africa. www.econ4env.co.za/wip/anna2%20-%20econ_beach.doc

- A value of beach naturalness to residents, valued at $1677 per property owner (or $913 at a 10% discount rate). This is a one-off cost. Spread across 1850 residents, this value totals approximately $3 million (at a 5% discount rate or $1.7 million at a 10% rate).
- The value of a beach visit to visitors on the basis of the full set of beach attributes. We make an assumption of the size of the surplus, above the costs of visiting the beach, as $10/visit. This corresponds to a total of $5.5 million per annum for 550,000 visits. We use sensitivity analysis to test higher amounts.

In analysis we make assumptions regarding the extent to which each management option contributes towards increases or decreases in total beach value.

7 Analysis of Management Options -General

Analysis of all options is undertaken relative to the current state of the beach in terms of naturalness and the values that it offers to visitors and residents. Thus the status quo is our counterfactual for analysis. This is different from the approach taken in the multi-criteria analysis. However, whereas the stance taken for cost benefit analysis will change the absolute values of costs and benefits, it will not change the ranking of options.

A number of assumptions are adopted for analysis. The general assumptions are summarised in Table 3.

Table 3: Assumptions for Economic Analysis

Factor	Assumption
Visitor numbers (per annum) – assumes one third each for N, S and mid-beach[13]	169,000[14]
Visitor nights (per annum) – assumes one third each for N, S and mid-beach	553,000[12]
Total Properties	1850
Growth in visitor numbers (per annum)	2.3%
Houses currently at risk of inundation	17
Average capital value of beach front property at risk of inundation	$820,000
Cost of house demolition	$10,000
Increase in beachfront property capital value from removal of erosion risk	$300,000
Further decrease in beachfront property capital value from removal of wall	$300,000
Increase in capital value of current 2nd row houses from becoming beachfront	$310000
Number of 2nd row houses that could potentially gain	15
Costs of moving a house and reconnecting to networks	$50,000
Value of beach naturalness to residents per household	$1677
Surplus value of beach visit obtained by visitors (including naturalness value)/visit	$10

[13] One third of visitors for each section of beach is used to avoid triple counting values.

[14] Tourism Coromandel, 2004

8 Analysis of Management Options – Buffalo North

8.1 Assumptions for Analysis

There are a number of assumptions that are specific to the individual management options. The naturalness change represents the improvement in the overall natural qualities of the total beach environment associated with the management options. We have assumed that these effects are small because they affect only a small part of the beach. And although we use the term naturalness, it effectively corresponds to a set of attributes that make up the attractiveness of the beach to people; this will include its natural character and the suitability of the beach for recreation. Under the options analysed, these characteristics move in the same direction. Large frontal seawalls will make the beach less natural to look at; they will also lead to more beach scouring reducing the amount of beach available for recreational activities, particularly at high tide. The individual percentages are used with the values of visits and the value of naturalness to residents. For example, a 5% improvement would be valued at $0.50/visit to the beach (5% of $10).

The start year for all projects is given as year zero (which might be any future start year). All costs and benefits are discounted back to year zero. We have used three discount rates for analysis—2%, 5% and 10% (see Annex B for a justification of these rates).

Table 4: Input Assumptions—Buffalo North

Option Specific Assumptions	Status Quo	Live with Erosion	TCDC Buy Properties and Rezone Open Space	Frontal Seawall	Relocate and Redevelop with a backstop wall	Groyne plus nourish-ment	Off-shore break-water
Naturalness change	0%	5%	5%	0%	5%	2%	2%
Year of start		0	0	0	0	0	0
Year of property pruchase			5				
Capital Cost ($ million)		0.035	0.035	2	1.64	2.4	4.25
Maintenance Cost ($'000 per annum)	30[1]		-	40	15	24[2]	420[3]
Houses moved off site		1	17		1		
Houses risk of inundation		15					
Houses moved back within site		4			4		

[1] For years 0 to 6; thereafter $250,000 p.a. until year 10

[2] Every 5 years.

[3] Every 10 years

The evaluation of the different options at Buffalo Beach North is given below.

8.2 Status Quo

There is an estimated $30,000 per annum cost for maintaining existing structures, but no additional capital costs. These maintenance costs are assumed to increase to $250,000 per annum in year 6 and to continue until year 10. The current beach qualities are maintained. At a 5% discount rate the total net cost is $1.0 million.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Maintenance Costs	-1.2	-1.0	-0.7
Benefits		0	0
Net Present Value	-1.2	-1.0	-0.7

8.3 Living with Coastal Erosion

This option involves removal of existing structures and allowing the beach to return to natural cycles. It is assumed that there will be a need to move 4 existing beachfront houses back within their current sites. In addition, 15 houses face additional risks of erosion and 1 house has to be moved off site. The benefits are in a gain in the naturalness of a small section of the beach—we assume that the gain is equal to 5% of the total beach surplus value. This option has high net costs because of the property losses; these are up-front losses to the capital value that occur when the current structures are removed. The naturalness benefits are spread out over time; thus the net costs of this option are higher under higher discount rates.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-0.035	-0.035	-0.035
Property Loss	-5.5	-5.5	-5.5
Total	-5.6	-5.6	-5.6
Benefits			
Naturalness gain	5.1	2.7	1.3
Net Present Value	-0.5	-2.9	-4.3

It is likely that there will be some additional transaction (legal) costs associated with this option; we have not quantified these.

8.4 TCDC Buy Properties and Rezone as Open Space

This option has similar impacts Living with Coastal Erosion, in that the existing structures are removed and there is no replacement with any structure to protect the current houses at risk. Under this option, 17 front row houses are compulsorily removed from their current sites and have to move elsewhere; we assume this occurs after 5 years. There is a compensating gain in property value for second row houses, which become beachfront properties. Because we assume there is a delay in the time of house removal—it will take some time to negotiate this policy—the property-related costs are delayed and are reduced further under higher discount rates.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital cost	-0.035	-0.035	-0.035
Property Cost	-12.8	-11.1	-8.8
Total	-12.8	-11.1	-8.8
Benefits			
Naturalness gain	5.1	2.7	1.3
Property gain	4.2	3.6	2.9
Total	9.3	6.3	4.2
Net Present Value	-3.5	-4.8	-4.6

It is likely that there will be some additional transaction (legal) costs associated with this option; we have not quantified these.

8.5 Frontal Seawall

The existing structures are replaced by a single, larger solid wall. We assume that, whereas it is a larger, more dominating structure, it is less ugly than what is there at the moment. Thus there is no change to the current naturalness of the site. There is an upfront capital cost and ongoing maintenance costs. There is a gain in property values compared with the status quo because of the greater certainty of protection of existing properties.

Most of the costs and benefits are up-front but there are ongoing maintenance costs that reduce in importance under higher discount rates.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-2.0	-2.0	-2.0
Maintenance Cost	-1.3	-0.8	-0.4
Total	-3.3	-2.8	-2.4
Benefits			
Property gain	5.1	5.1	5.1
Net Present Value	1.8	2.3	2.7

8.6 Relocate dwellings and redevelop with a backstop wall

The backstop wall has significant capital and maintenance costs, and there is an assumption that 4 properties will need to be moved backwards on their current sites and one moved off site.

There are benefits in terms of improved beach naturalness (5% gain) and gains to the value of beachfront properties because of the removal of risk of inundation[15]. In comparison with the frontal seawall, this option is a lower cost way to protect property values at the lowest discount rate (2%). At 5% and 10% rates, the value of improved naturalness affects the relative ranking of the options.

[15] Assuming that the structure is appropriately engineered to mitigate risk of inundation by considering future sea level rise effects (where sea level rise is estimated at 0.5 per 100 years – IPCC).

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-1.6	-1.6	-1.6
Maintenance Cost	-0.5	-0.3	-0.2
Property costs	-1.0	-1.0	-1.0
Total	-3.2	-3.0	-2.8
Benefits			
Naturalness gain	5.1	2.7	1.3
Property gain	5.1	5.1	5.1
Total	10.2	7.8	6.5
Net Present Value	7.0	4.8	3.6

8.7 Groyne plus Nourishment

There are significant capital and maintenance costs but a gain in improved naturalness (2% assumed) and gain to existing properties via protection of current value.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-2.4	-2.4	-2.4
Maintenance Cost	-0.1	-0.07	-0.04
Total	-2.5	-2.5	-2.4
Benefits			
Naturalness gain	2.0	1.0	0.5
Property gain	5.1	5.1	5.1
Total	7.1	6.1	5.6
Net Present Value	4.6	3.7	3.2

8.8 Offshore Breakwater

There are significant capital and maintenance costs but a gain in improved naturalness (2% assumed) and gain to existing properties via protection of current value.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-4.3	-4.3	-4.3
Maintenance Cost	-1.0	-0.6	-0.3
Total	-5.3	-4.8	-4.5
Benefits			
Naturalness gain	2.0	1.1	0.5
Property gain	5.1	5.1	5.1
Total	7.1	6.2	5.6
Net Present Value	1.8	1.3	1.1

8.9 Ranking of Options

The ranking of the options at 2%, 5% and 10% discount rates is given in Table 5.

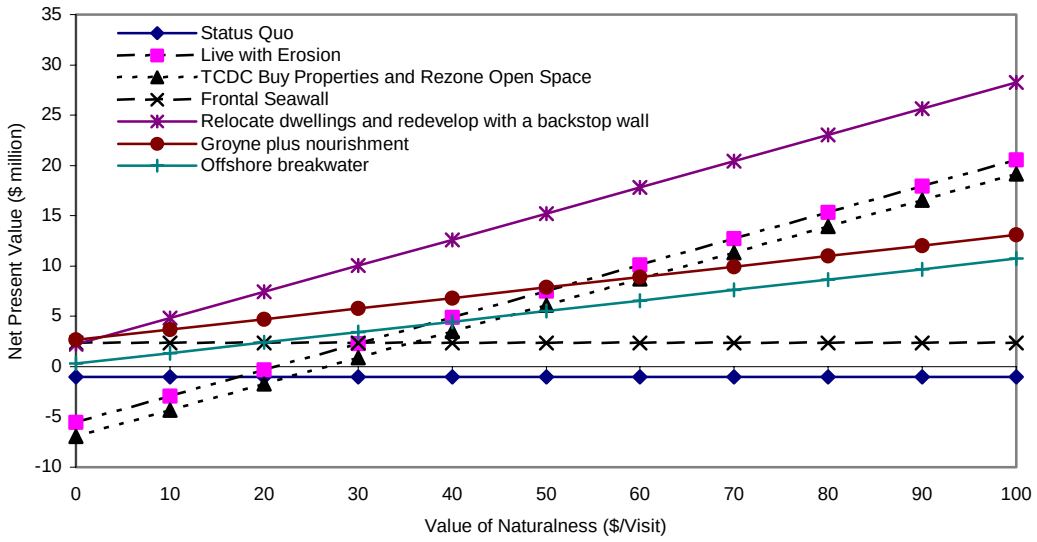
Table 5: Ranking and Net Present Value (NPV) of Management Options at 2%, 5% and 10% discount rates

2%		5%		10%	
Option	NPV ($ M)	Option	NPV ($ M)	Option	NPV ($ M)
Relocate and Redevelop with a backstop wall	$7.04	Relocate and Redevelop with a backstop wall	$4.80	Relocate and Redevelop with a backstop wall	$3.57
Groyne plus nourishment	$4.61	Groyne plus nourishment	$3.69	Groyne plus nourishment	$3.18
Offshore breakwater	$1.84	Frontal Seawall	$2.33	Frontal Seawall	$2.66
Frontal Seawall	$1.80	Offshore breakwater	$1.34	Offshore breakwater	$1.11
Live with Erosion	-$0.47	Status Quo	-$1.01	Status Quo	-$0.73
Status Quo	-$1.24	Live with Erosion	-$2.91	Live with Erosion	-$4.27
TCDC Buy Properties and Rezone Open Space	-$3.50	TCDC Buy Properties and Rezone Open Space	-$4.79	TCDC Buy Properties and Rezone Open Space	-$4.61

Figure 7 shows the impacts of using different values of naturalness at a 5% rate. "TCDC Purchase, backstop and resell" has the greatest net benefits above a value of $3 per visitor for the naturalness of the site[16], because it is a relatively low cost means of protecting the values of existing beachfront properties. At an assumed zero value of naturalness improvements, groyne plus nourishment is the best option.

Any positive value assigned to naturalness places "relocate and redevelop with a backstop wall" clearly above a frontal seawall.

Figure 7: Net Present Values of Management Options (5% Discount Rate) with different assumed naturalness values



[16] combined with an assumption that TCDC purchase, backstop and resell improves these values by approximately 5%, i.e. to a value of 15 cents per visitor.

The relative positions are similar at 10% (Figure 8) and 2% (Figure 9) discount rates. The main impact is the shift in the value of naturalness at which "Live with Erosion" and "TCDC Buy Properties and Rezone Open Space" become feasible (second- and third-placed) options. This is above $100/visit at a 10% rate and $26/visit (for Live with Erosion) at a 2% rate.

Figure 8: Net Present Values of Management Options (10% Discount Rate) with different assumed naturalness values

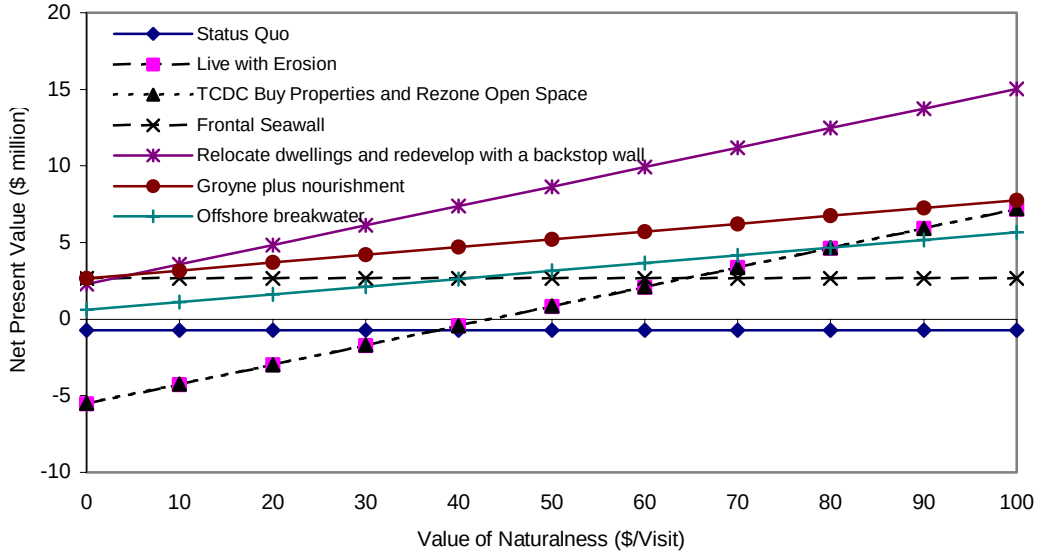
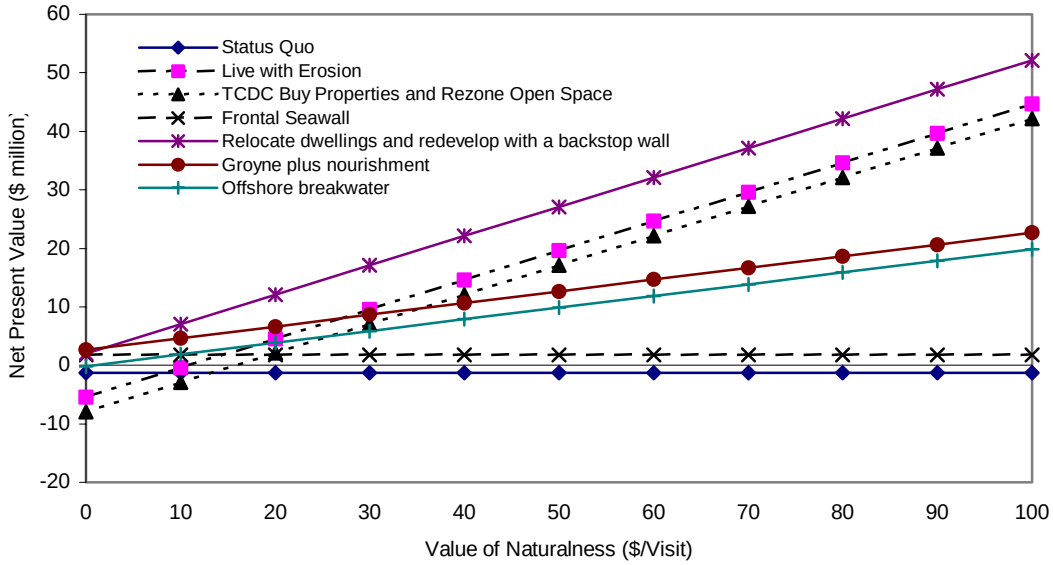


Figure 9: Net Present Values of Management Options (2% Discount Rate) with different assumed naturalness values



8.10 Distribution of Costs

The above analysis has assessed costs and benefits from the perspective of society as a whole. In this section we note the incidence of costs and benefits with respect to the beachfront property owners and the wider community. Impacts are summarised in Table 6.

Currently beachfront owners have favoured the frontal seawall; it has significant net benefits for them. However, the backstop wall could have significant benefits also, albeit that the costs are paid for by the public purse. For the wider community, "living with erosion" is the best option. However, this has very significant costs for beachfront property owners.

The analysis suggests that beachfront owners would still be better off with the backstop wall option if they were levied for up to $2.7 million of its total costs; at $2.7 million their net benefits are equal to the benefits of the frontal seawall. This could then provide net benefits to the wider community of up to $2.4 million; slightly ($0.3 million) less than would be obtained by the "living with erosion" option.

Table 6: Incidence of Costs and Benefits

Option	Impacts on Beachfront Property Owners	Impacts on the Wider Community
Status Quo	Costs of maintaining current structures **$1.0 M total costs**	Costs of continuing reduced beach naturalness **No net improvement**
Live with erosion	Costs of increased risk of inundation and thus reduced property prices **$5.5 M total cost**	Public benefits of increased naturalness **$2.7 M benefit**
TCDC Buy Properties and Rezone Open Space	17 beachfront houses lost but compensation paid ($820,000 per property) **No net impact**	Small cost of removing current structures ($35,000). Costs of compensating beachfront property owners ($11 M) Public benefits of increased naturalness ($2.7 M) Benefit of increased value to 2nd row houses ($3.6M) **Net cost $4.8 M**
Frontal Seawall	Assume beachfront properties pay for wall ($2M) and maintenance Gain in property price from reduced risk ($300,000 per property; $5.1 M total) **Net $2.3 M gain**	Costs of continuing reduced beach naturalness (impact assumed to be same as status quo) **No net improvement**
Relocate and redevelop with backstop wall	Assume public funding of wall. 4 houses shifted backwards on site and 1 off-site (at public expense). Gain in property price from reduced risk ($300,000 per property; $5.1 M total) **$5.1 M gain**	Costs of wall ($1.6 M plus $0.3 M maintenance) Costs of moving houses & compensation ($1.0 M) Benefits of increased naturalness ($2.7 M) **Net $0.3 M cost**
Groyne plus nourishment	Gain in property price from reduced risk ($5.1 M total) **$5.1 M gain**	Costs of construction ($2.4M) plus maintenance Naturalness gain $1.1 M **Net $1.4 M cost**
Offshore breakwater	Gain in property price from reduced risk ($5.1 M total) **$5.1 M gain**	Costs of construction ($4.25M) plus maintenance Naturalness gain $1.1M **Net $3.8 M cost**

9 Analysis of Management Options—Buffalo Mid

There are only two options analysed for the mid section of Buffalo. The option specific assumptions are set out in Table 7.

Table 7: Input Assumptions – Buffalo North

	Status Quo	Dune Restoration
Naturalness change	0%	0.5%
Capital Cost ($ million)		0.01
Maintenance Cost ($'000 per annum)	0	0.01
Houses moved off site		1
Houses risk of inundation		15
Houses moved back within site		4

The analysis produces zero costs and benefits for the status quo.

The impacts of the dune restoration option are given below. We assume a very small improvement in naturalness of the site and a small aggregate impact on property values ($100,000 spread across all houses). It ranks as the best option at all discount rates.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-0.01	-0.01	-0.01
Maintenance Cost	-0.3	-0.2	-0.1
Total	-0.3	-0.2	-0.1
Benefits			
Naturalness gain	0.5	0.3	0.1
Property gain	0.1	0.1	0.1
Total	0.6	0.4	0.2
Net Present Value	2.8	0.2	0.1

Given these assumptions, at a 5% rate, the status quo option would be better if naturalness was valued at less than $4/visit or if this option resulted in a perceived benefit of less than 2 cents per visitor to the mid section of the beach. If we assume no impact on property values, then the benefit would need to be less than 4 cents per visit.

10 Analysis of Management Options – Buffalo South

Input assumptions for the mid Buffalo analysis are set out in Table 8.

Table 8: Input Assumptions—Buffalo South

	Status Quo	TCDC Buy Properties and Rezone Open Space	Frontal Seawall	Realign existing seawall landward and one-lane road	Frontal Seawall and Rezone Commercial	Groyne plus nourish-ment
Naturalness change	0%	5%	0%	2%	2%	2%
Year of property purchase		5				
Capital Cost ($ million)		0.04	3.2	3.7	3.2	5.25
Maintenance Cost ($'000 per annum)	120	-	64	64	64	30[1]
Houses moved off site		17				

[1] Every 5 years

The evaluation of the different options at Buffalo Beach South is given below.

10.1 Status Quo

There is an estimated $120,000 per annum cost for maintaining existing structures, but no additional capital costs. The current beach qualities are maintained. At a 5% discount rate the total net cost is $2.3 million.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Maintenance Costs	-3.9	-2.3	-1.3
Benefits		0	0
Net Present Value	-3.9	-2.3	-1.3

10.2 TCDC Buy Properties and Rezone as Open Space

The existing structures are removed and there is no replacement with any structure to protect the current houses at risk. Under this option, 17 front row houses are compulsorily removed from their current sites and have to move elsewhere; we assume this occurs after 5 years. There is a compensating gain in property value for second row houses which become beachfront properties. Because we assume there is a delay in the time of house removal—it will take some time to negotiate this policy—the property-related costs are delayed and are reduced further under higher discount rates.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital cost	-0.042	-0.042	-0.042
Property Cost	-12.8	-11.1	-8.8
Total	-12.8	-11.1	-8.8
Benefits			
Naturalness gain	7.7	4.0	2.0
Property gain	4.2	3.6	2.9
Total	11.9	7.6	4.8
Net Present Value	-0.9	-3.4	-4.0

It is likely that there will be some additional transaction (legal) costs associated with this option; we have not quantified these.

10.3 Frontal Seawall

The existing structures are replaced by a single, larger solid wall. We assume that, whereas it is a larger, more dominating structure, it is less ugly than what is there at the moment. Thus there is no change to the current naturalness of the site. There is an upfront capital cost and ongoing maintenance costs. There is a gain in property values compared with the status quo because of the greater certainty of protection of existing properties.

Most of the costs and benefits are up-front but there are ongoing maintenance costs that reduce in importance under higher discount rates.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-3.2	-3.2	-3.2
Maintenance Cost	-2.1	-1.2	-0.7
Total	-5.3	-4.4	-4.4
Benefits			
Property gain	5.1	5.1	5.1
Net Present Value	-0.2	0.7	1.2

10.4 Realign Existing Seawall Landward and One-lane Road

There are significant capital and maintenance costs. There are benefits in terms of improved beach naturalness (2% gain) and gains to the value of beachfront properties because of the removal of risk of inundation.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-3.7	-3.7	-3.7
Maintenance Cost	-2.1	-1.2	-0.7
Total	-5.8	-4.9	-4.4
Benefits			
Naturalness gain	3.1	1.6	0.8
Property gain	5.1	5.1	5.1
Total	8.2	6.7	5.9
Net Present Value	2.4	1.8	1.5

10.5 Frontal Seawall and Rezone Town Centre (Commercial)

There are significant capital and maintenance costs. There are benefits in terms of improved beach naturalness (2% gain) and gains to the value of beachfront properties because of the removal of risk of inundation.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-3.2	-3.2	-3.2
Maintenance Cost	-2.1	-1.2	-0.7
Total	-5.3	-4.4	-3.9
Benefits			
Naturalness gain	3.1	1.6	0.8
Property gain	5.1	5.1	5.1
Total	8.2	6.7	5.9
Net Present Value	2.9	2.3	2.0

10.6 Groyne plus Nourishment

There are significant capital and maintenance costs but a gain in improved naturalness (2% assumed) and gain to existing properties via protection of current value. Discount rates make no difference to the net value because, under the assumptions used, there are up-front costs and benefits (in year zero, which do not change with the discount rate), while the annual maintenance costs and naturalness benefits are equal in size.

	$ million (2% discount rate)	$ million (5% discount rate)	$ million (10% discount rate)
Costs			
Capital Cost	-5.3	-5.3	-5.3
Maintenance Cost	-0.2	-0.1	-0.05
Total	-5.4	-5.3	-5.3
Benefits			
Naturalness gain	3.1	1.6	0.8
Property gain	5.1	5.1	5.1
Total	8.2	6.7	5.9
Net Present Value	2.8	1.4	0.6

10.7 Ranking of Options

The ranking of the options at 2%, 5% and 10% discount rates is given in Table 9.

Table 9: Ranking and Net Present Value (NPV) of Management Options at 2%, 5% and 10% discount rates

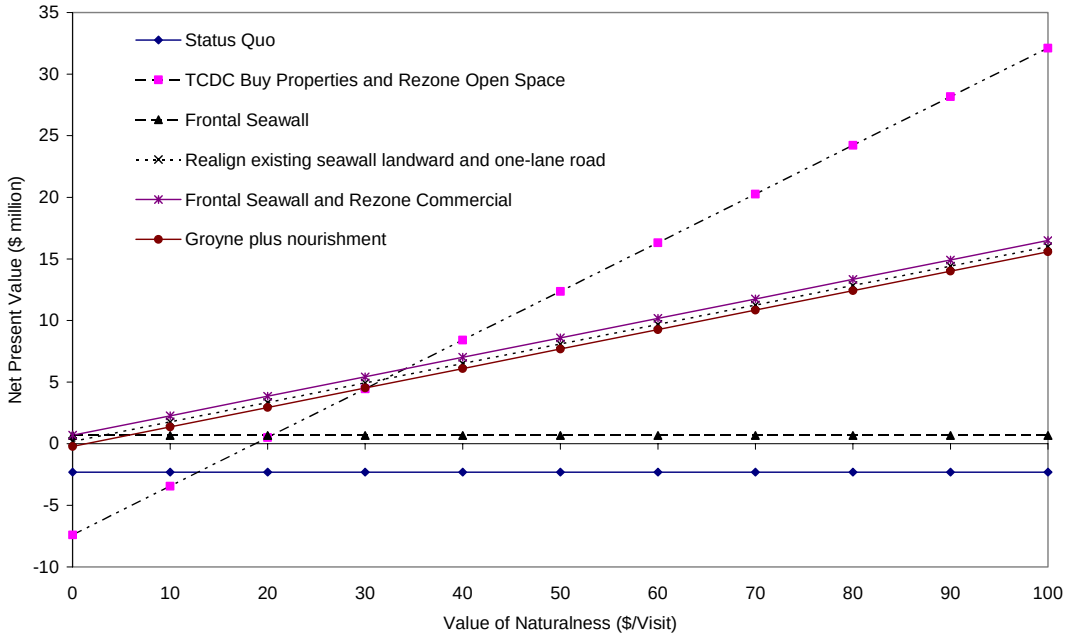
2%		5%		10%	
Option	NPV ($ M)	Option	NPV ($ M)	Option	NPV ($ M)
Frontal Seawall and Rezone Commercial	$2.90	Frontal Seawall and Rezone Commercial	$2.27	Frontal Seawall and Rezone Commercial	$1.98
Groyne plus nourishment	$2.77	Realign existing seawall landward and one-lane road	$1.77	Realign existing seawall landward and one-lane road	$1.48
Realign existing seawall landward and one-lane road	$2.40	Groyne plus nourishment	$1.36	Frontal Seawall	$1.20
Frontal Seawall	-$0.18	Frontal Seawall	$0.67	Groyne plus nourishment	$0.58
TCDC Buy Properties and Rezone Open Space	-$0.93	Status Quo	-$2.31	Status Quo	-$1.31
Status Quo	-$3.89	TCDC Buy Properties and Rezone Open Space	-$3.45	TCDC Buy Properties and Rezone Open Space	-$3.96

Despite the rankings above, the results are highly sensitive to the value of naturalness. Figure 10 shows the impacts of using different values of naturalness at a 5% rate. "TCDC buy properties and rezone open space" has the greatest net benefits above a value of $35

per visitor for the naturalness of the site[17]. At a 2% discount rate, the turning point is reached at $19/visit, and at $62/visit at a 10% rate. The overall naturalness value of the beach reflects the size of the wider community affected, i.e. the total number of residents and visitors. Where there are high visitor numbers, options with higher naturalness impacts will be favoured more highly, relative to those options where the greater benefit is from beachfront property protection.

The three options— Frontal Seawall and Rezone Commercial, Realign existing seawall landward and one-lane road, and Groyne plus nourishment—are relatively similar in terms of net benefits.

Figure 10: Net Present Values of Management Options (5% Discount Rate) with different assumed naturalness values



10.8 Distribution of Costs

The above analysis has assessed costs and benefits from the perspective of society as a whole. In this section we note the incidence of costs and benefits with respect to the beachfront property owners and the wider community. The impacts are summarised in Table 10.

Currently beachfront owners have favoured the frontal seawall; it has net benefits for them. However, there are a number of other options with very significant potential private benefits because the costs are paid for by the public purse. For the wider community, the status quo or the frontal seawall are the best options, because they have no net costs compared with the current situation.

[17] combined with an assumption that TCDC purchase, backstop and resell improves these values by approximately 5%, i.e. to a value of 15 cents per visitor.

The analysis suggests that beachfront owners could still be better off with the "frontal wall and rezone commercial" or other options if they were levied for some of the costs (up to $4.5 million). This could cover the costs for the public sector and yield net benefits for the "frontal wall and rezone commercial" of $1.7 million.

Table 10: Incidence of Costs and Benefits

Option	Impacts on Beachfront Property Owners	Impacts on the Wider Community
Status Quo	Costs of maintaining current structures **$2.3 M total costs**	Costs of continuing reduced beach naturalness **No net improvement**
TCDC Buy Properties and Rezone Open Space	17 beachfront houses lost but compensation paid ($820,000 per property) **No net impact**	Small cost of removing current structures ($42,000). Costs of compensating beachfront property owners ($8.8 M) Public benefits of increased naturalness ($4.0 M) Benefit of increased value to 2nd row houses ($3.6M) **Net cost $3.5 M**
Frontal Seawall	Assume beachfront properties pay for wall ($3.2M) and maintenance ($1.2M) Gain in property price from reduced risk ($300,000 per property; $5.1 M total) **Net $0.6 M gain**	Costs of continuing reduced beach naturalness (impact assumed to be same as status quo) **No net improvement**
Realign Existing Seawall	Assume public funding of wall Gain in property price from reduced risk ($300,000 per property; $5.1 M total) **$5.1 M gain**	Costs of wall ($3.7 M plus $1.2 M maintenance) Benefits of increased naturalness ($1.6 M) **Net $3.3 M cost**
Frontal Seawall and Rezone Commercial	Assume public funding of wall Gain in property price from reduced risk ($300,000 per property; $5.1 M total) **$5.1 M gain**	Costs of wall ($3.2 M plus $1.2 M maintenance) Benefits of increased naturalness ($1.6 M) **Net $2.8 M cost**
Groyne plus nourishment	Gain in property price from reduced risk ($5.1 M total) **$5.1 M gain**	Costs of construction ($5.3M) plus maintenance Naturalness gain $1.6 M **Net $3.7 M cost**

10.9 Conclusions of the Cost Benefit Analysis

The cost benefit analysis suggests the following options are ranked most highly:

	Buffalo North	Buffalo Mid	Buffalo South
Best Option	Relocate Dwellings and Redevelop with a Backstop Wall	Dune restoration	Frontal Seawall and Rezone Commercial
Second best	Groyne plus nourishment	Status Quo	TCDC Buy Properties and Rezone Open Space

- Annex A

Travel Cost Analysis

There are no data on total visitor numbers to Buffalo Beach. However, we can make an estimate of total visitors from peak data for Buffalo Beach and total data for the Coromandel.

Total visitor numbers to the Coromandel was estimated by as 1.1 million in 2002, of which 857,000 were domestic and 220,000 international, spending a total of 3.6 million visitor nights on the Coromandel[18]. The peak population of the Coromandel was 142,375. The peak at Whitianga was 21,888, which is 15% of the Coromandel peak. Assuming that the relationship between peak population and total visitors at Whitianga is the same as for the Coromandel as a whole, suggests that total visitors to Whitianga were approximately 169,000, spending approximately 553,000 visitor nights there. Growth rates in visitor numbers are estimated at 2.3% per annum[19].

Table A1: Origin of Day and Overnight Trips to the Waikato Region (Domestic Visitors), 2001

Origin Region	% of Day Trips	% of Overnight Trips
Waikato	44.4	19.7
Auckland	34.0	41.7
Bay of Plenty	16.4	15.6
Other	5.2	23.0

Source: Gravitas Research & Strategy Ltd (2002) New Zealand Domestic Travel Survey 2001

For analysis we weight the assumptions towards the overnight and landowner data and assume 50% of visitors are from Auckland, 30% Waikato, 10% Bay of Plenty, 6% other New Zealand and 4% international.

The analysis of travel costs uses the assumptions listed in Table A2; the road categories are those used by Transfund New Zealand. Auckland, Hamilton, Tauranga and Wellington are used to represent the origin of visits from the Auckland, Waikato and Bay of Plenty regions plus other domestic.

Table A2: Assumptions in Travel Cost Analysis

		Road Category			
Origin	Distance	Urban arterial	Urban other	Rural strategic	Rural other
Auckland	202	25%	5%	20%	50%
Waikato (Hamilton)	194	5%	5%	40%	50%
Bay of Plenty (Tauranga)	194	5%	5%	40%	50%
Other (Wellington)	659	5%	5%	40%	50%

Source: Whitianga Information Centre; AA; Covec assumptions

Travel times and costs are estimated from the assumptions in Table A3. Transfund estimates of car running costs are for inputs to cost benefit analyses and represent resource

[18] Barrett J (2004) Towards 2020: A Strategic Plan for Tourism in the Coromandel to the Year 2020. 3rd Edition—Revised April/May 2004.

[19] Barrett J (*op cit*)

costs only, i.e. they do not include tax. Petrol tax costs[20] have been added to this as they are costs faced by visitors.

Table A3: Cost assumptions

	Urban arterial	Urban other	Rural strategic	Rural other
Average speed (km/h)(1)	80	40	75	65
Time cost ($/h)(2)	14.09	14.10	19.21	18.59
Running costs (c/km)(2)	17.8	17.7	22.7	23.3
Revised running costs (c/km)(1)	23.7	23.6	30.2	31.0

Source: (1) Covec assumptions; (2) Transfund New Zealand (2003) Project Evaluation Manual PFM2

These result in the following estimates of the costs of travel.

In addition, there are expenditure costs associated with the trip that include the costs of accommodation. These are estimated to be $68 per night for overnight trips[21]; some of these costs would have been incurred if people had stayed at home. We net off the estimated average household spend on food[22]; this is equal to $28.80 per week or $4.11 per day. In comparing the data, we assume 2.2 people per vehicle; this is the estimated weekend occupancy of vehicles in rural roads[23]. On the basis of these cost estimates, the travel costs are estimated (Table A4).

Table A4: Estimated costs of travel to Whitianga ($/vehicle)

	Time Cost	Running Cost	Expenditure	Total cost
Auckland	103	116	476	695
Hamilton	105	116	476	698
Tauranga	105	116	476	698
Wellington	358	395	476	1229

Table A5 presents the estimated costs per person, assuming occupancy of 2.2 per vehicle. These data are then used to estimate the total costs for domestic visitors to travel to Whitianga. We assume that international visitors travel from Auckland, and costs from Auckland are used as the estimate of willingness to pay.

[20] http://www.med.govt.nz/ers/oil_pet/fuelduties.html

[21] 2001 data from Gravitas Research & Strategy Ltd (2002) New Zealand Domestic Travel Survey 2001

[22] Statistics New Zealand, Household Expenditure Survey.

[23] Transfund New Zealand (2003) Project Evaluation Manual PFM2

Table A5: Estimated costs of travel to Whitianga ($/person)

	Costs per person						
	Time Cost	Running Cost	Expendi-ture	Total	% of visitors from origin	Number of visitors	Total Cost
Auckland	47	53	216	316	54%	91,260	28,841,591
Hamilton	48	53	216	317	30%	50,700	16,082,831
Tauranga	48	53	216	317	10%	16,900	5,360,944
Wellington	163	179	216	559	6%	10,140	5,666,090
Total Costs							14,898,316
Costs per person							331

The travel costs for visiting Buffalo Beach are estimated to average approximately $330 per person.

▪ Annex B

Discount Rates

Discounting as Opportunity Cost

In economic analysis, all costs are defined as opportunity costs: the cost of using resources for one activity (project or policy) is that the opportunity to use them for another activity is given up. Discounting is a form of opportunity cost adjustment.

Local government is interested in improving well-being[24]. In economic terms, well-being is the outcome of consumption of goods and services. These are as disparate as food, education, community belonging, safety, views, clean air and recreation. Individuals reveal what contributes to their well-being through their actions—how they spend their time and money. By consuming in one time period we can reduce the ability to consume in another, e.g. by going to the beach today we are less able to go tomorrow because of the impacts on our available income. The first approach to discounting for public policy purposes is as a measure of the opportunity cost of consumption. This is the **Social Rate of Time Preference (SRTP)**. If a (local) government project only had the effect of delaying current consumption, the SRTP would be an estimate of the cost of that delay.

In addition, to changing consumption patterns, local government expenditure may change levels of private sector investment. Investments that yield positive real returns allow greater future consumption. Therefore an opportunity cost of investment or capital is frequently used in analysis. An opportunity cost of capital is the rate of return that an investment could have achieved in some other activity—by investing in one project (e.g. beach erosion control) we give up the opportunity to invest in another that would be expected to achieve a rate of return (the marginal investment undertaken by the private sector). The rate of return of projects depends on the behaviour of actors across a range of markets for inputs and outputs. The **Social Opportunity Cost of Capital (SOC)** is the relevant approach to defining discount rates where government expenditure results in fewer private sector projects.

Under perfectly competitive market conditions, the discount rate measured using the opportunity cost of consumption should be the same as an opportunity cost of investment. However, because markets are not perfect, the two approaches do not result in the same estimate of discount rate[25].

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[24] The purpose of local government is "… to promote the social, economic, environmental and cultural well-being of communities, in the present and for the future" (Section 10 Local Government Act 2002). Section 77(1) of the LGA 2002 requires local authorities to identify options and evaluate the costs and benefits of each in terms of the impacts on well-being.

[25] Market imperfections include the absence of perfect information about future rates of return, externalities and distortions such as tax.

Estimated Discount Rates

In New Zealand, there is no official guidance on discount rates, although a 10% discount rate has been used by government since the 1970s and is used by the Treasury where there is no other agreed rate[26].

Social Rate of Time Preference

The social rate of time preference has two components:

- The rate at which individuals discount future consumption over present consumption, which is largely[27] made up **pure time preference,** i.e. the extent to which individuals prefer to consume now rather than later, independent of all other effects, it can equal the savings rate in the economy; and
- The **marginal utility of income**—the extent to which total levels of consumption are expected to increase over time (people will be richer), against which the value of any unit of consumption will be reduced.

The pure savings rate can be measured from the real, after-tax rate of return on savings using long-term low-risk investments, e.g. government bonds[28]. Yields for 5 and 10 year bonds are similar currently, at about 5.9%, or approximately 3.8% real[29]. Real rates have averaged approximately 4.9% over the period January 1985 to February 2004; but the trend has been downwards[30]; we use a rate of 4%. With a tax on savings at 25%, this suggests a real savings rate of 3% without the effects of tax. Some analysts suggest that this might still need to be adjusted downwards. Rates of savings via government bonds reflect some elements of individual risk, e.g. the risk of death, which reduce savings rates at a given rate of return. This is relevant, because the individual risk of death is higher than the risk of society's disappearance[31].

However, combining the 3% figure with an estimate of the marginal utility of income, equal to the per capita GDP growth rate (average of 2.1% over the last ten years), would suggest a New Zealand SRTP of 5.1%.

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[26] The Treasury (1999) Office Minute 1999/B41 Guidelines for Costing Policy Proposals 21 December. In: Young (2002) Determining the Discount Rate for Government Projects. New Zealand Treasury Working Paper 02/21

[27] Some analysts also include a measure of catastrophe risk, i.e. the risk that a project will provide no benefits because of some natural unforeseen disaster

[28] Boscolo M, Vincent JR and Panayotou (1998) Discounting costs and benefits in carbon sequestration projects

[29] With inflation at approximately 2%, i.e. ((1 + 0.059)/(1 + 0.02)) - 1

[30] The average yield since January 1994 is 4.7% and since January 1999 is 4.2%.

[31] Boscolo M, Vincent JR and Panayotou (1998) Discounting costs and benefits in carbon sequestration projects. Environment Discussion Paper No 41. Harvard Institute for International Development. www.hiid.harvard.edu/pub/other/ieppub/edps/edp41.pdf

Social Opportunity Cost of Capital

In estimating the social opportunity cost of capital, we are interested in the rate of return on the marginal project avoided. The cost of capital is often estimated in the private sector using the capital asset pricing model (CAPM). It measures the discount rate as the pure cost of delay plus the price of risk times the amount of risk. Investments have two types of risk:

- Risk of being in the market. This is systematic risk, which cannot be diversified away and for which investors therefore require compensation. It includes risks such as global recession; and
- Unsystematic risk, specific to a company or investment. It can be eliminated through a diversified portfolio of assets or investments and would not therefore be compensated in a competitive market.

Estimates of the real cost of capital in New Zealand have suggested rates of approximately 10%. For example, Martin Lally in a study for the Business Roundtable used a number of techniques to produce results of 10.7%, 9.5% and 7.2%[32].

Sustainable Development and Future Generations

Discounting is a present generation concept. If we are equally concerned about the preferences of future generations then we would not use the time preference rate of current generations—we could assume that future generations would have the opposite preference, i.e. they would prefer consumption to occur in their generation rather than ours. However, the marginal utility of income is still a relevant consideration and would suggest a low but positive discount rate.

It is unlikely that current decision makers will ever truly be indifferent to impacts across generations. However, the indifferent position would suggest a rate of approximately 2%

Applications to Local Government Decisions

Analyses of weighted average costs of capital for local government include an estimate of 4.75%[33]; this was based on the average of a real pre-tax discount rate (4.5%) based on the current interest rate for council borrowings, and an estimate of the opportunity cost of capital to a rate-payer based on returns in a balanced portfolio (5%).

Chosen Rates for Analysis

There is no unambiguously correct rate to use for analysis. We have therefore used three rates in analysis to reflect this uncertainty. These are:

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[32] Martin Lally (2000) The Real Cost of Capital in New Zealand. Is it Too High? New Zealand Busienss Roundtable.

[33] Beattie Rickman (2003) Financial Analysis for Review of Otorohanga & Waitomo Districts. In: Capital Strategy Ltd (2003) Review of the Beattie Rickman Report on the Proposed Amalgamation of the Waitomo and Otorohanga Districts. Report to the Local Government Commission.

- 10% — because of its long history in government analysis in New Zealand and similarity to some estimates of the private opportunity cost of capital;
- 5% — close to our estimate of a social rate of time preference for New Zealand;
- 2% — to incorporate consideration of long term issues relating to future generations.

Appendix G

Definition of Indicators

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1 Introduction

The following section defines each impact category assessed in the matrix in terms of social, environmental and economic impacts. Each impact category was assessed qualitatively (expert opinion) to allow for a ranking of proposed coastal erosion management options. The assessments are based on a 50-year timeframe to provide for a long-term management approach to coastal erosion at Buffalo Beach.

In general terms the gradings are given in terms of whether the option has a significant impact or only moderate impacts (either positive or negative) as follows:

High Positive Grading	=	significant positive effects.
Medium Positive Grading	=	moderate positive effects.
Low Positive Grading	=	minor positive effects.
High Negative Grading	=	significant negative impacts/effects.
Medium Negative Grading	=	moderate negative impacts/effects.
Low Negative Grading	=	minor negative impacts/effects.
0 Grading	=	no impact/not applicable.

2 Social Impacts

2.1 Policy Compliance

The degree to which the management option complies with existing national, regional and district policies/provisions/guidance.

- High Positive Grading = option consistent with most/all policies.
- High Negative Grading = option not consistent with most/all policies.

2.2 Beach Amenity Values

Refers to the peoples 'sense of place', visual aesthetics of the option, public access and recreational impacts such as cycling, walking, running, surfing and boating. The question is asked, "will the option have a positive or negative impact on peoples desire to go to the beach"?

As defined in the RMA 1991: 'Those natural or physical qualities and characteristics of an area that contribute to peoples appreciation of its pleasantness, aesthetic coherence and cultural and recreational attributes'. The option will be assessed as having amenity impacts that either achieve the strategy vision or hinder reaching the vision.

- High Positive Grading = option helps achieve a beach with high amenity value.

- High Negative Grading = option significantly adversely impacts on beach amenity values.

2.3 Public Access

Public access is considered in terms of whether the option has a positive or negative impact on access both to the coast and along the coast. This is identified as a matter of 'national importance' in the RMA.

- High Positive Grading = option facilitates public access both to and along the coast.
- High Negative Grading = option significantly hinders public access both to and along the coast.

2.4 Construction Nuisance

Refers to disruptions, interference and noise levels impacting on visitors and the local community from any construction works (either temporary placement or on-going maintenance) required for the option. Assessments are either negative grading (as construction cannot have a positive nuisance impact) or 0 where no construction is required in association with an option.

- High Negative Grading = option has a high level of on-going maintenance or significant placement construction works associated with it that would cause significant adverse nuisance effects.
- 0 Grading = no construction required/not applicable.

2.5 Public Safety

Refers to the level of impact on public safety from the option such as navigation safety, accidents caused by construction activities associated with the option and injury/life risk to property owners.

- High Positive Grading = option significantly enhances public safety.
- High Negative Grading = option has a high level of potential adverse impact on public safety.

2.6 Impact on Council

The extent to which the management option relieves, maintains or increases pressure and/or Council liability to undertake coastal protection works to safeguard private property. Pressure may be compounded by increasing numbers of properties at risk, or relieved by options that reduce the number of properties at risk. Also refers to level of commitment required by council in the long term in terms of maintenance, resources provided, etc.

- High Positive Grading = option has no impact on EW/TCDC in terms of pressure from the community, on-going commitment of resources to maintain the option and no liability issues.
- High Negative Grading = option has a significant impact on EW/TCDC in terms of pressure from the community, on-going commitment of resources to maintain the option and liability issues.

2.7 Uncertainty

The level of certainty the option provides property owners on extent of protection afforded against future erosional events, i.e. loss or damage of property.

- High Positive Grading = option provides the public with a high level of certainty in the long term on erosion management.
- High Negative Grading = option has a high level of uncertainty in the management of coastal erosion.

2.8 Public Resistance

Refers to the expected resistance levels, public perceptions and disagreements within the community as a result of a proposed action. Assessments are either negative grading (as public resistance cannot have a positive impact) or 0 grading where there is expected to be no public resistance

- High Positive Grading = option expected to receive little or no public resistance
- High Negative Grading = option expected to receive a large amount of public resistance and result in disagreements within the community.

2.9 Cultural Values

Includes a consideration of the impact of the option on values important to tangata whenua.

NOTE: this category is not assessed here as information on the level of impact of options on cultural values can only be obtained through extensive consultation with tangata whenua (see Action Plan). EW and TCDC have indicated that they will undertake this extensive consultation as part of the wider regional coastal erosion strategy work being undertaken.

2.10 Historic Heritage

Refers to the natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures. Includes a broad assessment of

potential impacts on both recorded and unrecorded archaeological sites. The assessment on the degree of impact on present and potentially present archaeological sites is hypothetical as the degree of impact will be directly related to the nature of the site (in terms of its depth below ground, how intact the site is and what type of site it is). Further consultation with the NZHPT and possibly even site investigation by archaeologists will remove the uncertainty.

Historic heritage is defined in the RMA as a matter of 'national importance'.

- High Positive Grading = option protects historic heritage/archaeological sites.
- High Negative Grading = option hinders or adversely affects the preservation of historic heritage/archaeological sites.

2.11 Equity

Assessment of the balance of benefits to be gained between the wider community and private beachfront property owners etc.

- High Positive Grading = option creates equal benefits for the community as a whole.
- High Negative Grading = option benefits one group of individuals/part of community to a greater degree than others in the community.

3 Environmental Impacts

3.1 Biodiversity – Species and Habitats

Refers to the impact of the option on indigenous species and habitats including endangered and threatened species within the coastal environment.

- High Positive Grading = option enhances and promotes biodiversity.
- High Negative Grading = option adversely impacts on biodiversity.
- 0 Grading = no impact on biodiversity.

3.2 Natural Character

Refers to the extent of impact, either positive or negative the option has on landforms, ecosystems and natural processes. Defined in the RMA as a matter of 'national importance'.

- High Positive Grading = option has a positive impact on the enhancement of natural character of the beach.
- High Negative Grading = option hinders achieving a high level of beach natural character.

3.3 Coastal Processes

Refers to level of impact the option has on natural coastal processes such as wave action, currents and resulting sediment movement.

- High Negative Grading = option is or possibly will have a significant adverse effect on natural coastal processes.
- 0 Grading = option has no effect on natural coastal processes.

3.4 Coastal Flooding

Refers to the effect of the option on coastal flooding risk. It includes wave overtopping, storm surge, wave run-up, etc.

- High Positive Grading = option protects properties from the effects of coastal flooding.
- High Negative Grading = option significantly increases the risk of coastal flooding of properties.

3.5 Climate Change

Refers to how the option will face climate change and the effects of global warming, associated sea level rise and effects on coastal erosion.

- High Positive Grading = option effective in dealing with coastal erosion given the long-term effects of climate change.
- High Negative Grading = option not considered to be effective in dealing with coastal erosion given the long-term effects of climate change.

3.6 Environmental Footprint

Refers to the degree of impact the option has on environmental resources (such as the type of resource required to be used, amount needed for option etc). It refers to how we might quantify our use of nature, and compare this with the carrying capacity of our ecosystems, so that we can assess environmental sustainability.

- High Positive Grading = option requires little or no resources and will promote the sustainable management of the environment.
- High Negative Grading = option requires the use of valuable non-renewable resources in large volumes and does not promote sustainable long-term management.

3.7 Reversibility of option

Refers to the reversibility and easiness of restoring the affected area back to its original state prior to when the option was implemented.

- High Positive Grading = option is easily reversed in the future.
- High Negative Grading = option cannot be reversed without significant adverse environmental effects or cost.

4 Economic Impacts

4.1 Structure Construction, Works and Maintenance costs

Refers to both initial costs associated with construction of engineered structures and maintenance/works associated with the option over a 50-year time frame. NOTE, maintenance costs have a 5% discounted rate included for calculations over the 50-year period.

4.1.1 Buffalo Beach North Gradings

- 0 Grading = No costs associated with option
- High Negative Grading = Total costs of initial construction and on-going maintenance greater than $2 million
- Medium Negative Grading = Total costs of initial construction and on-going maintenance between $1 million and $2 million
- Low Negative Grading = Total costs of initial construction and on-going maintenance between $1 and $1 million

4.1.2 Buffalo Beach Mid Section Gradings

- 0 Grading = No costs associated with option
- High Negative Grading = Total costs of initial construction and on-going maintenance greater than $2 million
- Medium Negative Grading = Total costs of initial construction and on-going maintenance between $0.5 million and $2 million
- Low Negative Grading = Total costs of initial construction and on-going maintenance between $1 and $0.5 million

4.1.3 Buffalo Beach South Gradings

- 0 Grading = No costs associated with option
- High Negative Grading = Total costs of initial construction and on-going maintenance greater than $5 million

- Medium Negative Grading = Total costs of initial construction and on-going maintenance between $3.5 million and $5 million
- Low Negative Grading = Total costs of initial construction and on-going maintenance between $1 and $3.5 million

4.2 Capital Costs

Refers to the cost of property relocation or purchase associated with some options.

- 0 Grading = no relocation or purchase of property required with option
- High Negative Grading = significant costs associated with relocation and/or purchase of property.
- Medium Negative Grading = moderate costs associated with relocation and/or purchase of property.
- Low Negative Grading = low or minor costs associated with relocation and/or purchase of property.

4.3 Local Economy

Refers to the contribution and spill over effects the option has on the local economy, i.e. the potential for increased local employment, spending, and other economic activities in the local community.

- High Positive Grading = option has potential to increase local employment, spending and economic activity.
- High Negative Grading = option reduces potential for local employment, spending and economic activity.
- 0 Grading = no impact on local employment, spending and economic activity in the area.

4.4 Transaction Costs

Refers to the efforts and hence costs that go into choosing, organising, negotiating and entering into contracts and implementation of options (e.g. resource consents, litigation process, etc). Includes costs borne by the local and regional councils as well as private property owners. Assessment is either a negative grading (as you cannot have transaction costs that have a positive impact) or 0 grading (no transaction costs).

- High Negative Grading = significant transaction costs associated with option.
- 0 Grading = no transaction costs/not applicable.

4.5 Tourism

Refers to the contribution of the option towards local tourism in terms of visitor numbers, tourist spending, etc.

- High Positive Grading = option enhances numbers of tourists or tourist spending.
- High Negative Grading = option reduces numbers of tourists or tourist spending.

4.6 Private Capital

The extent to which an option affects private capital and equity gain such as an increase or decrease in property prices; includes both adjacent beachfront properties and the whole community. Also includes cost of property relocation or purchase associated with some options.

- High Positive Grading = option significantly increases capital value.
- High Negative Grading = option significantly decreases capital value.

4.7 Protection of Public Infrastructure

Refers to how likely the mitigation option will provide protection for assets other than property such as infrastructure (e.g. public reserves, road and rail links), services (water, sewerage, electricity, gas) and impact on costs.

- High Positive Grading = option provides a significant level of protection to public infrastructure.
- High Negative Grading = public infrastructure likely to be significantly adversely affected due to option.
- 0 Grading = no public infrastructure at risk/not applicable.

Appendix H

Assessment Of Options

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1 Introduction

The level and type of impact of the chosen options were assessed against each indicator. The options were assessed against each indicator qualitatively using available data and current coastal science knowledge. The table below provides full details for each indicator of the expected impact, whether positive or negative with justifications for the gradings. In addition to assessing whether there is a potential positive and/or negative impact caused by each option, the degree of impact was also assessed as being High, Medium or Low (H, M or L). For some indicators it was considered that there are potentially both positive (+ve) and negative (-ve) impacts from the option.

Each option has been assessed against the indicators based on whether or not it will have a positive or negative impact on the environment, society and the economy and also the level at which it will achieve the strategy vision over a 50-year timeframe. The following assessment is based on a consensus view of the project team.

2 Buffalo Beach Southern Section Beach Assessment of Options

2.1 Status Quo

Impact Category	Status Quo Assessment	+ve	-ve
Policy/ Statutory Compliance	It is understood that none of the existing structures along the foreshore currently have authorisation under either the RMA or the Harbours Act. Therefore the status quo option at Buffalo Beach south has negative impacts in regards to compliance with statutory legislation, as it would mean that existing structures would need to obtain resource consent, and therefore TCDCs permission as landowner, to remain in the CMA. The TCDC have a draft policy presently being considered by Council that advocates for hard structures such as the existing seawalls to not be permitted adjacent to TCDC owned land. It is therefore unlikely that resource consent for the existing structures could be obtained as landowners permission is unlikely to be forthcoming. Hard engineering structures also have adverse environmental effects that are contrary to the provisions of the NZCPS, WRPS, WRCP and TCDP which require soft options be considered in preference to hard structural options as sustainable solutions to coastal erosion.		**M**
Beach Amenity Values	The existing rock wall encroaches onto the active beach, and some parts of the structure are in a state of disrepair. The structures are unsightly and adversely affect visual amenity. Loss of high tide beach also adversely impacts recreational		**H**

Impact Category	Status Quo Assessment	+ve	-ve
	values.		
Public access	The existing rock wall structure north of Albert Street restricts access along the shore during higher stages of the tide as it eliminates the high tide 'dry' beach. These adverse effects become very severe during erosional periods and will be further aggravated by any erosion accompanying projected sea level rise. There is also currently only a narrow strip of grassed road reserve land along the top of the seawall so access along the top is also limited. The existing rock seawall also steepens the interface between foreshore and beach, thus reducing ease of access from the foreshore to the beach.		**H**
Construction nuisance	The only construction associated with the status quo option occurs during maintenance of existing structures. Construction nuisance (such as noise impacts) associated with maintenance works will be temporary and therefore have only minor effects in the long term.		**L**
Public safety	The existing seawalls are not properly engineered and loose rocks and holes may pose potential hazards to people accessing the beach over the wall. Rocks dislodged onto the foreshore could also create a hazard for beach users. There is also a risk of injury from fall, especially for children and the elderly.		**M**
Impact on Council	This option is likely to result in ongoing demands on TCDC to repair and maintain the structure following severe storm damage. Over time, there may also be increased community concern in respect of the adverse effects of the structures on beach use. Consenting and granting landowner permission for the existing structures may also expose EW/TCDC to future liability.		**M**
Uncertainty	The existing rock wall structure was not properly engineered and there is uncertainty as to how it will perform under conditions of severe erosion. Therefore, there is considerable uncertainty in regard to the level of protection provided to the road and Council reserve. There is uncertainty in regard to the level of maintenance/upgrade likely to be required in the future given the degraded state of the wall and the potential for erosion to worsen in the future.		**M**
Public resistance	In the longer-term, there may be resistance from beach users because of adverse effects associated with the existing structures and the uncertainties in protection they provide.		**L**
Cultural values	Consultation to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic heritage	The walls presently provide protection to any unknown archaeological or cultural sites that may be present buried in the sands behind the structures.	**L**	
Equity	The option protects public infrastructure and reserve as well as private property further landward – but at the expense of public beach values.		**L**

Impact Category	Status Quo Assessment	+ve	-ve
Biodiversity	The status quo option limits the width of the upper beach in places due to the existing protection structures and this may have some small local adverse effect on habitat. In addition, the status quo option prevents the development of a natural frontal dune along much of the affected area, so there is only limited and temporary space for natural dune vegetation to establish. The rock wall may provide additional habitat for rock dwelling fauna and flora. However, rock walls are often considered to provide habitat for rats.		**M**
Natural character	The back beach area is already developed with roading infrastructure and housing and therefore the natural character of the wider coastal environment in this section of Buffalo Beach is modified. However, the existing rock seawall further significantly reduces the natural character of the beach itself – the beach being backed by a human built structure rather than a natural dune and the structure encroaching well out over the beach in areas to the north of Albert Street. For instance, natural character of the beach in the affected area is considerably less than in the adjacent area to the immediate north where development has been setback a considerable distance from the shore and the beach is backed by a grassed reserve.		**H**
Coastal Processes	The existing seawall separates the dune sand reserves from the beach, preventing natural shoreline response to erosion events and potentially aggravating beach erosion in front of the wall during storm events. The existing coastal protection structure may also cause exacerbated erosion of adjacent unprotected areas at the northern end (known as “end effects” erosion) in the future. There are no unprotected areas in the stretch of coast south of the toilet block.		**M**
Coastal flooding	This option does nothing to mitigate the serious existing problems with coastal flooding in this area.		**M**
Climate change	The existing rock wall structure is unlikely to provide adequate protection in the event that existing erosion is aggravated by current IPCC predictions for future sea level rise. Increases in storm wave run-up as sea level rises will also result in increased overtopping of the seawall. Adverse effects on beach values (natural character, amenity, public access) would also be considerably worsened. Therefore, the status quo option is unlikely to be sustainable in the event of climate change effects.		**H**
Environmental Footprint	The beach resource will be lost as the existing structures protect physical resources (road) but at the cost of natural resources (beach). The status quo situation does not use many additional resources except for materials required for on-going maintenance of the seawall.		
Reversibility of option	It will be very easy to reverse this option as it does not involve any changes to the existing situation.	**H**	

Impact Category	Status Quo Assessment	+ve	-ve
Structure construction, works and maintenance costs	The existing structure is relatively inexpensive compared to more rigorously engineered seawalls but requires a high level of maintenance after coastal storms. Over time, costs are likely to be similar to a properly engineered structure.		**L**
Capital Costs	There are no relocation or property purchase costs associated with this option or costs for construction of a structure.	**0**	**0**
Local Economy	The adverse effects on the beach and the potential for these effects to be aggravated over time has the potential to adversely impact on the local economy time in the future.		**M**
Transaction costs	Resource consent process could be complex, depending on level of objection by wider community. There is the potential for future litigation.		**L**
Tourism	Very small, if any, reduction in numbers of total visitors to Coromandel because of beach amenity impacts (reduced natural character, etc). Any reduction in beach visitors will probably be to Buffalo Beach itself – with some visitors possibly choosing other Coromandel beaches in preference because of the reduced beach values.		**L**
Private Capital	These structures presently protect private property from erosion but not from coastal flooding. However, the degradation of the beach may adversely affect the values of some local properties compared to what they would otherwise be.		**L**
Protection of Public Infrastructure	The existing seawall structure currently provides protection to the road and small strip of reserve land immediately behind.	**L**	

2.2 TCDC Purchase of Private Land Adjacent to the Beach + Relocation + Rezoning to Open Space/Reserve

Impact Category	TCDC Purchase of Private Land Adjacent to the Beach + Relocation + Rezoning to Open Space/Reserve Assessment	+ve	-ve
Policy/ Statutory Compliance	The TCDP has setbacks imposed under the Building Act, with no buildings to be located within the 30m setback line and only relocatable houses may be located within the 60 metre setback line. This option is therefore consistent with the Building Act, discouraging development located within the high risk hazard area. By relocating existing development out of the hazard risk area and rezoning to prevent further development along the foreshore is consistent with objectives and policies of the WRCP and TCDP and the NZCPS, which promote the avoidance of natural hazards and hard engineering structures. In particular the TCDP Policy (222.4) ensuring development is located, built or carried out in such a way that the effects of natural hazards are avoided or the creation of a hazard is avoided. However, in terms of the LG A, significant public benefits would have to be demonstrated to justify public expenditure of this magnitude. The site would also have to be established as a high priority relative to other benefits that could be obtained for this expenditure. It is doubtful that this option would meet these standards.	**M**	

Impact Category	TCDC Purchase of Private Land Adjacent to the Beach + Relocation + Rezoning to Open Space/Reserve Assessment	+ve	-ve
Beach Amenity Values	Removing development and providing more open public space will improve recreational use and amenity in this section of Buffalo Beach – as will the restoration of the high tide beach that will occur with this option.	**H**	
Public access	Public access both to and along the foreshore at high tides will be significantly improved with restoration of the high tide beach and creation of a wide reserve on the landward side.	**H**	
Construction nuisance	The relocation of buildings and the removal of existing structures will involve temporary construction nuisance.		**L**
Public safety	Small benefits for public safety once development and existing walls are removed as there will be no hard engineering structures on the foreshore.	**L**	
Impact on Council	The option would resolve the immediate hazard issues. However, the very large expenditure involved with this option could have major implications for district and regional council rates and considerable ratepayer resistance and associated increased pressure on both EW and TCDC will probably be encountered.	**H**	**M**
Uncertainty	High level of long term certainty provided by this option as threatened development is removed and owners are compensated at market value. However, properties further landward could be impacted by aggravation of erosion in the longer-term.	**M**	
Public resistance	Major resistance is likely from beachfront owners and the wider community. Owners will probably wish to retain this high value land and are likely to prefer options that enable continued occupation and use. District and regional ratepayers are likely to be very resistant to the costs of this option, given other funding priorities.		**H**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic heritage	The option will prevent further development disturbance of any unknown sites in the area of purchased land that is not lost to erosion. However, land close to the shoreline will be subject to erosion associated with dynamic fluctuations. Although there are no recorded archaeological sites in the frontal dunes of this section of Buffalo Beach, there is the potential for negative impact on any unrecorded archaeological sites, particularly areas adjacent to the harbour where there is a high probability of sites.	**L**	**L**
Equity	Provided owners are fairly compensated for their land, the option will provide benefits to both private property owners and the wider community. However, there will probably be equity issues and concerns associated with the requirement for the affected owners to sell their land and move from this high value area	**M**	**L**
Biodiversity	The option would enable the re-establishment of a native dune ecosystem along the margin – though human intervention will be required to facilitate this.	**L**	
Natural character	Significant improvement of natural character due to removal of human built elements (existing houses and structures) and restoration of natural dune environment along margin.	**H**	
Coastal	No effect on natural erosion rate or processes as natural processes will be allowed to continue with a buffer zone (sand	**0**	**0**

Impact Category	TCDC Purchase of Private Land Adjacent to the Beach + Relocation + Rezoning to Open Space/Reserve Assessment	+ve	-ve
Processes	dune) in place.		
Coastal flooding	Relocation of development away from the shore and dune restoration will largely eliminate coastal flooding hazard, although properties further landward may still be affected by severe storm events.	**M**	
Climate change	This option enables natural shoreline adjustment to climate change effects. However, existing hazard lines suggest that many properties immediately landward of the purchased area may be significantly impacted in the event of aggravated erosion associated with projected sea level rise to 2100.	**M**	
Environmental footprint	The option involves some resource loss (e.g. associated with demolition of non-relocatable dwellings) but restores the natural beach and dune system in this area. Overall, effects on the environment are reduced and the environmental footprint decreased.	**H**	
Reversibility of option	Once existing protection has been removed, this land would not be suitable for restoration to development without expensive protection works		**H**
Structure Construction, Works and Maintenance costs	Moderate capital costs associated with this option as it involves the removal of existing seawalls and roads		**M**
Capital costs	Significant costs associated with the purchase of expensive properties and the relocation of a large number of dwellings.		**H**
Local Economy	Increased incentive for economic activity with the improved natural character and amenity values likely to significantly enhance motels, cafes and other commercial establishments in this locality very close to the town centre.	**M**	
Transaction costs	Likely to be very high costs (legal and otherwise) associated with negotiation and implementation of this option.		**H**
Tourism	Moderate increase in numbers of total visitors to Whitianga and possibly to the Coromandel as a while because of beach amenity improvements.	**M**	
Private Capital	Affected land owners should receive fair return for their property, assuming market price is paid. However, they lose potential opportunities for future capital gain – generally high for beachfront properties. Overseas work also suggests potential for increase in the values of other property in this immediate area (relative to what otherwise would have occurred) because of positive impacts on beach amenity and natural character		**M**
Protection of Public Infrastructure	The existing road and additional public assets in the form of created public reserve land will be at risk as the beach will be exposed to the dynamic fluctuations of the shoreline with no protection. The existing road within the affected area is likely to be closed.		**M**

2.3 Frontal Seawall

Impact Category	Frontal Seawall Assessment	+ve	-ve
Policy/ Statutory Compliance	Coastal defence structures above the line of mean high water springs (MHWS) are a non-complying activity in the TCDP. Coastal defence structures below the line of MHWS are a discretionary activity in the WRCP. The seawall is likely to be placed within and above the CMA and therefore require resource consent from both the Regional Council and TCDC, as well as permission from TCDC for placement on Council-owned reserve. Depending on the length of seawall required it may be classed as a restricted coastal activity and require Minister of Conservation approval. Seawalls are generally contrary to the policy provisions of the district, and regional plans and the NZCPS unless they are considered the most appropriate option for erosion control over and above soft engineering solutions. Seawalls are not consistent with the draft policy paper currently being considered by TCDC that advocates for soft engineering approaches to coastal erosion management on TCDC owned land.		**H**
Beach Amenity Values	A seawall located on TCDC-owned reserve seaward of the road will generally be exposed on most occasions and therefore reduce visual amenity. The width of high tide beach will also be reduced and, in some places eliminated – particularly during erosional periods. Therefore, public amenity in respect of the beach and use of it will generally be reduced by this option.		**H**
Public access	Public access along the coast will be adversely impacted at higher stages of the tide due to elimination of the high tide dry beach along some areas of the wall (arising from encroachment of the wall onto the beach) and during erosional periods (due to passive erosion effects). These adverse effects will be particularly notable in the area north of Albert Street. The seawall will also steepen the interface between the beach and adjacent land therefore making access to the beach more difficult and probably necessitating access structures to avoid clambering over rocks.		**H**
Construction nuisance	Temporary construction effects associated with construction and maintenance of the seawall.		**M**
Public safety	Rock structures represent a hazard that is not present in a natural foreshore/dune situation. Seawall structures can be dangerous for people traversing them to get to the beach.		**L**
Impact on Council	There is the possibility of EW and/or TCDC being held liable for consented structures that fail. Maintenance will be required and therefore on-going commitment from TCDC would be expected. There is likely to be reduced pressure on TCDC from private property owners. However, there may be an increase in pressure on TCDC in the future from wider community due to adverse effects of the structure on amenity of the beach and public access.		**M**
Uncertainty	There are some uncertainties associated with the seawall option such as longer-term impacts on the structure associated with climate change (particularly sea level rise and associated erosion which may increase wave damage and aggravate		**M**

Impact Category	Frontal Seawall Assessment	+ve	-ve
	adverse environmental effects). Therefore, the structure may not be a sustainable solution in the long term with changing coastal processes. However, in the short to medium term this option eliminates uncertainty for affected private property owners.		
Public resistance	At present, there is generally little public resistance to hard engineering structures. However, there may be some resistance from the wider community in the future due to the loss of beach amenity, natural character and public access that is associated with such structures.		**L**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Minor negative impacts on fringe of seawall construction works. However, the frontal dunes and area immediately landward is not expected to have many archaeological sites due to the dynamic nature of the front beach area (although areas adjacent to the Harbour entrance may have). In the long term the wall will protect any unknown archaeological sites that may be located within the protected area.	**M**	**L**
Equity	The option protects both public infrastructure and reserve as well as private property further landward – but at the expense of public beach values.		**M**
Biodiversity	The seawall option will limit the width of the upper beach in places and this may have some small local adverse effect on habitat. In addition, a seawall will prevent the development of a natural frontal dune along much of the affected area, so there is only limited and temporary space for natural dune vegetation to establish. The rock wall may provide additional habitat for rock dwelling fauna and flora. However, rock walls also generally provide habitat for rats.		**M**
Natural character	This seawall option will result in a highly visible engineered structure along the back of the beach and will substantially reduce natural character of the beach relative to adjacent unprotected and undeveloped areas.		**H**
Coastal Processes	Seawalls may interfere with wave patterns (reflecting waves off their face) and cause a lowering of the beach in front because they lock up sediment that would otherwise be available in the system. Unprotected areas adjacent to the structure may also suffer from accelerated erosion due to end effects erosion.		**M**
Coastal flooding	The seawall option being considered would have a higher crest elevation than the existing structures and would probably decrease the potential for coastal flooding. If a rock structure is used this will also tend to dissipate wave energy and reduce overtopping. Nonetheless, some wave overtopping of the structure may occur.	**M**	
Climate change	Changes accompanying climate change, including sea level rise would significantly aggravate erosion of the beach in front of the structure and lead to serious degradation of beach values (such as public access, beach amenity and natural character). Increased wave attack on the wall arising from elevated sea levels and erosion would also be likely to lead to more frequent and severe damage to the wall.		**L**

Impact Category	Frontal Seawall Assessment	+ve	-ve
Environmental footprint	A seawall requires resources for the construction of the structure and potentially resources for the maintenance of the structure in the long term. This will include rock and other construction materials as well as fuel for the construction and maintenance equipment.		**L**
Reversibility of option	A seawall is not easily removed as it will involve disturbance associated with construction works, cost of removal of the structure and rehabilitation of the beach. The value of assets at risk (land and development) may significantly increase and reversal of the option could be very expensive. Also it is expected that there will be a large amount of public resistance to removing the structure once it is there.		**M**
Structure construction, works and maintenance costs	Over the long term, a well engineered and built sea wall will have a moderate capital cost and a low maintenance cost.		**M**
Capital costs	There is no relocation or property purchase required with this option and therefore no capital costs.	**0**	**0**
Local Economy	The adverse effects on the beach caused by the seawall and the potential for these effects to be aggravated over time has the potential to adversely impact on the local economy over time.		**L**
Transaction costs	High transaction costs could be expected from this option given the requirement for resource consent, the status of the activity in the District Plan, and the associated potential adverse environmental effects. In the longer-term, the adverse effects of the structure on community values (and possibly on properties further landward) may also lead to increased community concern and even to litigation.		**H**
Tourism	There may be a very small reduction in numbers of total visitors to Whitianga because of reduced beach amenity from the presence of a seawall and lack of high tide beach access.		**L**
Private Capital	The more secure hazard protection works may increase the value of beachfront property, although overseas work also suggests potential for decrease in the values of other property in this immediate area (relative to what otherwise would have occurred) because of adverse impacts on beach amenity and natural character	**L**	
Protection of Public Infrastructure	Public reserves adjacent to either end of the wall may experience some aggravated erosion associated with end effects. However the road and reserve immediately behind the structure will be protected from coastal erosion.	**M**	**L**

2.4 Frontal Seawall+ Rezoning of Beach Front Land to Town Centre (Commercial)

Impact Category	Frontal Seawall+ Rezoning of Beach Front Land to Town Centre (Commercial) Assessment	+ve	-ve
Policy/ Statutory Compliance	Rezoning to commercial will involve a public notification and submission process and the production of a Section 32 analysis report of the variation to the zoning in the TCDP. By rezoning to Town Centre, commercial development would be allowed in an erosion prone area subject to Building Act restrictions. Increasing the value of development within the hazard area is not consistent with objectives and policies of the Regional and District Plans which promote the avoidance of natural hazards. In particular commercial rezoning of beachfront land would be contrary to TCDP policy 222.4 ensuring development is located, built or carried out in such a way that the effects of natural hazards are avoided or the creation of a hazard is avoided. Seawall structure required in conjunction with commercial rezoning would make this option contrary to the provisions of the NZCPS, WRPS, WRCP and TCDP which promote soft engineering options and also the draft policy paper presently being considered by TCDC on soft engineering approaches as protection for Council owned land.		**H**
Beach Amenity Values	By rezoning to commercial adjacent to the coast then larger scale development would be expected, degrading peoples 'sense of place' while at the beach. However, some types of commercial development such as cafes, restaurants etc facilitate people's use and enjoyment of the coastal area and may therefore enhance the beach amenity value. A seawall located on TCDC-owned reserve seaward of the road will generally be exposed on most occasions and therefore reduce visual amenity. The width of high tide beach will also be reduced and, in some places eliminated – particularly during erosional periods.	**M**	**H**
Public access	Public access to and along the foreshore will be improved as commercial operations are not usually restrictive to public access. However the seawall used in conjunction with commercial rezoning will restrict access along the foreshore at high tides.	**M**	**H**
Construction nuisance	There could be construction nuisance expected from the development of commercial scale buildings/activities adjacent to the coast but these would be temporary and have only a minor effect over the long term. Temporary construction effects associated with construction and maintenance of the seawall.		**M**
Public safety	There may be effects on public safety caused by the seawall structure steepening the interface between the land and foreshore and during construction activities.		**L**
Impact on Council	There will be resources (costs and staff time) associated with the variation to the plan to rezone beachfront land commercial. However, commercial operators are considered to be accustomed to working with risk and therefore the pressure on Council from commercial operators to protect beachfront land is likely to be less than the pressure placed on Council by individual property owners.	**M**	**M**
Uncertainty	Rezoning of beachfront land as commercial does not remove the coastal erosion hazard and there would still be a significant level of uncertainty for commercial operators in regards to the effectiveness of the seawall in long term erosion mitigation.		**M**
Public resistance	There is not expected to be large public resistance to rezoning of beachfront land to Town Centre as it will allow existing beachfront property owners to undertake commercial activities on their land and will allow enhanced enjoyment of the coastal area for the wider public with, possibly, beach-themed commercial operations. However, some beachfront owners	**L**	**M**

Impact Category	Frontal Seawall+ Rezoning of Beach Front Land to Town Centre (Commercial) Assessment	+ve	-ve
	may oppose the rezoning of beachfront land to commercial as they value the beachfront as a residential area. Also there may be future resistance from the wider community in regards to the seawall structure as it impacts on beach amenity values.		
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Commercial rezoning of beachfront land may mean that increased development of beachfront properties occur, putting unrecorded archaeological sites at risk. However, the seawall will protect any archaeological sites landward of the structure from dynamic fluctuations of the shoreline.	**L**	**L**
Equity	Rezoning is likely to benefit both beachfront property owners, as they will have more freedom to undertake a wider range of activities on their property and the wider community as they are likely to have improved access to beachfront land through public commercial activities. However, the seawall will affect beach amenity values for the wider community in order to provide protection to beachfront commercial properties.	**M**	**L**
Biodiversity	The seawall option will limit the width of the upper beach in places and this may have some small local adverse effect on habitat. In addition, a seawall will prevent the development of a natural frontal dune along much of the affected area, so there is only limited and temporary space for natural dune vegetation to establish. The rock wall may provide additional habitat for rock dwelling fauna and flora. However, rock walls are considered to provide good habitats for rats.		**M**
Natural character	Natural character will be reduced with the rezoning of beachfront land to Town Centre as there is likely to be further intensification of development, further modifying the natural beach character. Also, the seawall will be an engineered structure at the back beach rather than a natural dune and will therefore have adverse effects on natural character.		**H**
Coastal Processes	The seawall structure associated with the commercial rezoning of beach front land will affect natural processes by locking up sediment that would normally be available. There is the potential for adjacent unprotected areas to suffer from end effect erosion.		**M**
Coastal flooding	The risk of coastal flooding would be increased as the level of development increased, exposing more activities to the effects of storm surge, wave run-up etc in the long term. However, the seawall will tend to dissipate wave energy and reduce overtopping. Nonetheless, some wave overtopping of the structure may occur.	**M**	**M**
Climate change	Commercial rezoning of beachfront land results in an intensification of development and therefore increased risk to adverse impacts caused by climate change. Changes accompanying climate change, including sea level rise would significantly aggravate erosion of the beach and the seawall could seriously degrade beach values – including public access, beach amenity and natural character. Increased wave attack on the seawall arising from elevated sea levels and erosion would also be likely to lead to more frequent and severe damage to the structure.		**M**

Impact Category	Frontal Seawall+ Rezoning of Beach Front Land to Town Centre (Commercial) Assessment	+ve	-ve
Environmental footprint	The seawall associated with this option will require resources for the construction of the structure and resources for the maintenance of the structure in the long term. This will include rock and other construction materials as well as fuel for the construction and maintenance equipment.		**L**
Reversibility of option	It will be difficult to reverse this option as to rezone the beachfront land TCDC will need to go through a public notification and submission process and to reverse the decision they would need to undertake a similar process to change the zoning again. A seawall is not easily removed as it will involve disturbance associated with construction works, cost of removal of the structure and rehabilitation of the beach. The value of assets at risk (land and development) may significantly increase and reversal of the option could be very expensive. Also it is expected that there will be a large amount of public resistance to removing the structure once it is there.		**H**
Structure construction, works and maintenance costs	The seawall used in combination with rezoning will have a moderate construction cost and a low maintenance cost.		**M**
Capital costs	There is no relocation of buildings or purchase of property associated with this option.	**0**	**0**
Local Economy	The adverse effects on the beach caused by the seawall and the potential for these effects to be aggravated over time has the potential to adversely impact on the local economy over time. However, the increase in commercial activity may increase the numbers of people visiting this section of Buffalo Beach. Commercial zoning will also allow the easy establishment of small scale business in this area, such as beachfront cafés, motels, etc.	**H**	L
Transaction costs	Costs associated with plan change process. Also high transaction costs could be expected given the requirement for resource consent for the seawall, the status of the activity in the District Plan, and the associated potential adverse environmental effects. In the longer-term, the adverse effects of the structure on community values (and possibly on properties further landward) may also lead to increased community concern and even to litigation.		**H**
Tourism	Increase in numbers of total visitors to Coromandel because of beach amenity improvements and opportunities for commercial operations. Visitors to the area will be able to use facilities such as café's and motels. However, there may be a very small reduction in numbers of total visitors to Whitianga because of reduced beach amenity from the presence of a seawall and lack of high tide beach access.	**H**	L
Private Capital	Protection of beach-front property will reduce present uncertainty and help offset the difference between the value of these properties and adjacent beachfront land. There could be some potential for reduction in values due to the seawall.	**M**	

Impact Category	Frontal Seawall+ Rezoning of Beach Front Land to Town Centre (Commercial) Assessment	+ve	-ve
	Overseas work also suggests potential for reduction in the values of other property in this immediate area (relative to what otherwise would have occurred) because of adverse impacts on beach amenity and natural character[1] but the properties will probably increase in value due to being commercial zone.		
Protection of Public Infrastructure	Public infrastructure such as the reserve and road behind the structures would be provided with a measure of protection from the seawall.	**M**	

2.5 Realign Existing Frontal Seawall Landwards + One Laning of Road

Impact Category	Realign Existing Frontal Seawall Landwards + One Laning of Road Assessment	+ve	-ve
Policy/ Statutory Compliance	The works involved in realigning the seawall landwards (excavation, placement of rock material and construction of seawall) will require resource consent from TCDC and EW. Seawalls are generally contrary to the policy provisions of the district, and regional plans and the NZCPS unless they are considered the most appropriate option for erosion control over and above soft engineering solutions. Seawalls are not consistent with the draft policy paper currently being considered by TCDC that advocates for soft engineering approaches to coastal erosion management on TCDC owned land. One-laning or closure of the road will also require a notified public process.		**H**
Beach Amenity Values	The engineered structure will continue to be exposed along the back of the beach and will reduce visual amenity and continue to impact on people's sense of place while at the beach. However, the restoration of a high tide dry beach on most occasions by realigning the seawall landward will significantly enhance recreational amenity of the beach.	**M**	**M**
Public access	The location of the seawall further landward will significantly improve public access along the beach at higher stages of the tide. However, people will still have to clamber over a steep rock seawall to get access to the beach, unless access structures are added.	**L**	**M**
Construction nuisance	There will be temporary construction effects associated with construction and reduction in width of the sealed road and on-going maintenance of the seawall.		**M**
Public safety	Rock structures represent a hazard that is not present in a natural foreshore/dune situation. Seawall structures can be dangerous for people traversing them to get to the beach.		**L**

[1] Kriesel, W and Friedman, R: 2003: Coping with coastal erosion; Evidence for community wide impacts. Shore and Beach, Volume 71 (3) July 2003.

Impact Category	Realign Existing Frontal Seawall Landwards + One Laning of Road Assessment	+ve	-ve
Impact on Council	There is the possibility of TCDC being held liable for consented structures that fail. Maintenance will be required of the seawall and therefore on-going commitment from TCDC is expected. There may be increased pressure on TCDC from the wider community due to the one-laning of the beachfront road and therefore reduction in ease of vehicular access. There may also be an increase in pressure on TCDC in the future from the wider community due to the adverse effects of the structure on amenity of the beach and public access. – though to a lesser extent than with a frontal seawall		**H**
Uncertainty	There are some uncertainties associated with this seawall option such as longer-term impacts on the structure associated with climate change (particularly sea level rise and associated erosion which may increase wave damage). Therefore, the structure may not be a sustainable solution in the long term with changing coastal processes.		**L**
Public resistance	At present, there is generally little public resistance to hard engineering structures. However, there may be some resistance from the wider community in the future due to the loss of beach amenity, natural character and public access that is associated with such structures, although lesser than a frontal seawall. Therefore, even if consented, this option may not gain a long-term consent. There may also be some resistance from the wider community in relation to inconvenience associated with one laning or closure of the road.		**M**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Minor negative impacts on fringe of seawall construction works. However, as the area to be excavated for the placement of the re-aligned seawall has already been disturbed with the placement of the road and past erosion damage, there are unlikely to be any significant adverse effects on archaeological sites. The wall will provide protection to any unknown sites buried in sands further landward.	**L**	**L**
Equity	There are benefits to both private beachfront property owners and the wider community from this option as the seawall will provide protection for land and public assets, although there will still be an engineered structure on the back beach area which will affect public beach amenity values.	**L**	L
Biodiversity	The seawall located landwards is likely to provide more opportunity for a natural dune to establish in front of the structure, however in the long term there are unlikely to be any major benefits from this option. As with all rock walls, the seawall may provide a habitat for pests such as rats.		**L**
Natural character	This seawall option will result in a highly visible engineered structure along the back of the beach and will substantially reduce natural character of the beach relative to adjacent unprotected and undeveloped areas.		**M**

Impact Category	Realign Existing Frontal Seawall Landwards + One Laning of Road Assessment	+ve	-ve
Coastal Processes	The seawall will limit coastal erosion during severe storms but may cause some aggravated erosion of the beach in front during such events. The location of the seawall landwards will minimise the effects on coastal processes.		**L**
Coastal flooding	The seawall option being considered would have a higher crest elevation than the existing structures and would probably decrease the potential for coastal flooding. If a rock structure is used this will also tend to dissipate wave energy and reduce overtopping. However, some overtopping of the structure may occur during severe storm events.	**M**	
Climate change	Changes accompanying climate change, including sea level rise would significantly aggravate erosion of the beach in front of the structure and lead to serious degradation of beach values – including public access, beach amenity and natural character. Increased wave attack on the wall arising from elevated sea levels and erosion would also be likely to lead to more frequent and severe damage to the wall. Therefore, the benefits obtained by the option are unlikely to be sustained in the event of future sea level rise.		**L**
Environmental footprint	A seawall requires resources for the construction of the structure and potentially resources for the maintenance of the structure in the long term. This will include rock and other construction materials as well as fuel for the construction and maintenance equipment.		**L**
Reversibility of option	A seawall is not easily removed as it will involve disturbance associated with construction works, cost of removal of the structure and rehabilitation of the beach. Over time the value of assets at risk (land and development) may significantly increase and reversal of the option could be very expensive. Also it is expected that there will be a large amount of public resistance to removing the structure once it is there. The road would also require construction works to restore it to a two lane carriageway.		**H**
Structure construction, works and maintenance costs	Over the long term, a well engineered and built sea wall will have a moderate capital cost and a low maintenance cost. The single laning of the road would require its reconstruction. When this cost is added to that of the seawall, the option has moderate costs.		**M**
Capital costs	There is no relocation of houses or purchase of property associated with this option and therefore no capital costs.	**0**	**0**
Local Economy	The reduction in the width of the road and the presence of the seawall may impact negatively on the local economic activities.		**L**
Transaction costs	High transaction costs could be expected from this option given the requirement for resource consent, the status of the activity in the District Plan, and associated adverse environmental effects.		**H**
Tourism	There may be a very small reduction in numbers of visitors to Whitianga because of reduced beach amenity in this area due to the seawall and reduced road width.		**L**
Private Capital	It is probable that this option will increase the values of local properties because of enhanced protection from coastal erosion and inundation and the enhanced beach values from locating the seawall further back on the beach profile.	**L**	

Impact Category	Realign Existing Frontal Seawall Landwards + One Laning of Road Assessment	+ve	-ve
Protection of Public Infrastructure	Although reduced in width, the public road will be protected from the effects of coastal erosion.	**M**	

2.6 Groyne + Nourishment

Impact Category	Groyne + Nourishment Assessment	+ve	-ve
Policy/ Statutory Compliance	Groyne structure and deposition of sand material is a discretionary activity and a publicly notified resource consent will be required from EW and (for those areas above MHWS - i.e. the landward end) from TCDC. Landowner permission would also be required from TCDC for those parts of the structure on Council-owned reserve. A groyne structure on council reserve is also not consistent with the draft policy paper presently being considered by TCDC. Depending on the length of groyne required, the works may be classed as a restricted coastal activity and require Minister of Conservation approval. Groynes are generally contrary to the policy provisions of the WRPS, WRCP and TCDP unless they are considered the most appropriate option for erosion control over and above soft engineering solutions. However, beach nourishment is generally consistent with local, regional and national policy as this is a 'soft' engineered approach.		**M**
Beach Amenity Values	The beach formed on the western side of the groyne would enhance the width of high tide beach along the front of the existing structures and improve beach amenity. However, the groyne would be highly visible during lower stages of the tide and is likely to have a significant adverse effect on visual amenity. The groyne is also a highly visible engineered structure and therefore may affect people's 'sense of place' when visiting the beach. However, groynes can also enhance beach amenity – often being used for fishing, sitting, lying down, children to play on, etc.	**M**	**L**
Public access	The beach retained by the groyne will improve public access to and along the coast. Some groynes also provide improved public access to the CMA and as they can be used for fishing off, etc. Access along the shore may be restricted by the structure, depending on its design.	**L**	**L**
Construction nuisance	Temporary construction effects will be associated with construction and maintenance of the groyne and beach nourishment. Any works required are likely to be conducted outside of peak holiday periods.		**M**
Public safety	May be a minor public safety issues associated with clambering over the groyne structure.		**L**
Impact on Council	TCDC will have a (potentially significant) on-going commitment associated with maintaining the groyne and beach nourishment works.		**M**

Impact Category	Groyne + Nourishment Assessment	+ve	-ve
Uncertainty	There are many uncertainties associated with the effects of this option and physical modelling would be required to design the option and assess effects with any confidence. Maintenance requirements for the beach nourishment are likely to be a major cost uncertainty. If the structure is located too close to the entrance, there are also potential uncertainties around scour during extreme entrance flows – particularly as experienced with tsunami (such as the event of May 1960).		**H**
Public resistance	There may be some resistance from the wider community due to the costs and uncertainties associated with the protection provided by this option and the significant visual effects in this popular and very natural entrance area.		**M**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Any unknown archaeological sites buried in sands behind the present shoreline will be protected from erosion.	**L**	
Equity	The option has benefits for both adjacent landowners and the wider community. For instance, adjacent landowner will benefit from enhanced property protection and increased beach amenity. Similarly, the wider community will gain from the greatly enhanced beach in this area. However, there will also be disbenefits to the wider community associated with adverse impacts on visual amenity and natural character.	**L**	**L**
Biodiversity	Creation of wider high tide beach may provide small additional habitat for beach dwelling species and the opportunity for a natural foredune to develop.	**L**	
Natural character	The groyne structure reduces the natural character of the beach, as the hard engineering structure will be highly visible. However, the creation of the beach (and possibly a dune) along the face of the properties will enhance natural character in this immediate area.	**L**	**M**
Coastal Processes	The groyne will limit the littoral movement of sediment along the shore and therefore may enhance erosion on the downdrift shoreline.		**M**
Coastal flooding	The wider high tide beach formed by nourishment may enhance protection from coastal flooding associated with wave run up and storm surge. However, there will still be flooding of beachfront properties during severe storm events.	**L**	
Climate change	A groyne and nourishment option is likely to face climate change reasonably well as it will reduce the erosion risk from sea level rise and provides a mechanism to trap any increase in sediment supply into the system from climate change effects. However, the groyne may need to be upgraded and raised to deal with more frequent and severe wave action associated with projected sea level rise.	**L**	
Environmental footprint	The construction of the groyne and the nourishment with sandy beach material will use resources both during the initial construction stage and also with the periodic renourishment expected to be required to maintain a wide high tide beach. Over the long term a large amount of resources (including sand and fuel) may be required to obtain nourishment sands.		**H**
Reversibility of option	Once the groyne is constructed and nourishment material placed then it will be very difficult and expensive to remove the option. An alternative coastal erosion management solution would also be required.		**M**
Structure construction, works and maintenance costs	The groyne will be expensive to construct but if well designed maintenance costs may be low.		**H**

Impact Category	Groyne + Nourishment Assessment	+ve	-ve
Capital Costs	There is no property relocation or purchase required with this option and therefore no construction costs.	**0**	**0**
Local Economy	Imperceptible change in numbers of total visitors to Coromandel. Capital spend not necessarily local An improved beach environment through nourishment has the potential to provide incentives for additional tourism related businesses to set up (such as motels and café's).	**M**	
Transaction costs	High transaction costs expected as resource consent and design costs are likely to be high both for the groyne (including engineering designs) and for ongoing nourishment of the beach.		**H**
Tourism	Imperceptible changes in numbers of total visitors to Coromandel. The improved amenity values as a result of an enhanced beach may attract more visitors to Whitianga but equally this may be offset by the loss in natural character associated with the groyne.	**L**	
Private Capital	The value of beach-front and other local properties are likely to be enhanced due to increased protection from coastal hazards and the improved beach amenity.	**M**	
Protection of Public Infrastructure	Public road and reserve directly behind nourished beach (updrift side of groyne) protected from erosion	**M**	

3 Buffalo Beach Mid Section Assessment of Options

3.1 Status Quo

Impact Category	Status Quo Assessment	+ve	-ve
Policy/ Statutory Compliance	The status quo option at this section of Buffalo Beach would be consistent with the provisions of the NZCPS, WRPS, WRCP and TCDP which promote the maintenance and enhancement of natural buffers and the avoidance of coastal erosion hazards through appropriately located development. There is no development adjacent to the shore at this location and the land is zoned open space and so development is further restricted. This option is also therefore consistent with natural character provisions of the NZCPS, WRPS, WRCP and TCDP. The 'do nothing' approach is the first priority in the hierarchy of options advocated by the NZCPS for managing impacts of climate change and natural hazards.	**H**	
Beach Amenity Values	The status quo option at this section of the beach has high beach amenity values as there is no development adjacent to the shore, no hard engineering structures and good public access along the foreshore.	**H**	
Public access	This option has good public access as there are no hard engineering structures present, there is a wide high tide dry beach and the land adjacent to the beach is public reserve. There is therefore good access both to and along the foreshore. However, the dune can be steep when cutback by erosion, limiting access to the foreshore.	**M**	

Impact Category	Status Quo Assessment	+ve	-ve
Construction nuisance	There is no construction associated with this option and therefore no construction nuisance	**0**	**0**
Public safety	No effects on public safety as there are no hard engineering structures on the foreshore and no development close to the shore at risk.	**H**	
Impact on Council	Very little impact on Council with this option as there are no private properties at risk in this section of Buffalo Beach and therefore no assumption that TCDC must do something to mitigate natural hazard risk. There is little on-going commitment required by TCDC or EW with this option.	**H**	
Uncertainty	Very little uncertainty with this option as there is no hazard present and no hard engineering protection structures	**H**	
Public resistance	No public resistance expected.	**H**	
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Although there are no recorded archaeological sites in the foredunes of this section of Buffalo Beach, dynamic fluctuations of the shoreline (if allowed to occur uninhibited) could potentially threaten any unrecorded archaeological sites, particularly near the stream where there is the potential for a number of unrecorded sites (Warren Gumbley, pers. Comm.).		**L**
Equity	No difference in benefits to be obtained by any particular group with this option.	**H**	
Biodiversity	There is no affect on biodiversity from this option.	**0**	**0**
Natural character	High level of natural character of the beach maintained with this option as development is well setback from the foreshore and there are no hard engineering structures present.	**H**	
Coastal Processes	No effect on natural processes or coastal erosion with this option.	**0**	**0**
Coastal flooding	No risk of coastal flooding as there is no development adjacent to the foreshore.	**H**	
Climate change	This option will face climate change well as there is a natural buffer in place and no development adjacent to the foreshore at risk from the effects of climate change.	**H**	
Environmental footprint	No resources needed for this option and no impact on natural environment as it lets nature take its course and there is no human modification of the system.	**H**	
Reversibility of option	Very easy to reverse this option as there will have been no change to the natural state of the beach if the option is maintained.	**H**	
Structure construction, works and maintenance costs	There are no hard engineering structures associated with this option and therefore no construction or maintenance costs	**0**	**0**
Capital costs	No relocation or purchase of properties required with this option	**0**	**0**

Impact Category	Status Quo Assessment	+ve	-ve
Local Economy	No change to existing situation	**0**	**0**
Transaction costs	No transaction costs	**0**	**0**
Tourism	No change to existing situation	**0**	**0**
Private Capital	No change to existing situation	**0**	**0**
Protection of Public Infrastructure	The public reserve land is currently unprotected and will therefore be vulnerable to dynamic shoreline fluctuations in the future. However, the area of reserve land is significantly large and therefore areas lost through erosion will only have minor effects in the long term.		**L**

3.2 Dune Restoration

Impact Category	Dune Restoration Assessment	+ve	-ve
Policy/ Statutory Compliance	No resource consents will be required for this option as it mostly involves clearing exotic vegetation and restoration of a low naturally vegetated foredune. The re-establishment of a natural foredune would be consistent with the provisions of the NZCPS, WRPS, WRCP and TCDP that promote the maintenance and enhancement of natural buffers. This option is also therefore consistent with natural character provisions of the NZCPS, WRPS, WRCP and TCDP. The NZCPS states that it is a national priority to protect features that are essential or important elements of the natural coastal environment. If native dune plants are used to re-establish the dunes then the option will be consistent with, in particular, policy 3.2.10 of the NZCPS.	**H**	
Beach Amenity Values	Re-establishment of the dune with plants, especially native dune plants will slightly enhance the amenity of the beach and peoples 'sense of place' while at the beach	**L**	
Public access	There will be restrictions to public access over the dunes while dune plants are establishing but with the construction of simple accessways to provide for public access to and from the beach to avoid trampling damage to the sensitive dune vegetation this would be only be a minor effect in the long term. By restoring a natural dune then access to the foreshore will be maintained in the long term.	**L**	**L**
Construction nuisance	There may be minimal works associated with clearance of exotic vegetation prior to planting of native sand binders. However, this will only be a temporary and minor effect in the long term.		**L**
Public safety	No effects on public safety as there are no hard engineering structures on the foreshore and no development close to the shore at risk.	**H**	
Impact on Council	There is likely to be some objection from residents directly landward who will be concerned that any natural dune may build over time and affect their views. There is a small on-going commitment required by TCDC and/or EW with this option in relation to management of dune restoration processes – which could readily addressed by the local Beachcare group.		**L**

Impact Category	Dune Restoration Assessment	+ve	-ve
Uncertainty	Very little uncertainty with this option as there is no hazard present and no hard engineering protection structures. Dune restoration projects in other areas of New Zealand have generally been very successful.	**H**	
Public resistance	Public support for this option is expected to be high and resistance low as communities generally agree with 'beach care' works where there is no infrastructure at risk. However, resistance is likely from some residents directly landward as a built up dune may eventually block some seaviews they currently have.	**M**	
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Dune restoration is not considered to adversely affect any archaeological sites as plantings will only disturb the very top layers of the dune. The restoration of the dune in the long term is likely to provide an additional buffer to archaeological sites landward of the frontal dunes.	**L**	
Equity	Everyone is expected to benefit equally from the enhanced dune at this location – though there may be very minor impacts on views from properties directly landward.	**M**	
Biodiversity	A natural dune and the removal of exotic species (replanting with natives) will enhance biodiversity.	**H**	
Natural character	The re-establishment of a natural dune with this option will enhance natural character and maintain it in the long term.	**H**	
Coastal Processes	The improved natural dune will assist in buffering land behind from wave attack during storm events. Coastal processes will occur uninhibited.	**0**	**0**
Coastal flooding	The restored dune will reduce wave overtopping, though coastal flooding is not presently an issue of any significance on the reserve.	**H**	
Climate change	This option will face climate change well as the enhanced natural buffer (dune) will slightly improve the protection of land from the effects of climate change .	**H**	
Environmental footprint	Native plants will be required and there are some resources involved in growing these and planting them, although minor in the long-term.	**M**	
Reversibility of option	This option is easily reversed as there are no hard engineering structures required and there is very little human modification of the dune other than re-vegetating with plants.	**H**	
Structure construction, works and Maintenance costs	The costs of re-establishing a vegetated natural dune are relatively minimal. Some minor ongoing maintenance may be required associated with factors such as vegetation damage from trampling and access management		**L**
Capital costs	There is no relocation of buildings or property purchase required for this option and therefore no capital costs.	**0**	**0**
Local Economy	There may be some small stimulation of local economic activity associated with the enhanced natural character of the foreshore, such as walking clubs, bird watchers, etc.	**L**	
Transaction costs	The only transaction costs for this option will be in regards to the purchase of plants which is minor.	**0**	**0**
Tourism	There may be a small increase in numbers of total visitors to Whitianga arising from the improvements in beach amenity and natural character.	**L**	

Impact Category	Dune Restoration Assessment	+ve	-ve
Private Capital	No effect on private capital	**0**	**0**
Protection of Public Infrastructure	The public reserve land will be provided with a level of protection from dynamic shoreline fluctuations because of the additional buffering capacity of a re-established frontal dune. However, reserve land may still be at threat from severe storm erosion.	**L**	

4 Buffalo Beach Northern Section Assessment of Options

4.1 Status Quo

Impact Category	Status Quo Assessment	+ve	-ve
Policy/ Statutory Compliance	One of the current seawalls has now been granted a short-term (6 year but presently subject to appeal) resource consent. However, the other seawalls still require authorisation. If the status quo option were pursued then all the seawalls would require resource consent to remain in the CMA for the longer term. Statements made in the Hearing decision in consideration of the presently consented seawall consent indicate that the structure is not considered a viable long-term solution for this section of beach and the other seawalls are generally lesser structures – so longer term resource consent may be difficult to obtain. Hard engineering structures have adverse environmental effects that are contrary to the provisions of the NZCPS, WRPS, WRCP and TCDP which require soft options be considered in preference to hard structural options as sustainable solutions to coastal erosion. The seawall structures are also inconsistent with the draft TCDC policy paper currently being considered that suggests TCDC will only permit soft engineering solutions to coastal erosion of council owned land.		**H**
Beach Amenity Values	The existing seawalls have an adverse visual effect on the beach at this location as they are constructed with material inconsistent with the local environment and are engineered structures. The structures also adversely impact on community recreational enjoyment of the coast, as there is no access over the seawalls, and reduced access along the shore through the reduction in dry beach at high tide. The possibility of wall failure could contribute to reduced amenity values in the long term as rock may become dislodged from structure and scatter on the beach – particularly with the smaller rock sizes used in the northernmost structures.		**H**
Public access	Public access both to and along the foreshore at high tide is restricted at the moment because of the location of the existing mass block and rock seawall on the foreshore. Existing consent conditions require that beach nourishment be undertaken to mitigate these effects when sand comes available from the Waterways development.		**H**
Construction nuisance	Only long term construction works required is infrequent maintenance of existing structures. This nuisance will be temporary in nature and have only minor effects.		**L**

Impact Category	Status Quo Assessment	+ve	-ve
Public safety	It is understood the existing seawalls were not properly engineered and therefore some pose potential hazards to people accessing the beach over them. Rocks dislodged onto the foreshore could also create a hazard for beach users.		**L**
Impact on Council	This option is likely to result in ongoing demands on both TCDC and EW time following severe storm damage to act to mitigate the effects of coastal hazards and (possibly) increased community concern in respect of the adverse effects of the structures on beach use. Consenting and granting landowner permission for the existing structures may also expose EW/TCDC to future liability.		**M**
Uncertainty	The existing seawalls have not been built to normal engineering standards and it is not known how adequately they will perform under conditions of severe erosion. Therefore, there is considerable uncertainty in regard to the level of protection provided to property and to those dwellings close to the foreshore – especially with the less rigorous seawalls at the very northern end of the affected area. There is uncertainty in regard to the level of maintenance/upgrade likely to be required if erosion worsens in the future. There is also uncertainty as to whether the existing seawalls would be granted long term consent given existing policies. The end effects associated with the existing consented structure also creates uncertainty for neighbouring beachfront properties.		**H**
Public resistance	The uncertainties associated with this option may raise concerns for affected property owners. There may also be resistance from beach users and/or adjacent property owners because of adverse effects associated with the existing structures.		**M**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	The status quo option will protect the values of any archaeological sites landward of the seawall from the effects of erosion. However, unprotected areas would continue to erode and may potentially lead to the damage of archaeological sites.	**L**	**L**
Equity	This option provides some property erosion protection benefits for the relevant property owners but adversely impacts on beach use values (e.g. natural character, amenity values, public access) important to the wider community. There is also potential for adverse impacts from some existing structures on adjacent TCDC owned reserve land.		**H**
Biodiversity	The status quo option limits the width of the upper beach in places due to the existing protection structures and this may have some small local adverse effect on habitat. The seawalls also prevent the development of a natural frontal dune along much of the affected area during erosional periods as there is only limited and temporary space for natural dune vegetation to establish. The rock wall may provide additional habitat for rock dwelling fauna and flora, though rock walls may provide a habitat for rats.		**M**

Impact Category	Status Quo Assessment	+ve	-ve
Natural character	The back beach area is developed and therefore the natural character of the wider coastal environment is already modified. However, the existing seawalls further significantly reduce the natural character of the beach itself – the beach being backed by a human built structure rather than a natural dune. For instance, natural character of the beach in the affected area is considerably less than in the adjacent area to the immediate south where the beach is backed by a natural dune and there is no development adjacent to the shore. Natural character is also reduced by encroachment of some of the structures onto the active beach.		**H**
Coastal Processes	The existing walls separate the dune sand reserves from the beach, preventing natural shoreline response to erosion events and potentially aggravating beach erosion in front of the walls during storm events. The existing mass block seawall structures is clearly causing exacerbated erosion of adjacent unprotected areas (known as “end effects” erosion), however consent conditions requiring that mitigating measures be undertaken to reduce this effect.		**M**
Coastal flooding	The lack of a natural dune buffer along the frontage of most properties increases the potential for coastal flooding.		**M**
Climate change	The existing structures are unlikely to provide adequate protection in the event that existing erosion is aggravated by current IPCC predictions for sea level rise. Increases in storm wave run-up as sea level rises would also result in increased overtopping of the seawalls and damage to the properties immediately behind the wall. Adverse effects on beach values (natural character, amenity, public access) would also be considerably worsened. Therefore, the status quo option is unlikely to be sustainable in the event of climate change effects.		**H**
Environmental Footprint	The existing structures protect physical resources (property and buildings) but at the cost of natural resources (beach) so are therefore not considered to be a sustainable option. The status quo situation only uses minor resources required for the on-going maintenance of existing seawalls		**L**
Reversibility of option	This option very easy to reverse back to the existing situation as it essentially promotes ‘do nothing’.	**H**	
Structure construction, works and maintenance costs	The costs of building existing structures has been relatively high to date and ongoing maintenance costs will probably also be high. There will also be moderate long term costs associated with the nourishment currently required as part of seawall approval.		**M**
Capital costs	There are no capital costs associated with this option.	**0**	**0**
Local Economy	The adverse effects of the structures on the beach may have a small impact on the local tourist economy.		**L**

Impact Category	Status Quo Assessment	+ve	-ve
Transaction costs	Could be high costs to TCDC in the event of any future litigation arising from the structures. Resource consent process for the existing structures could also be complex, depending on level of objection by wider community.		**L**
Tourism	Very small, if any, reduction in numbers of total visitors to Coromandel because of beach amenity impacts (reduced natural character, etc). Any reduction in beach visitors will probably be to Buffalo Beach itself – with some visitors possibly choosing other Coromandel beaches in preference because of the reduced beach values.		**L**
Private Capital	It is probable that the affected properties would continue to have significantly lower capital values than beachfront sites elsewhere on the eastern Coromandel because of ongoing uncertainties and the adverse effects associated with this option. The values of other properties in this general area may also be reduced against what their values would otherwise be because of the adverse effects on beach values.		**M**
Protection of Public Infrastructure	There are a small amount of unprotected reserve areas that will be subject to dynamic fluctuations of the shoreline and may be lost altogether		**L**

4.2 Living with Coastal Erosion

Impact Category	Living with Coastal Erosion Assessment	+ve	-ve
Policy/ Statutory Compliance	Living with coastal erosion at this site is not consistent with the natural hazards provisions of planning documents as it does not avoid the effects of natural hazards (which could pose a serious threat to properties and dwellings in this area) or protect existing physical resources. However, this option is consistent with provisions relating to natural character as it involves removing natural structures and allowing natural processes to take their course.	**L**	**L**
Beach Amenity Values	The removal of the existing structures would restore a high tide dry beach and a natural backshore, improving visual and recreational amenity values.	**H**	
Public access	The removal of any coastal protection structures will allow for improved physical public access to and along the foreshore. However, coastal erosion may result in the high tide beach becoming located on private land and legal access may then be lost.	**L**	**M**
Construction nuisance	The removal of existing structures would require diggers on the site to remove seawall material. However the noise and disturbance caused by demolition works would only be temporary and there would be no on-going construction disturbance once structures removed from the foreshore.		**L**

Impact Category	Living with Coastal Erosion Assessment	+ve	-ve
Public safety	The removal of the existing coastal protection structures would potentially put private property and dwellings at risk, Removal of the existing structures would also eliminate the risk of injury caused by accidents on these structures. However, during periods of erosion the dunes may be cutback and have steep faces that may be unsafe for the public.	**L**	
Impact on Council	Outcome statements from both the EW and TCDC LTCCP processes indicate that the community expects both Councils to act to protect them from natural hazards. The living with coastal erosion option does not meet this community expectation. Existing hazard lines suggest there is potential for severe property damage with this option and some properties may be rendered unusable. Therefore, it is almost certain property owners would not accept this option and that complex and expensive litigation would arise if the option were pursued. If implemented, parties adversely affected by coastal processes would probably hold TCDC and EW responsible for those effects and complex and expensive litigation is very likely.		**M**
Uncertainty	The removal of existing levels of protection will increase uncertainty and emotional stress on beachfront property owners and the future of beachfront properties and dwellings would be very uncertain with this option.		**H**
Public resistance	The beachfront owners are expected to be the source of greatest resistance to this option as they stand to lose the most by the removal of existing coastal protection structures. Consultation with the community in the past has indicated that they would resist the "living with nature" option as it is seen as TCDC and EW being inactive in managing a natural hazard.		**M**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	There are no recorded archaeological sites in the foredunes of the northern section of Buffalo Beach. However, dynamic fluctuations of the shoreline (if allowed to occur uninhibited) could potentially threaten any unrecorded archaeological sites, particularly in the areas near the streams where there is the potential for a large number of undiscovered archaeological sites[2].		**M**
Equity	The wider community would benefit from improved beach values but private land owners may experience considerable costs/losses and very high levels of stress. Removal of structures will enhance amenity but at the cost of private land.		**M**

[2] Warren Gumbley pers. comm., July 2004

Impact Category	Living with Coastal Erosion Assessment	+ve	-ve
Biodiversity	A natural dune and associated vegetation would eventually re-establish naturally or could be assisted by human intervention.	**L**	
Natural character	Natural character of the beach will be enhanced with the removal of human-made structures, however development adjacent to the beach remains reducing natural character.	**M**	
Coastal Processes	Once structures were removed there would be no effect on natural erosion rate or processes and these would be allowed to continue naturally.	**0**	**0**
Coastal flooding	Coastal flooding of beachfront properties may increase with removal of structures until a natural dune re-established. Original development involved levelling of the dunes and removal of the dune buffer, leaving low lying beachfront land subject to flooding by high seas.		**H**
Climate change	Any aggravation of erosion by projected sea level rise will continue unabated with this option, leaving properties and dwellings vulnerable to effects of climate change. Existing hazard lines suggest this could leave 14-15 properties unusable by 2100. Existing hazard lines also suggest that Buffalo Beach Road could be affected in the longer-term. The risk of serious coastal flooding would also increase considerably with sea level rise.		**M**
Environmental Footprint	No resources needed for this option and no impact on natural environment as it lets nature take its course and there is no human modification of the system. Some resources would be needed to remove the existing structures but these are considered to be minor.	**H**	
Reversibility of option	Intervention would be required to reverse the option and appropriately protect properties and dwellings if this option was pursued. However, some losses may be incurred before such action is practical.		**L**
Structure construction, works and maintenance costs	The costs of excavating and removing the structures would be relatively low. There are no maintenance costs as there will be no structures present.		**L**
Capital costs	Severe damage and even loss of some beachfront properties could arise, with a high negative impact on the affected landowners.		**H**
Local Economy	Loss of rates from any sections that had to be abandoned. Low capital spend/local labour requirement apart from the initial removal cost. Little effect on tourist or visitor spending is likely.	**L**	
Transaction costs	Likely to be very high legal costs associated with refusal to allow existing beachfront properties to protect their land & dwellings. Compensation may also be required if the courts rule there were alternative practicable options that could have been pursued that would have avoided the cost to affected landowners.		**H**
Tourism	Little if any affect on numbers of total visitors to Coromandel – if there is any affect it will be an increase in numbers due to a beach with higher natural values and improved public access.	**L**	

Impact Category	Living with Coastal Erosion Assessment	+ve	-ve
Private Capital	Severe damage and even loss of some beach-front properties could arise, with a high negative impact on the affected landowners. Moreover, beachfront property prices would be depressed by the high level of uncertainty associated with the option.	**L**	**H**
Protection of Public Infrastructure	No public infrastructure likely to be affected due to the erosion hazard resulting from short-term storm cycles. However, existing hazard lines suggest there may be some threat to Buffalo Beach Road by 2100 if erosion is aggravated by sea level rise.		**M**

4.3 TCDC Purchase of Beach Front Land + Relocation + Open Space/Reserve Rezoning

Impact Category	TCDC Purchase of Beach Front Land + Relocation + Open Space/Reserve Rezoning Assessment	+ve	-ve
Policy/ Statutory Compliance	The TCDP states that setbacks are imposed under the Building Act and no buildings are to be located within the 30 metre setback line and only relocatable houses may be located within the 60 metre setback line. This option is therefore consistent with the Building Act, discouraging development located within the hazard area. By relocating existing development out of the hazard risk area and rezoning to prevent further development along the foreshore is consistent with objectives and policies of the WRCP and TCDP and the NZCPS, which promote the avoidance of natural hazards and hard engineering structures. In particular the TCDP Policy (222.4) ensuring development is located, built or carried out in such a way that the effects of natural hazards are avoided or the creation of a hazard is avoided. This option is also consistent with provisions in plans that promote the creation of reserve along the coast that provide access (policy 212.4 TCDP). However, in terms of the LGA, significant public benefits would have to be demonstrated to justify public expenditure of this magnitude. The site would also have to be established as a high priority relative to other benefits that could be obtained for this expenditure. It is doubtful that this option would meet these standards.	M	
Beach Amenity Values	Removing development and providing more open public space will improve recreational use and amenity in this section of Buffalo Beach	**H**	
Public access	Public access both to and along the foreshore at high tides will be significantly improved with land transferred into TCDC ownership	**H**	
Construction nuisance	Temporary construction nuisance with the relocation of buildings and the removal of existing structures.		**L**
Public safety	Small benefits for public safety once development and existing walls are removed. However, during periods of erosion the dunes may be cutback and have steep faces that may be unsafe for the public.	**L**	

Impact Category	TCDC Purchase of Beach Front Land + Relocation + Open Space/Reserve Rezoning Assessment	+ve	-ve
Impact on Council	The option would resolve the immediate hazard issues. However, the very large expenditure involved with this option could have major implications for district and regional council rates and considerable ratepayer resistance and associated increased pressure on both EW and TCDC will probably be encountered.	**H**	**M**
Uncertainty	High level of long-term certainty provided by this option as threatened development is removed and owners are compensated at market value.	**H**	
Public resistance	Major resistance is likely from beachfront owners and the wider community. Owners will probably wish to retain this high amenity land and are likely to prefer options that enable continued occupation and use. District and regional ratepayers are likely to be very resistant to the costs of this option, given other funding priorities.		**H**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Rezoning to an open space policy area will prevent further development disturbance of the land that may potentially have unrecorded sites. However, as erosion of the shoreline would occur uninhibited, there is the potential for loss of any unrecorded archaeological sites, particularly areas likely to contain sites such as near Taraporiki Stream[3].	**L**	**L**
Equity	Provided owners are fairly compensated for their land, the option will offer benefits to both private property owners and the wider community.	**M**	
Biodiversity	The option would enable the re-establishment of a native dune ecosystem along the margin – though human intervention will be required to facilitate this.	**L**	
Natural character	Very significant improvement of natural character due to removal of human built elements (existing houses and structures) and restoration of natural dune environment along margin.	**H**	
Coastal Processes	No effect on natural erosion rate or processes.	**0**	**0**
Coastal flooding	Relocation of development away from the shore and dune restoration will largely eliminate coastal flooding hazard.	**M**	
Climate change	This option enables natural shoreline adjustment to climate change effects. However, existing hazard lines suggest there may be some threat to Buffalo Beach Road by 2100 if erosion is aggravated by sea level rise.	**M**	
Environmental footprint	The option involves some resource loss (e.g. associated with demolition of non-relocatable dwellings) but restores natural beach and dune system in this area. Overall, effects on the environment are reduced and the environmental footprint decreased.	**H**	
Reversibility of option	Difficult to reverse this option and return to the state of the beach prior to implementation of the option as it involves relocating houses which is at a high cost and rezoning which is a public and, sometimes, lengthy process.		**H**

[3] Warren Gumbley, Regional Field Archaeologist, pers. comm. July 2004

Impact Category	TCDC Purchase of Beach Front Land + Relocation + Open Space/Reserve Rezoning Assessment	+ve	-ve
Structure construction, works and maintenance costs	Capital costs of this option should be small as no structures required to be built or maintained.		**L**
Capital costs	Large costs associated with purchasing properties and relocating buildings offsite.		**H**
Local Economy	May be an increased incentive for economic activity with the improved natural character and amenity values leading to improved tourism opportunities – though the affected area of the beach is away from the main town.	**L**	
Transaction costs	Likely to be very high costs (legal and otherwise) associated with negotiation and implementation of this option.		**H**
Tourism	Small, if any, increase in numbers of total visitors to Coromandel because of beach amenity improvements.	**L**	
Private Capital	Affected land owners should receive fair return for their property, assuming market price is paid. However, they lose potential opportunities for future capital gain – generally high for beachfront properties. Other local properties would probably experience significant value gains, especially those on the landward side of Buffalo Beach Road.		**H**
Protection of Public Infrastructure	No public infrastructure likely to be affected due to the erosion hazard resulting from short-term storm cycles. However, existing hazard lines suggest there may be some threat to Buffalo Beach Road by 2100 if erosion is aggravated by sea level rise.		**L**

4.4 Frontal Seawall

Impact Category	Frontal Seawall Assessment	+ve	-ve
Policy/ Statutory Compliance	Coastal defence structures above the line of mean high water springs (MHWS) are a non complying activity in the TCDP. Coastal defence structures below the line of MHWS are a discretionary activity in the WRCP. There is therefore a difference in the activity status depending on the location of the structure. A seawall is likely to be placed within and above the CMA and therefore require resource consent from both the Regional Council and TCDC, as well as permission from TCDC for placement on Council-owned reserve. Depending on the length of seawall required it may be classed as a restricted coastal activity and require Minister of Conservation approval. Seawalls are generally contrary to the policy provisions of the district, and regional plans and the NZCPS unless they are considered the most appropriate option for erosion control over and above soft engineering solutions. Seawalls are not consistent with the draft policy paper currently being considered by TCDC that advocates for soft engineering approaches to coastal erosion management on TCDC owned land.		**M**
Beach Amenity Values	A seawall located on Council-owned reserve seaward of the front property boundaries will generally be exposed on most occasions and therefore reduce visual amenity. The width of high tide beach will also be reduced and, in some places		**H**

Impact Category	Frontal Seawall Assessment	+ve	-ve
	eliminated – particularly during erosional periods. Therefore, public amenity in respect of the beach and use of it will generally be reduced by this option.		
Public access	Public access along the coast will be adversely impacted at higher stages of the tide due to elimination of the high tide dry beach along some areas of the wall (arising from encroachment of the wall onto the beach) and during erosional periods (due to passive erosion effects) The seawall will also steepen the interface between the beach and adjacent land therefore making access to the beach more difficult and probably necessitating access structures to avoid clambering over rocks.		**H**
Construction nuisance	Temporary adverse construction effects associated with the construction and maintenance of the seawall.		**L**
Public safety	Rock structures represent a hazard that is not present in a natural foreshore/dune situation. Seawall structures can be dangerous for people traversing them to get to the beach.		**L**
Impact on Council	There is the possibility of EW and/or TCDC being held liable for consented structures that fail. Maintenance of the seawall will be required and therefore on-going commitment from TCDC is expected. There is likely to be reduced pressure on TCDC from private property owners. However, there may be an increase in pressure on TCDC in the future from wider community due to adverse effects of the structure on amenity of the beach and public access.		**M**
Uncertainty	There are some uncertainties associated with the seawall option such as longer-term impacts on the structure associated with climate change (particularly sea level rise and associated erosion which may increase wave damage and aggravate adverse environmental effects). Therefore, the structure may not be a sustainable solution in the long term with changing coastal processes. However, in the short to medium term this option eliminates uncertainty for affected private property owners.		**L**
Public resistance	At present, there is generally little public resistance to hard engineering structures. However, there may be some resistance from the wider community in the future due to the loss of beach amenity, natural character and public access that is associated with such structures.	**M**	**M**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Minor negative impacts on fringe of seawall construction works. However, the frontal dunes and area immediately landward is not expected to have many archaeological sites due to the dynamic nature of the front beach area (although areas adjacent to the Harbour entrance may have). In the long term the wall will protect any unknown archaeological sites that may be located within the protected area.	**M**	**L**

Impact Category	Frontal Seawall Assessment	+ve	-ve
Equity	The option protects both public infrastructure and reserve as well as private property further landward – but at the expense of public beach values.		**M**
Biodiversity	Depending on the design of the seawall it may provide an additional habitat for some fauna. However, the structure is most likely to be rock and these types of seawalls tend to provide habitats suitable for rats. The seawall is also located too far seaward on the beach to allow a frontal dune to establish in front of the structure, preventing re-establishment of dune vegetation and a natural coastal ecosystem.		**L**
Natural character	This seawall option will result in a highly visible engineered structure along the back of the beach and will substantially reduce natural character of the beach relative to adjacent unprotected and undeveloped areas.		**H**
Coastal Processes	Seawalls may interfere with wave patterns (reflecting waves off their face) and cause a lowering of the beach in front because they lock up sediment that would otherwise be available in the system. Unprotected areas adjacent to the structure may also suffer from accelerated erosion due to end effects erosion.		**M**
Coastal flooding	The seawall option being considered would have a higher crest elevation than the existing structures and would probably decrease the potential for coastal flooding. If a rock structure is used this will also tend to dissipate wave energy and reduce overtopping. Nonetheless, some wave overtopping of the structure may occur.	**L**	
Climate change	Changes accompanying climate change, including sea level rise would significantly aggravate erosion of the beach in front of the structure and lead to serious degradation of beach values – including public access, beach amenity and natural character. Increased wave attack on the wall arising from elevated sea levels and erosion would also be likely to lead to more frequent and severe damage to the wall.		**L**
Environmental footprint	The option will protect property and dwellings but degrade the natural beach resource. A seawall requires resources for the construction of the structure and potentially resources for the maintenance of the structure in the long term. This will include rock and other construction materials as well as fuel for the construction and maintenance equipment.		**L**
Reversibility of option	A seawall is not easily removed as it will involve disturbance associated with construction works, cost of removal of the structure and rehabilitation of the beach. It is expected that there will be a large amount of public resistance to removing the structure once it is there.		**H**
Structure construction, works and maintenance costs	Over the long term, a well engineered and built sea wall will have a moderate capital cost and a low maintenance cost.		**M**
Capital costs	No capital costs associated with this option as no relocation or purchase of property required.	**0**	**0**
Local Economy	Potential for small adverse impact on local economy because of degradation of beach values and access. There would be some capital spend on construction of the seawall with some local labour requirements as well as ongoing maintenance requirements.	**L**	**L**

Impact Category	Frontal Seawall Assessment	+ve	-ve
Transaction costs	High transaction costs could be expected from this option given the requirement for a notified resource consent, the status of the activity in the TCDP, and the associated potential adverse environmental effects. In the longer-term, the adverse effects of the structure on community values (and possibly on properties further landward) may also lead to increased community concern and even to litigation.		**H**
Tourism	There may be a very small reduction in numbers of total visitors to Coromandel because of beach amenity impacts – but this is unlikely.		**L**
Private Capital	Protection of beach-front property will reduce present uncertainty and increase the value of these properties. However, the properties will probably continue to have a lower value than other equivalent properties elsewhere because of the reduced beach values associated with the seawall. Overseas work also suggests potential for reduction in the values of other property in this immediate area (relative to what otherwise would have occurred) because of adverse impacts on beach amenity and natural character		**L**
Protection of Public Infrastructure	The seawall will protect public reserve land and the road from dynamic fluctuations of the shoreline.	**M**	

4.5 Relocate Dwellings and Redevelopment with Backstop Wall

Impact Category	Relocate Dwellings and Redevelopment with Backstop Wall Assessment	+ve	-ve
Policy/ Statutory Compliance	A backstop wall is considered a coastal protection structure and will require resource consent from TCDC as a non-complying activity. No resource consents will be required from EW as the works occur above the line of MHWS. As a backstop wall will only have minor effects on the natural character of the area, coastal processes and temporary effects caused by construction work, the chances of obtaining resource consent are high. The relocation aspect of this option is consistent with natural hazards, natural character and public access policies of local, regional and national planning documents as the effects of the hazard are mitigated and by relocating development back from the foreshore natural character and other coastal values are enhanced.	**H**	**L**
Beach Amenity Values	If an appropriate setback of the wall can be achieved, it will remain hidden for most of the time and only be exposed during severe storm events – having little adverse effect on amenity values.	**M**	
Public access	Public access along the beach will be improved with this option as there will be no coastal protection structures on the beach – though public acquisition of the land in front of the wall will be required to ensure no future legal problems with access along the shore.	**M**	

Impact Category	Relocate Dwellings and Redevelopment with Backstop Wall Assessment	+ve	-ve
Construction nuisance	Minor and temporary construction nuisance with the construction of the backstop wall.		**L**
Public safety	As the structure is buried, public safety can only be affected when the structure is exposed following severe storm events.		**L**
Impact on Council	Pressure on TCDC from beachfront property owners is likely to decrease in the long term as the backstop wall will provide security for property owners. However, TCDC may receive pressure from beachfront property owners to relax current building restrictions within the hazard zones because of the presence of the structure. TCDC will still retain some liability as they will be providing consent for an erosion protection structure that may fail (although it this is unlikely).	**M**	 **M**
Uncertainty	High level of certainty provided by backstop wall in the event of severe storms. However, it is uncertain how the backstop wall would cope in the event of several severe storm events.	**M**	
Public resistance	District and regional ratepayers are likely to be very resistant to the initial coasts of this option.		**M**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Disturbance of any archaeological sites possible with the placement of backstop wall but will be minor and limited to the short term. However, any unknown archaeological sites behind the backstop wall will be protected from erosion.	 **M**	**L**
Equity	A backstop wall would benefit both future private beachfront property owners (providing effective protection to property and dwellings behind the wall) and the wider community (due to significant improvements in natural character, amenity values and beach access). As the benefits to the wider community are obtained at the expense of some private land (i.e. the area in front of the wall) a contribution from the wider community to total costs would be appropriate.	**H**	
Biodiversity	If the wall is located sufficiently far landward, it should be practical to restore and maintain a naturally vegetated sand dune in front of the structure on most occasions.	**L**	
Natural character	Natural character values for the beach would be significantly improved as, for the majority of time, there would be no hard engineering structures visible on the beach. While the structure will be exposed for short periods during and after severe storms, these periods will be very infrequent and of relatively short duration. If the wall is located sufficiently far landward to restore and maintain a naturally revegetated dune then natural character would be considerably enhanced.	**M**	
Coastal Processes	There will be no effect on coastal processes on most occasions except during large storm events when the structure will provide a landward limit to erosion, preventing any further cutback of beachfront properties. This effect would be minor and short-lived with existing coastal processes.		**L**
Coastal flooding	The relocation of houses landward will decrease the potential for the adverse effects of storm surge, wave run up etc on beachfront properties. The backstop wall is also elevated to reduce wave overtopping. Together with dune restoration in front of the wall, this option will markedly reduce the potential for wave flooding of the beachfront properties and dwellings.	**M**	

Impact Category	Relocate Dwellings and Redevelopment with Backstop Wall Assessment	+ve	-ve
Climate change	With projected sea level rise, there is potential for erosion to be aggravated sufficiently for the wall to become permanently exposed by 2100. Therefore, this option, while providing an effective solution for the next 50 years, may not be sustainable after that period.	**M**	
Environmental footprint	The backstop wall will use a limited amount of resources at the time of construction (e.g., rock and fuel) and may require maintenance following large storm events. Otherwise this option is not expected to have an impact on the environment or resources in the long-term.		**L**
Reversibility of option	The option is not considered to be easily reversible. Removing the structure would be expensive and would raise the need for an alternative protection option. If the structure has to be removed due to aggravated erosion accompanying projected sea level rise, an alternative soft option would be required or else some properties may become unusable.		**H**
Structure construction, works and maintenance costs	Construction costs will be similar to those for a sea wall, however maintenance costs should be less because the wall is not exposed to wave action (i.e., structure is buried).		**M**
Capital costs	There are some houses that would need to be relocated further landward to provide space for the backstop wall at a high cost.		**H**
Local Economy	May be some small benefits for the local economy (e.g. cafes, motels) with the improved natural character and beach use values. There would also be some capital spend on construction of the wall with some local labour requirements as well as ongoing maintenance requirements.	**M**	
Transaction costs	There will be costs involved with a resource consent application for backstop wall (given it is a non complying activity) and possible legal costs associated with relocation of dwellings.		**H**
Tourism	Small, if any, increase in numbers of total visitors to Coromandel because of beach amenity improvements. However, the restoration of the natural beach may assist in attracting more visitors to Whitianga relative to the existing situation.	**L**	
Private Capital	The option is likely to significantly increase the value and saleability of the beachfront sections relative to the existing situation – due to elimination of uncertainties in respect of coastal erosion and the improvement in beach values. There may also be some relative increase in the value of other properties in the vicinity because of beach amenity improvements.	**M** **M**	**M**
Protection of Public Infrastructure	Additional public infrastructure may be gained with this option if Council retains a strip of land as Public reserve adjacent to the shore when the property is resold. However, this beachfront asset (reserve) will have little protection from a backstop wall, apart from a natural buffer system which is exposed to dynamic fluctuations of the shoreline.		**L**

4.6 Groyne + Nourishment

Impact Category	Groyne + Nourishment Assessment	+ve	-ve
Policy/ Statutory Compliance	Groyne structure(s) and deposition of sand material would require a publicly-notified resource consent from EW – being discretionary activities in the CMA. A resource consent may also be required from TCDC for those areas of the wall located above MHWS (i.e. the landward end). Landowner permission would also be required from TCDC for those parts of the structure on Council-owned reserve. Groyne structures are not consistent with the draft policy paper presently being considered by TCDC for soft engineering options as erosion management for TCDC owned beachfront land. Depending on the length of groyne required it may be classed as a restricted coastal activity and require Minister of Conservation approval. Groynes are generally contrary to the policy provisions of the WRPS, WRCP and TCDP unless they are considered the most appropriate option for erosion control over and above softer solutions. Beach nourishment is generally consistent with local, regional and national policy being regarded as an environmentally 'soft' approach and considered more appropriate than 'hard' engineered approaches (such as seawalls and groynes). However, in this case, beach nourishment is being used in conjunction with a hard engineering structure and so the benefits from using a soft engineering approach are not as significant.	**L**	**M**
Beach Amenity Values	The option will enhance the width of high tide beach along the front of the existing structures and associated beach amenity. However, groynes are highly visible engineered structures and therefore may affect people's 'sense of place' when visiting the beach. The structure will extend some distance offshore and may interfere with restrict some recreational activities (such as sailing and kayaking) at higher stages of the tide. However, groynes can also enhance beach amenity, often being widely used for fishing, sitting, lying down, children to play on, etc.	**M**	**M**
Public access	The beach retained by the groyne will improve public access to and along the coast. Access along the shore may be restricted by the structure, depending on its design. Some groynes also provide improved public access to the CMA as they can be used for fishing off, etc.	**L**	**L**
Construction nuisance	Temporary construction effects will be generated by the construction and maintenance of the groyne(s) and beach nourishment. Minor nuisance could be expected with ongoing maintenance to both the groyne and associated sand replenishment but these effects will be temporary and of relatively limited duration. Also any works required are likely to be conducted outside of peak holiday periods.		**M**
Public safety	There may be a minor effect on public safety if they have to traverse the groyne.		**L**
Impact on Council	TCDC (assuming they will hold the resource consent and take responsibility for the structure) will have a large on-going commitment to maintaining the structure and renourishing the beach to maintain protection of beachfront properties.		**M**

Impact Category	Groyne + Nourishment Assessment	+ve	-ve
Uncertainty	There are many uncertainties associated with the effects of this option and physical modelling would be required to design the option and assess effects with any confidence. It is also uncertain as to how long nourishment material would stay in the upper beach profile and what effects there would be on beach areas east of the wall if starved of longshore sediment supply by the groyne.		**H**
Public resistance	There may be some resistance from beachfront property owners to groyne structures due to the costs and uncertainties associated with the protection provided by this option. Resistance from the wider community may also be marked due to the significant visual effects associated with this structure.		**M**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historic Heritage	Archaeological sites protected behind area of nourished beach from dynamic shoreline fluctuations in the long term.	**M**	
Equity	The option provides benefits to the wider community (in terms of enhanced beach amenity relative to existing situation) and beachfront property owners directly behind groyne and created beach (in terms of enhanced property protection, increased property values and enhanced beach amenity). However, benefits to the wider community will be offset by adverse impacts on visual amenity and natural character and by possible erosion of reserve land on the eastern side of the groyne. Overall, property owners are likely to be the main beneficiaries with this option and would probably have to fund the larger portion of capital and maintenance costs.		**M**
Biodiversity	Creation of wider high tide beach may provide additional habitat for beach dwelling species and the opportunity for a naturally-vegetated foredune to be restored. The groyne structure is also likely to provide a suitable habitat for marine fauna and flora.	**M**	
Natural character	The groyne structure reduces the natural character of the beach, as the hard engineering structure will be highly visible. However, the creation of the beach (and possibly a dune) along the face of the properties will enhance natural character in this immediate area.	**L**	**M**
Coastal Processes	A groyne structure works by capturing any longshore movement of sediment and holding it in place. In conjunction with nourishment it will cause the creation of wider high tide beach. However, the beach profile on the downdrift side of the structure may suffer from more erosion if poor design results in this option being starved of an upstream supply of sediment. The option therefore has a significant affect on coastal processes.		**H**
Coastal flooding	The wider high tide beach formed along the seaward face of the properties will enhance protection form coastal flooding associated with wave run up and storm surge.	**L**	
Climate change	A groyne and nourishment option is likely to face climate change reasonably well as it will reduce the erosion risk from sea level rise and provides a mechanism to trap any increase in sediment supply into the system from climate change effects. However, the groyne may need to be upgraded and raised to deal with more frequent and severe wave action associated with projected sea level rise. More frequent maintenance of nourishment may also be required.	**M**	

Impact Category	Groyne + Nourishment Assessment	+ve	-ve
Environmental footprint	The construction of the groyne and the nourishment with sandy beach material will use resources both during the initial construction stage and also with periodic renourishment expected to be required to maintain a wide high tide beach. Over the long term a large amount of resources (including sand and fuel) will be used in obtaining and maintaining the nourishment sands.		**H**
Reversibility of option	Once the groyne is constructed and nourishment material placed then it will be difficult and expensive to remove the option. An alternative solution would also be required.		**M**
Structure construction, works and maintenance costs	The groyne will be initially expensive to construct but if well designed then maintenance costs may be low. The sand for nourishment will be expensive as it will need to be brought in from outside of the local beach system (rather than redistribution of existing sands). Relatively inexpensive sand may be available for initial construction and maintenance in the first 10-15 years. However, in the longer-term sand will probably need to be sourced from continental shelf sources significant distances from Buffalo Beach and Mercury Bay – increasing maintenance costs considerably		**M**
Capital costs	No relocation or purchase of properties required with this option.	**0**	**0**
Local Economy	Imperceptible change in numbers of total visitors to Coromandel. There may be some capital spend on construction of the groyne with some local labour requirements as well as ongoing maintenance requirements. An improved beach environment through nourishment may result in a small increase in local economic activity (e.g. motels and café's).	**M**	
Transaction costs	High transaction costs expected as resource consent and design costs are likely to be high both for the groyne (including engineering designs) and for ongoing nourishment of the beach.		**H**
Tourism	Imperceptible changes in numbers of total visitors to Coromandel because of beach amenity improvements. However, the improvements in beach amenity may result in a small increase in the number of visitors to Whitianga relative to the existing situation.	**L**	
Private Capital	The values of beach-front properties are likely to be significantly increased by this option. Other local properties may also increase in value because of the beach amenity improvements.	**M**	
Protection of Public Infrastructure	The groyne and nourished beach will provide protection for remaining areas of public reserve and the road.	**M**	

4.7 Offshore Breakwater + Nourishment

Impact Category	Offshore Breakwater + Nourishment Assessment	+ve	-ve
Policy/ Statutory Compliance	An offshore breakwater is a major structure within the CMA and will require a publicly notified resource consent from the Regional Council. Depending on the length of the breakwater, consent may be required as a restricted coastal activity and Minister of Conservation approval. Placement of nourishment material on the beach will also require resource consent from EW. Breakwaters are hard engineering structures and are therefore generally contrary to the policy provisions of the WRPS, WRCP, TCDP and national policy unless they are considered the most appropriate option for erosion control over and above do nothing or soft engineering solutions.		**M**
Beach Amenity Values	A breakwater that was exposed for all or part of the tidal cycle would have significant adverse effects on visual amenity. A submerged structure would have less adverse effects, though breaking waves would occur in areas where they were not previously noted. Whether visible or not, a breakwater will reduce the amenity of the waterspace by creating a navigation restriction that was not there before. However, if effective, a breakwater in combination with beach nourishment would improve beach amenity by helping to create a wider beach and a more sheltered nearshore environment. The wider beach arises from the shoreline bulge (known as a salient) that forms behind the structure due to wave refraction. Beach nourishment will assist in salient formation and will reduce erosion of adjacent beach areas	**M**	**M**
Public access	If the breakwater structure and nourishment were successful in creating a wider high tide beach along the front of the properties then public access to and along the shore would be improved.	**L**	
Construction nuisance	There will be temporary construction nuisance associated with the construction and maintenance of the breakwater and the placement of the nourishment. , but this would not affect many people as it would be offshore and temporary. Some ongoing maintenance of the breakwater would probably be required but again this would be offshore and likely to have low negative impacts on the beach users. Beach nourishment will have some minor construction nuisance associated with the placement of the beach material.		**L**
Public safety	Some issues of public safety may arise from the breakwater, particular in relation to navigation.		**L**
Impact on Council	Breakwaters have not always been as effective as intended due to various design and construction difficulties. If the structure was unsuccessful or had significant adverse effects, there could be significant repercussions for TCDC given the expenditure required. Similarly, if the structure was only partially successful and some properties were not protected, or if formation of the salient led to erosion of adjacent beach areas and new erosion problems, TCDC could be placed under additional pressure. If navigation problems or accidents occurred, there could also be significant liability issues. There will be an on-going maintenance commitment required by TCDC (assuming they would be the resource consent holder and therefore responsible for compliance with consent conditions) to ensure the structure stays in good condition.		**M**

Impact Category	Offshore Breakwater + Nourishment Assessment	+ve	-ve
Uncertainty	There are significant design and construction uncertainties with breakwaters, For instance, it is uncertain how much of a 'shadow zone' the breakwater structure will create and the amount of dry beach expected to be built up and the volumes of nourishment required to avoid aggravating erosion in adjacent beach areas. Similarly, with the performance of the structure under various different storm wave conditions (i.e. variations in height, period and direction) that may arise and onshore effects under these wide variety of potential conditions. If a wide beach is created, then the properties in this area will probably have a high level of protection.		**H**
Public resistance	To date, there has generally been good wider community support for breakwaters. However, the uncertainties associated with design and construction of the breakwater structure may mean that beachfront property owners would be reluctant to risk investing large sums in this option.		**L**
Cultural values	Consultation is to be undertaken by EW/TCDC with tangata whenua in regards to the benefits/impacts on cultural values of this option as part of wider consultation associated with regional strategy development.		
Historical Heritage	Beach nourishment associated with the breakwater may provide land based archaeological sites with protection from dynamic shoreline fluctuations. There is potential for impact on offshore wrecks but there is a lack of information available and with no specific design to be able to confirm this[4].	**M**	**M**
Equity	Beachfront property owners directly behind offshore breakwater and the wider community will benefit from the wider nourished beach. The potential for adverse effects on navigation could also result in these benefits being obtained at the expense of increased navigation hazard boating activities in this area.		**M**
Biodiversity	Rock breakwaters act as reefs and are therefore considered to provide useful habitat for marine fauna and flora. The impact on biodiversity of this option is therefore generally viewed as positive.	**M**	
Natural character	The breakwater structure is likely to have a negative effect on natural character, particularly significant with a fully or partially emergent structure. The wider beach formed in the area of the salient will improve natural character of the beach.	**L**	**L**
Coastal Processes	If inadequate nourishment occurs, formation of the salient may aggravate erosion in adjacent areas of shoreline (both to the north and to the south). If the structure works effectively, properties behind the breakwater will have a wider high tide beach to protect from erosion and dynamic fluctuations of the shoreline may be reduced.		**M**
Coastal flooding	A wider high tide beach will provide additional protection of beachfront properties against storm surge and wave run up. A breakwater will also help dissipate large waves during storm events and this has the potential to further mitigate wave run-up effects.	**L**	

[4] Warren Gumbley pers. comm., 2004.

Impact Category	Offshore Breakwater + Nourishment Assessment	+ve	-ve
Climate change	An offshore breakwater has the potential to reduce the risk from climate change effects (such as increased storm activity and wave run-up) by providing a 'first line' of defence. However, the breakwater may need to be modified in response to sea level rise.	**H**	
Environmental Footprint	Initial resources for the construction of the breakwater will be required (such as rock and fuel) and also beach nourishment material. In the long term.		**H**
Reversibility of option	It will be difficult and involve large costs to remove an offshore breakwater once installed (depending on material used in original construction). Beach material placed as nourishment could be left to naturally redistribute itself while the beach returned to equilibrium.		**M**
Structure construction, works and maintenance costs	Large capital cost for construction and on-going nourishment that is likely to be required. Ongoing maintenance will also be required.		**H**
Capital costs	There is no relocation or property purchase required for this option and therefore no capital costs	**0**	**0**
Local Economy	There may be a small increase in the total numbers of visitors to Whitianga in association with enhanced beach amenity and, potentially, for diving on the reef. If an offshore surfing reef were used, then there may also be some surfing activity possible - at present a small amount of surfing occurs at this beach. This could provide enhanced opportunities for businesses such as dive shops, charter operators and café's. There may be some capital spend on construction of the seawall with some local labour requirements as well as ongoing maintenance requirements.	**M**	
Transaction costs	There may be significant transaction costs associated with the resource consent applications and design of the breakwater and on-going nourishment.		**H**
Tourism	Imperceptible change in numbers of total visitors to Coromandel. Depending upon the design of the breakwater (if it includes a surf break) there would be opportunities for increased local tourism associated with surfing. Additional tourism opportunities will arise from the new marine habitat provided. This could result in improved opportunities for dive tour operators in the area using the breakwater as an 'attraction'.	**L**	
Private Capital	If the option provides effective protection to beach-front properties, the values of these properties are likely to increase significantly due to the enhanced protection and beach amenity. Increases in the value of other local properties may also increase slightly because of beach amenity improvements.	**M**	
Protection of Public Infrastructure	Public assets (such as reserves and infrastructure) behind structure protected from erosion by wider beach and more sheltered wave environment.	**M**	

Appendix I

Results of Assessments

1 Introduction

Following the assessment of each option against the indicators, the grades were transferred into a matrix and cost benefit analysis. The qualitative matrix provides an 'image' of the potential impacts and the ability to compare the options. The quantitative cost-benefit analysis paints a 'picture' of the economic impact of each option. The comparison of the two assessments then provided the opportunity to prioritise the options in the context of sustainable development.

2 Qualitative Assessment Matrix

The impacts for each option assessed against the indicators were graded as to the level of negative and/or positive impact the option could have (multi-criteria analysis). A red or green bar was used depending on whether the option is expected to have a negative (red) and/or positive (green) effect in the long term (50-year planning horizon). In addition to assessing whether there is a potential positive and/or negative impact caused by each option, the degree of impact was also assessed as being High, Medium or Low. The length of the bar in the matrix represents the level of impact (high impact is a longer bar, low impact a shorter bar). Some impact categories are considered to be not relevant to some options and where this occurs a 0 (zero) grading was applied to indicate the option has no impact (and no coloured bar appears in the matrix for that indicator).

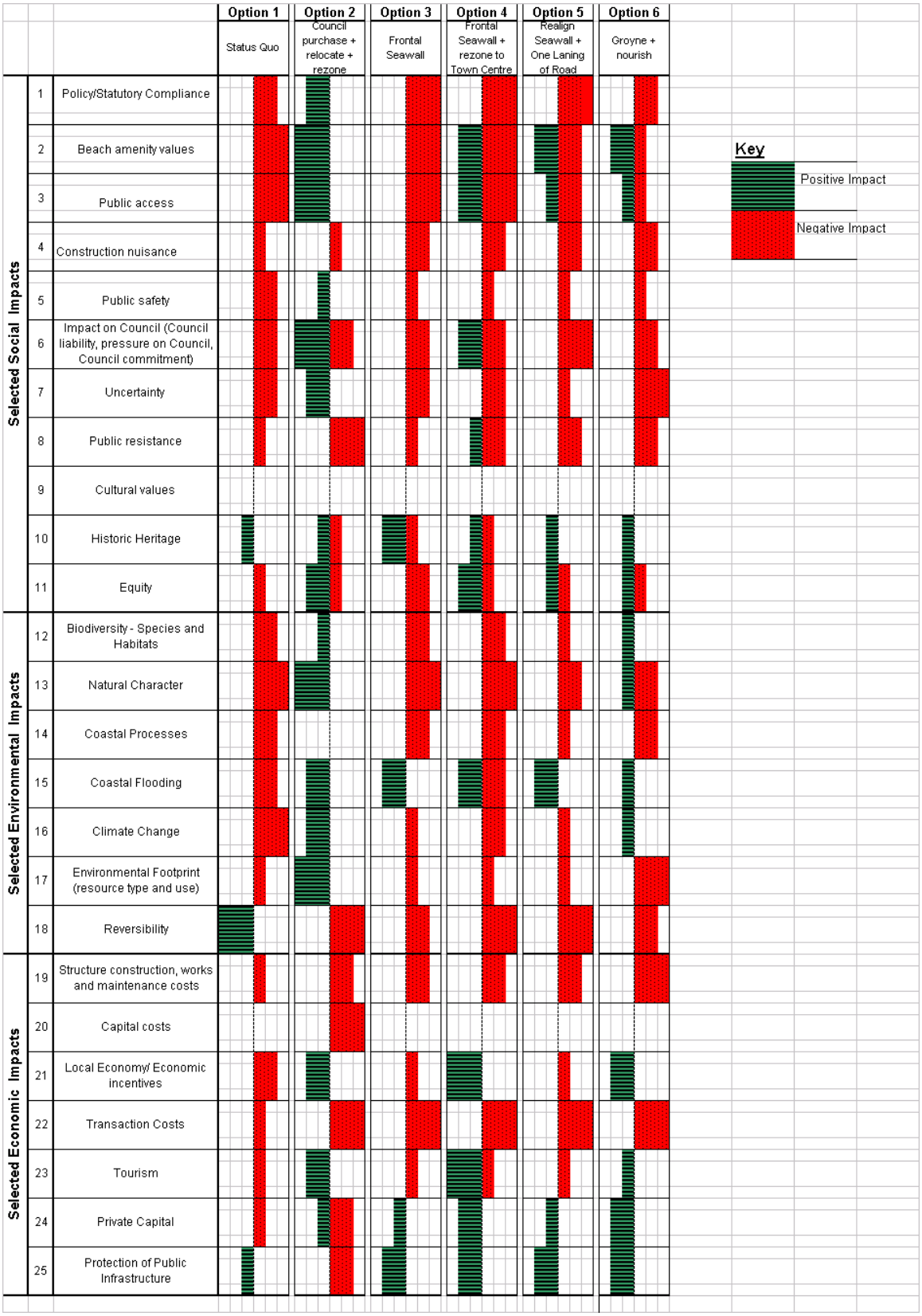
The matrix produces an 'image' of the most preferred option and/or combination of options to achieve sustainable development and triple-bottom line outcomes at each section of Buffalo Beach.

3 Cost Benefit Analysis

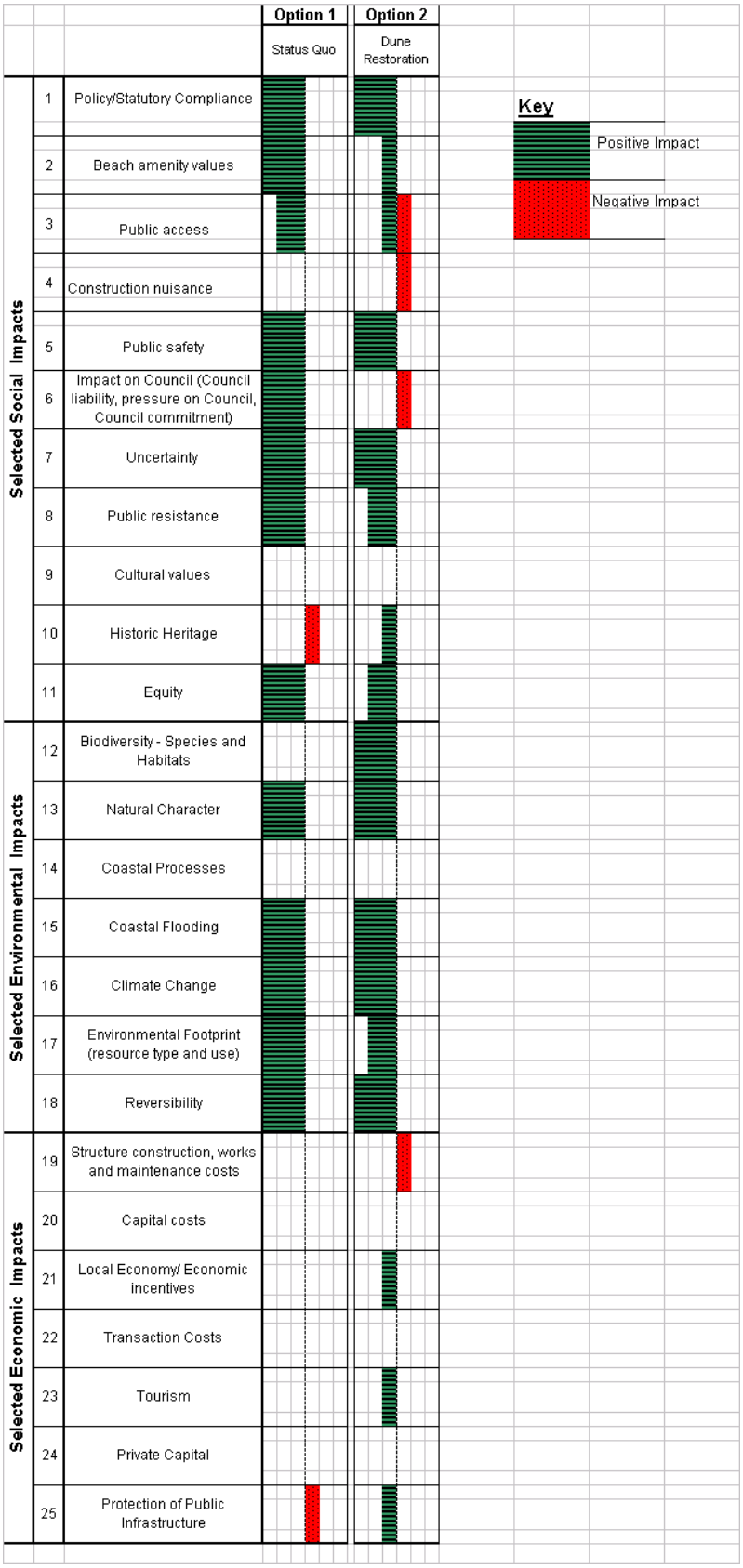
The cost-benefit analysis is used to measure the overall well-being (or welfare) impacts of the different options for managing coastal erosion at Buffalo Beach. The following cost-benefit analysis tables provide a 'picture' of these economic impacts, including capital costs, property loss, naturalness gains, and property gain and the net economic benefit/costs of each option.

The following tables then provide the opportunity to compare and rank the options to identify a preferred option for each section of Buffalo Beach.

Buffalo Beach Southern Section Qualitative Assessment Matrix



Buffalo Beach Mid Section Qualitative Assessment Matrix



Buffalo Beach Northern Section Qualitative Assessment Matrix

Buffalo Beach Southern Section Quantitative Cost Benefit Analysis

Option Specific Assumptions	Status Quo	TCDC Buy Properties and Rezone Open Space	Frontal Seawall	Realign existing seawall landward and one-lane road	Frontal Seawall and Rezone Commercial	Groyne plus nourishment
Naturalness change	0%	5%	0%	2%	2%	2%
Year of start		0	0	0	0	0
Year of start		5				
Capital Cost		42,000	3,200,000	3,700,000	3,200,000	5,250,000
Maintenance Cost	120,000	-	64,000	64,000	64,000	30,000
Changed Maintenance cost	120,000					
Year of change	-					
Years of nourishment	50					
Houses moved off site		17			0	
Houses risk of inundation						
Houses moved back within site					0	

Results	Status Quo	TCDC Buy Properties and Rezone Open Space	Frontal Seawall	Realign existing seawall landward and one-lane road	Frontal Seawall and Rezone Commercial	Groyne plus nourishment
Costs						
Capital Cost	$0.00	-$42,000	-$3,200,000	-$3,700,000	-$3,200,000	-$5,250,000
Maintenance Cost	-$2,310,711	$0	-$1,232,379	-$1,232,379	-$1,232,379	-$93,161
Property Loss		-$11,055,554			$0	
Naturalness Loss	$0		$0			
Total	-$2,310,711	-$11,097,554	-$4,432,379	-$4,932,379	-$4,432,379	-$5,343,161
Benefits						
Naturalness Gain		$4,003,627		$1,601,451	$1,601,451	$1,601,451
Property gain		$3,643,397	$5,100,000	$5,100,000	$5,100,000	$5,100,000
Total		$7,647,024	$5,100,000	$6,701,451	$6,701,451	$6,701,451
Net Benefit	-$2,310,711	-$3,450,530	$667,621	$1,769,072	$2,269,072	$1,358,290
Rank	5	6	4	2	1	3
Beach Front Owners						
Costs	-$2,310,711	-$11,055,554	-$4,432,379			
Benefits		$11,055,554	$5,100,000	$5,100,000	$5,100,000	$5,100,000
Net	-$2,310,711	$0	$667,621	$5,100,000	$5,100,000	$5,100,000
Wider Community						
Costs		-$11,097,554		-$4,932,379	-$4,432,379	-$5,343,161
Benefits		$7,647,024		$1,601,451	$1,601,451	$1,601,451
Net	$0	-$3,450,530	$0	-$3,330,928	-$2,830,928	-$3,741,710

Discount Rate	5%
Duration of analysis (years)	50

Assumptions	
Proportion of visitor numbers to Buffalo	0.33
Visitor numbers	84,500
Visitor nights	276,500
Total Properties	1,850
Property loss per house	820,000
Demolition cost	10,000
Houses at risk	17
Property loss	14,110,000
Beachfront propertygain/house	300,000
beachfront property gain	5,100,000
Cost of extra risk without wall	300,000
2nd row house gain	310,000
2nd row houses	15
2nd row Property gain	4,650,000
Costs of moving a house	50,000
Value of naturalness/resident	1,677
Total resident value of naturalness	1,023,703
Value of naturalness/visit	10
Total visitor value of naturalness	2,765,000

Order		
1	Frontal Seawall	$2.27
2	Realign existing	$1.77
3	Groyne plus nou	$1.36
4	Frontal Seawall	$0.67
5	Status Quo	-$2.31
6	TCDC Buy Prop	-$3.45

	Results
	Input assumptions
	Calculations (do not change the

Buffalo Beach Mid Section Quantitative Cost Benefit Analysis

Option Specific Assumptions	Status Quo	Dune Restoration
Naturalness change	0%	0.5%
Year of start		0
Year of start		
Capital Cost		10,000
Maintenance Cost		10,000
Houses moved off site		1
Houses risk of inundation		15
Houses moved back within site		4

Results	Status Quo	Dune Restoration
Costs		
Capital Cost	$0.00	-$10,000
Maintenance Cost	$0	-$192,559
Property Loss		
Naturalness Loss	$0	
Total	$0	-$202,559
Benefits		
Naturalness Gain		$265,980
Property gain		$100,000
Total		$365,980
Net Benefit	$0	$163,420
Rank	2	1
Beach Front Owners		
Costs		
Benefits		$100,000
Net	$0	$100,000
Wider Community		
Costs		-$202,559
Benefits		$265,980
Net	$0	$63,420

Results	
Input assumptions	
Calculations (do not change these)	

Discount Rate	5%
Duration of analysis (years)	50

Assumptions	
Proportion of total visitors	0.33
Visitor numbers	55,770
Visitor nights	182,490
Total Properties	1,850
Property loss per house	820,000
Demolition cost	10,000
Houses at risk	0,024
Property loss	19,920,000
Beachfront propertygain/house	300,000
beachfront property gain	7,200,000
Cost of extra risk without wall	300,000
2nd row house gain	310,000
2nd row houses	0,020
2nd row Property gain	6,200,000
Costs of moving a house	50,000
Value of naturalness/resident	1,677
Total resident value of naturalness	1,023,703
Value of naturalness/visit	10
Total visitor value of naturalness	1,824,900
Growth in visitor numbers pa	2.3%

Buffalo Beach Northern Section Quantitative Cost Benefit Analysis

Option Specific Assumptions	Status Quo	Live with Erosion	TCDC Buy Properties and Rezone Open Space	Frontal Seawall	Relocate and redevlop with backstop wall	Groyne plus nourishment	Offshore breakwater
Naturalness change	0%	5%	5%	0%	5%	2%	2%
Year of start		0	0	0	0	0	0
Year of start			5				
Capital Cost		35,000	35,000	2,000,000	1,640,000	2,400,000	4,250,000
Maintenance Cost	30,000		-	40,000	15,000	24,000	420,000
Changed Maintenance cost	250,000						
Year of change	6						
Years of nourishment	10						
Houses moved off site		1	17		1		
Houses risk of inundation		15					
Houses moved back within site		4			4		

Results	Status Quo	Live with Erosion	TCDC Buy Properties and Rezone Open Space	Frontal Seawall	Relocate and redevlop with backstop wall	Groyne plus nourishment	Offshore breakwater
Costs							
Capital Cost	$0.00	-$35,000	-$35,000	-$2,000,000	-$1,640,000	-$2,400,000	-$4,250,000
Maintenance Cost	-$1,007,949		$0	-$770,237	-$288,839	-$74,529	-$572,975
Property Loss		-$5,530,000	-$11,055,554		-$1,030,000		
Naturalness Loss	$0			$0			
Total	-$1,007,949	-$5,565,000	-$11,090,554	-$2,770,237	-$2,958,839	-$2,474,529	-$4,822,975
Benefits							
Naturalness Gain		$2,659,797	$2,659,797		$2,659,797	$1,063,919	$1,063,919
Property gain		$0	$3,643,397	$5,100,000	$5,100,000	$5,100,000	$5,100,000
Total		$2,659,797	$6,303,194	$5,100,000	$7,759,797	$6,163,919	$6,163,919
Net Benefit	-$1,007,949	-$2,905,203	-$4,787,361	$2,329,763	$4,800,958	$3,689,390	$1,340,944
Rank	5	6	7	3	1	2	4
Beach Front Owners							
Costs	-$1,007,949	-$5,530,000	-$11,055,554	-$2,770,237			
Benefits			$11,055,554	$5,100,000	$5,100,000	$5,100,000	$5,100,000
Net	-$1,007,949	-$5,530,000	$0	$2,329,763	$5,100,000	$5,100,000	$5,100,000
Wider Community							
Costs		-$35,000	-$11,055,554		-$2,958,839	-$2,474,529	-$4,822,975
Benefits		$2,659,797	$6,303,194		$2,659,797	$1,063,919	$1,063,919
Net	$0	$2,624,797	-$4,752,361	$0	-$299,042	-$1,410,610	-$3,759,056

Results
Input assu
Calculatio

Discount Rate	5%
Duration of analysis (years)	50

Assumptions	
Proportion of visitor numbers to Buffalo	0.33
Visitor numbers	55,770
Visitor nights	182,490
Total Properties	1,850
Property loss per house	820,000
Demolition cost	10,000
Houses at risk	0,017
Property loss	14,110,000
Beachfront propertygain/house	300,000
beachfront property gain	5,100,000
Cost of extra risk without wall	300,000
2nd row house gain	310,000
2nd row houses	0,015
2nd row Property gain	4,650,000
Costs of moving a house	50,000
Value of naturalness/resident	1,677
Total resident value of naturalness	1,023,703
Value of naturalness/visit	10
Total visitor value of naturalness	1,824,900
Growth in visitor numbers pa	2.3%

Order		
1	Relocate and re	$4.80
2	Groyne plus nou	$3.69
3	Frontal Seawall	$2.33
4	Offshore breakv	$1.34
5	Status Quo	-$1.01
6	Live with Erosio	-$2.91
7	TCDC Buy Prop	-$4.79

Appendix J

Action Plan and Lessons Learned

1 Introduction

The Buffalo Beach CEMS has identified a number of suitable options for managing coastal erosion, following qualitative (multi-criteria analysis) and quantitative (cost benefit analysis) assessments of viable options at each section of the Beach. From the assessments the options that are most likely to achieve triple bottom line outcomes (and therefore the most likely to be a sustainable solution over the next 50 years and achieve the strategy vision) have been identified.

The results of the two analyses show that there are a number of options that ranked highly in both assessments. The preferred options for Buffalo Beach South from both analyses were "Groyne plus Nourishment", "Frontal Seawall plus Rezone Town Centre (Commercial) "and "Realign Frontal Seawall and reduce the road to One Lane". It is possible that a combination of options for this section of beach would be appropriate and this could be investigated further as well as undertaking preliminary design of the preferred options to further refine costs and benefits of each.

The preferred option for Buffalo Beach Mid section was "Dune Restoration", which scored similarly to "Status Quo" in the qualitative assessment but has greater economic benefits in the longer term.

The preferred option in both the economic quantitative and the qualitative (multi-criteria analysis) for Buffalo Beach Northern section is "Relocate Dwellings and Redevelop with a Backstop Wall".

As no community consultation has been undertaken as part of this strategy, the selection of options for each section of Buffalo Beach should be taken to the community for further development. The strategy vision and objectives will also need to be further refined with community and stakeholder input.

The following section provides guidance on general actions that EW, TCDC, the community and stakeholders could undertake to further refine the CEMS for Buffalo Beach. Following consultation the Buffalo Beach CEMS will need to be updated to better reflect the chosen option(s) and the actions required to implement this.

Whilst the CEMS will provide guidance over a 50-year time horizon, the following general actions should be implemented in the short term (within the next 5 years) to develop the CEMS to the next stage (preferred option(s) with community support).

2 Action Plan

2.1 General

Investigative and Design Work (pre- consultation).

This study identified the need for further investigative or pre-feasibility work into selected options such as sensitivity analysis and preliminary design for engineered options to confirm costs and impacts, etc.

Feasibility Study (post-consultation).

Following identification of the most preferred option or combination of options for each section of Buffalo Beach (once community consultation has been completed) the option(s) will require further feasibility assessments (including field investigations and preliminary design) to make sure the option or combination of options is viable and practical to implement.

Funding Policies

The allocation for funding and the recognition of where the costs will fall for the selected options will need to be identified. It is recommended that this is undertaken in accordance with existing council funding policies and discussion undertaken with the local community, in particular the beachfront property owners. The impact category "equity" in the matrix produced for this strategy can also be used for guidance on where costs should fall.

Implementation Plan

Following consultation with tangata whenua, the community and stakeholders, and once a preferred option(s) is determined for each section of Buffalo Beach, it is recommended that EW and TCDC develop an implementation plan for the preferred option(s) and include a timeframe of actions.

Structure Plan

Community and stakeholder consultation may result in many differing values and wants for different parts of the Buffalo Beach strategy area. If this is encountered then it is recommended that a local structure plan be developed that can address site-specific combinations of options at each section of the study area at a more detailed level.

Resource Consents

It is recommended that TCDC/EW proceed with appropriate resource consent applications for the preferred option(s) identified from consultation as soon as possible to initiate implementation of the Buffalo Beach CEMS.

2.2 Consultation

The first step to further develop the CEMS for Buffalo Beach is to take the selection of options presented in this report to the community for comment and discussion. In particular tangata whenua should be consulted to allow an assessment of the impact of the various options on cultural values.

Consultation, or outreach, is also useful to increase awareness and understanding, at a local and regional level of the CEMS. The following table identifies outreach mechanisms that can be used by EW/TCDC for consultation on the Buffalo Beach CEMS. This list is not exhaustive and should be considered in addition to any existing consultation plan for the region-wide joint Coastal Erosion project.

Outreach Mechanism	Stakeholders	Purpose	Stage*
Council Workshops	- Internal council staff - Councillors	For internal council staff and/or councillors to provide an opportunity to present on the information and to work through the findings of the CEMS.	1 and 2
Hui	- Tangata Whenua	For tangata whenua consultation on selected options at local marae. Provides for consultation with tangata whenua at a location where they feel comfortable and are able to accord appropriate protocol to the occasion.	1 and 2
One-on-one Meetings	- Beachfront property owners	With individual beachfront property owners at an appropriate location to provide the opportunity to discuss the likely impacts of the CEMS (selected options) on each property owner.	1 and 2
Cottage Meetings	- Adjacent property owners	With adjacent property owners and directly affected parties. The location will typically be a local resident's house. Provides an informal means of discussion.	1 and 2
Issues and Options Paper	- All Buffalo Beach ratepayers	This paper will summarise the CEMS and opportunities for consultation involvement in its development.	1
Public Newsletters/ Flyers	- Local community - General public	To inform the community of upcoming consultation sessions (including open days). Feedback of information gathered to date.	1 and 2
Press Releases	- Local community - Local businesses - General public - Environmental groups	These should be following the approval of the CEMS for public consultation, following the adoption of the CEMS by both EW and TCDC and at appropriate stages of the implementation of the CEMS.	1 and 2
Letters	- Government officials - Key community representatives	These letters should detail the purpose and need for CEMS and outcomes of community consultation.	1 and 2
Website	- Local community - Local businesses - General public - Environmental groups	Website page on both EW and TCDC websites and regular updates following initial consultation and implementation.	1 and 2
Open Day	- Local community - General public - Environmental groups	For the general public. This could also include a site visit to the area of the CEMS to provide a practical opportunity for people to present their views on the issues at hand.	2

Outreach Mechanism	Stakeholders	Purpose	Stage*
	- Local businesses		
Public Displays	- Local community - General public	To present the CEMS information to the wider community at a central location (such as local libraries and community centres).	2
Conference Presentations	- Professional organisations - Territorial authorities	Presentation of findings. Potential opportunities are the NZ Coastal Society Annual Conference and the NZ Planning Institute Annual Conference.	2

*Stage 1 **= Following the approval of the CEMS for public consultation by both EW and TCDC.**
*Stage 2 **= Following the adoption of the CEMS by both EW and TCDC**

2.3 Monitoring

The Local Government Climate Change Guidance notes prepared by MFE state that with the onset of climate change, effects on coastal hazards are likely to accelerate with time. For this reason, any strategy to manage coastal erosion needs to be a working document. Also, as time passes, communities change as does development, priorities and perceptions of the coast. As the strategy is focussed around a shared community vision, this should also be reviewed and changed as necessary to reflect the community's values.

As coastal hazards may change with time, it is essential that on-going monitoring is undertaken, interspersed with regular reviews or audits of the methods used, and adjustments made where necessary. For this reason, it is recommended that a formal Monitoring Plan be developed by both Councils that addresses, at the very least, the items in the table below. This list is not exhaustive and should be considered in addition to any existing monitoring plan for the region-wide joint Coastal Erosion project.

Monitoring type	Who should monitor?	Purpose	Timeframe (Stage*)
Review of CEMS	- Coastal Erosion Steering Group It is considered that the best approach to ensuring effective implementation of the strategy is to create a sub committee of the steering group made up of the sponsoring authorities that will manage the Buffalo Beach CEMS.	To monitor the effectiveness of the CEMS and changing community values. To incorporate the implementation of the preferred option(s) from community consultation including re-evaluation of the matrix.	1
Physical Shoreline Monitoring	- EW coastal specialist - TCDC	To monitor beach width and volume, scour depths around existing protection structures, sand size and colour, sediment supply, wave climate, etc. Beach profiling should be undertaken at least yearly and following storm events. Beach profiling should be undertaken in the area of worst erosion hazard and the site marked so that consistent measurements can be taken.	1 and 2

Monitoring type	Who should monitor?	Purpose	Timeframe (Stage*)
Community Survey	- EW consultation specialist - TCDC consultation specialist	Surveys should be undertaken to reassess community and stakeholders values of the coast and to review the effectiveness of the strategy in achieving the shared vision. Community values and the shared vision should be reviewed every five years and the matrix re-evaluated at the same time. Monitoring of changing community values/perceptions could be by way of workshops, surveys, one-on-one meetings, etc.	2

***Stage 1 =** Following the approval of the CEMS for public consultation by both EW and TCDC.
***Stage 2 =** Following the adoption of the CEMS by both EW and TCDC

3 Lessons Learned

A number of challenges were encountered while developing this strategy. As a result the following are lessons learned and recommendations for other site specific CEMS's:

- **Weighting of the matrix**. Multi-criteria analysis[18] is a useful assessment approach as it allows for individual preferences to be reflected in the analysis by weighting the impact categories. As there was no consultation as part of this strategy development (recognising that extensive consultation would be undertaken with the community as part of EW/TCDC wider strategy development) it was not possible to accurately assign a weighting to each impact category assessed in the matrix. In future site specific strategies it is recommended that community and stakeholder consultation be undertaken prior to strategy development to determine an appropriate weighting to give to each impact category. This could be easily achieved by way of a community/stakeholder survey requesting that impact categories are ranked in terms of that individuals opinion of their importance. This type of weighting can be re-assessed over the timeframe of the strategy through further surveys to update people's opinion on level of importance of certain assessment categories.
- **Other options?** To build on the above community/stakeholder survey, the survey could also ask people to list options they wish EW/TCDC to investigate further at the screening level stage. This could therefore be addressed in strategy development.
- **Design details.** Due to the timeframe and budget constraints of the present CEMS project, it was not possible to produce design details for each potential option. If there were design details for each option (such as the various types of seawalls, rock, timber, gabion basket, recycled tyres etc) then assessment of options could be on a specific rather than a generic level.
- **Two assessments and possible discrepancies.** As there are two assessments involved in the methodology of CEMS development, it is recognised that there is potential for

[18] See Glossary in Appendix L for definition of multi-criteria analysis

discrepancies between ranked results from the two types of assessment, qualitative and quantitative (as was the case for Buffalo Beach Mid and Southern sections in this analysis). It is suggested that in those situations where there are discrepancies in preferred options from the two assessments weight be given to those options in the lower tiers of the hierarchy of response options promoted by the NZCPS and national guidance documents on climate change (see discussion in Appendix E).

Summary – Action Plan

It is recommended that EW and TCDC undertake consultation, monitoring of the strategy and its effectiveness, funding policy reviews, pre-feasibility and preliminary design work. In particular the consultation with the community and other stakeholders will enable EW/TCDC to further refine the shared vision for Buffalo Beach and to discuss the outcomes of this study in the selection of a preferred strategy for each section of Buffalo Beach.

Lessons Learned

In future site specific strategies it is recommended that community and stakeholder consultation be undertaken prior to strategy development to determine an appropriate weighting to give to each impact category. A suggested way of achieving this is to conduct a survey of the community and stakeholders.

Also, site-specific strategies such as this will benefit in the future from a detailed design analysis of options as part of the analysis. Design details would allow a direct comparison between different types of options within each option (e.g. rock vs. timber vs. gabion basket vs. recycled tyre seawall etc).

Appendix K

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Appendix L

Glossary

Glossary

Accretion	Accumulation of sediment that builds up land. May be the result of either natural (e.g. by the action of Aeolian transport) or artificial (by the action of humans) activity.
Backshore	That part of the beach/coast landward of mean high water mark. The backshore area is generally only subject to wave activity during significant storm events, especially when they coincide with periods of high water.
Beach	Beaches are accumulations of unconsolidated sediment (usually sand) that extend from the mean low tide line to the inland limit of the littoral zone (i.e. usually beyond the high water mark where there is a marked change in relief and/or to the line of permanent vegetation).
Beach Material/Sediments	Granular sediments (usually sand, shell or gravel), which are transported by coastal processes.
Beach Profile	The outline or shape of the beach, usually surveyed from a fixed position landward of the zone that can be disturbed by storm events, such as behind the frontal dune, extending seawards to or near the line of Mean Low Water.
Climate Change	Any significant change or trend in climate over time, either in the average state of the climate and/or in its variability. It includes 'natural' change and that attributable to human activities.
Coastal Marine Area (CMA)	The area below Mean High Water Springs, including the wet part of the beach, the foreshore and seabed. The seaward boundary of the CMA is the outer limits of the territorial sea.
Coastal Processes	Collective term covering the action of natural processes on the coastline and seabed.
Coastal Protection Works	Any structure or works erected, placed or carried out on or adjacent to the foreshore to alter natural coastal processes, in order to protect land above MHWS against erosion or encroachment of the sea.
Coastal Zone	The 'coastal zone' is a component of the Proposed Thames Coromandel District Plan that provides the statutory basis under the Resource Management Act 1991. The Coastal Zone is defined in the TCDP as "*generally the land between the coast and the first ridgeline inland and other land where the coast is a significant part, even though it might not be visible from the coast or a public road'*. Within the coastal zone are policy areas, such as the Open Space policy area.
Downdrift	In the direction in which a current or sediment is moving
Dunes	Mounds of loose sand formed by wind, considered part of a soft coast.
Dynamic Shoreline Fluctuations	A state of the shoreline where the beach profile undergoes periods of erosion and accretion, usually associated with climatic events.

ENSO	El Nino Southern Oscillation. ENSO is a disruption of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe.
Erosion	A general term for the removal of material from exposed surfaces by the action of natural processes.
Esplanade Reserve	Means any land set apart for any public purpose
Esplanade Strips	These retain private ownership of land but provide for a public accessway of fixed width from the coast, regardless of whether the land is lost as a result of erosion or added to through accretion.
EW	Environment Waikato
Foredune/Frontal Dune	The dune lying between the foreshore and the backdune. This is often the most seaward dune.
Foreshore	The 'wet' area of land and beach between the high-tide and low-tide marks.
Hazard	The interaction of coastal processes with human use, property or infrastructure, the action of which adversely affects or may adversely affect human life, property or assets.
Hierarchy of Options	Refers to assessment options to manage risk from coastal hazards (Tier 1=most preferred, Tier 3=least preferred as stated in New Zealand Coastal Policy Statement)): 1. Activities and land use practices to protect natural barriers such as sand dunes, gravel ridges, cliffs, salt marshes, other vegetation and other non-structural methods (e.g. beach nourishment). 2. Soft structural works including beach dewatering. 3. Hard structural works such as seawalls, rock armouring or groynes. This is a method to address the appropriateness of each option in a 'hierarchy', with the most preferred first. The optimal management approach may involve a selection of options.
Infrastructure	The means for delivering physical services to communities, including roads, public reserves, septic tanks, power lines and stormwater pipes.
IPO	Interdecadal Pacific Oscillation. The IPO is an 'ENSO-like' feature of the climate system that operates on time scales of several decades.
Littoral Drift/Longshore Drift	The movement of beach material in the nearshore zone by waves and currents.
Long Term Council Community Plan (LTCCP)	A document required to be produced by the local authority under the Local Government Act 2002. The purpose of the LTCCP is to outline desired community outcomes and identify how councils will contribute towards achieving these outcomes in the future.
Mean High Water Springs (MHWS)	The average of the heights of each pair of successive high waters during that period of about 24 hours each semi-lunation, when the range of the tide is greatest.

Multi-Criteria Analysis	An assessment approach to determine overall preferences among alternative options. It is used in this strategy to describe the qualitative assessment of options that does not rely predominantly on monetary valuations.
Natural Character	The degree of naturalness of an area. Natural character depends on the extent of modification of landforms, ecosystems and natural process and the presence of structures and buildings. A landform having a low level of human modification is considered as having a proportionally higher natural character.
NZCPS	New Zealand Coastal Policy Statement
Relocation	When a community, infrastructure or property is at risk from a coastal hazard relocation involves moving away from the area of risk, as opposed to other hazard management options including promoting natural buffers, constructing structural defences or designing buildings to minimise the likelihood of damage.
Risk	Refers to coastal hazards and considers the probability that a hazard event (e.g. storm surge) will occur and the potential cost or consequence of this event on communities, infrastructure, land and/or property.
Scour	Removal of material by hydrological forces, especially at the base or toe of a structure.
Seawall	A structure separating land and the sea, primarily designed to prevent erosion of the land due to wave action.
Shadowzone	Refers to the area immediately landward of an offshore breakwater that is sheltered by the breakwater from wave energy.
Stakeholders	Those persons or parties who have an interest in Buffalo Beach greater than the public in general and includes, Beachfront property owners, adjacent property owners, local residents, tangata whenua, resident and ratepayers groups, Department of Conservation, boating clubs, community board, New Zealand Historic Places Trust, recreational groups, local businesses, local tourism operators and environmental groups (e.g. The Royal Forest & Bird Protection Society).
Statutory	Key statutory resource management instruments are the Local Government Act 2002, the Resource Management Act 1991, the Historic Places Trust Act 1993, the Conservation Act 1987 and the Treaty of Waitangi/Te Tiriti o Waitangi 1840. These define the roles and responsibilities of the Thames Coromandel District Council, Waikato Regional Council, Department of Conservation, NZ Historic Places Trust and Transit NZ as well as other stakeholders in the Buffalo Beach Coastal Erosion Management Strategy.
Stewardship	The ethic of guardianship or caring for the Buffalo Beach coastal environment. It includes the concept of *kaitiakitanga.*
Storm Surge	The combined effects of atmospheric pressure set up and wind set up, causing a localised increase in water elevation.

Sustainable Management	Refer to Section 5 of the Resource Management Act 1991. In the Act, "*sustainable management*" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety whilst sustaining the potential of natural and physical resources for future generations, safeguarding the life-supporting capacity of air, water, soil and ecosystems and avoiding, remedying or mitigating any adverse effects of activities on the environment.
TCDC	Thames Coromandel District Council
TCDP	Proposed Thames Coromandel District Plan
Triple Bottom Line Outcomes	Options that have the least negative impact and most positive impact when assessed against economic, environmental and social indicators.
Wave Runup	The vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.
Wave Setup	The increase in water level within the surf zone above mean still water level caused by the breaking action of waves.
WRCP	Proposed Waikato Regional Coastal Plan
WRPS	Operative Waikato Regional Policy Statement