

Porthcawl Sandy Bay Coastal Risk Management Coney Beach Fairground Frontage – Outline Feasibility Study Report

August 2020

FINAL ISSUE



1 Introduction



Credit: CBC

Scope and Background

Ove Arup and Partners (Arup) have been appointed by Bridgend County Borough Council (BCBC) to undertake an outline feasibility study of options to reduce coastal flood and erosion risk to a section of the Coney Beach Fairground frontage of Sandy Bay, Porthcawl. This preliminary study will form evidence to support the proposed Local Development Plan update.

Background

The private defence structures along the Coney Beach Fairground are in a poor condition. The bank crest level is not adequate in places although the extent of predicted flooding is limited to adjacent commercial properties.

The Local Development Plan identifies a 100-acre site surrounding Sandy Bay as a Strategic Regeneration Growth Area for the borough. Coastal risk management is an essential component in bringing the site forward whilst meeting planning policy requirements. Supplementary Planning Guidance sets a vision for the regeneration of the waterfront is a key element in the future development of Porthcawl as a premier seaside resort.

The project builds on Arup's work:

- supporting BCBC to prepare an Outline Business Case (OBC) in 2017 justifying Coastal Risk Management of Sandy Bay;
- the November 2018 preliminary long-list appraisal work undertaken to inform the Coney Beach

Fairground frontage optioneering workshop;

- the 2020 detailed design improvements to the Western Breakwater, Eastern Promenade, Relict Dunes and Rhych Point.

The OBC considered options for the Coney Beach Fairground frontage, however these proposals (known as Phase 2 in OBC) were constrained to broadly maintain the current promenade landward alignment.

Since then this key constraint has now been relaxed providing the opportunity to revisit the coastal protection options in this area to inform the Local Development Plan.

Assumptions and Limitations

This study assumes Welsh Government Coastal Risk Management Programme (CRMP) improvements have been completed. This includes Phase 1 works at the Western Breakwater, Eastern Promenade, Relict Dunes and Rhych Point.

The desk study has been informed by information provided by BCBC on land ownership, emerging regeneration proposals and other constraints. No further survey, modelling or design has been completed.

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

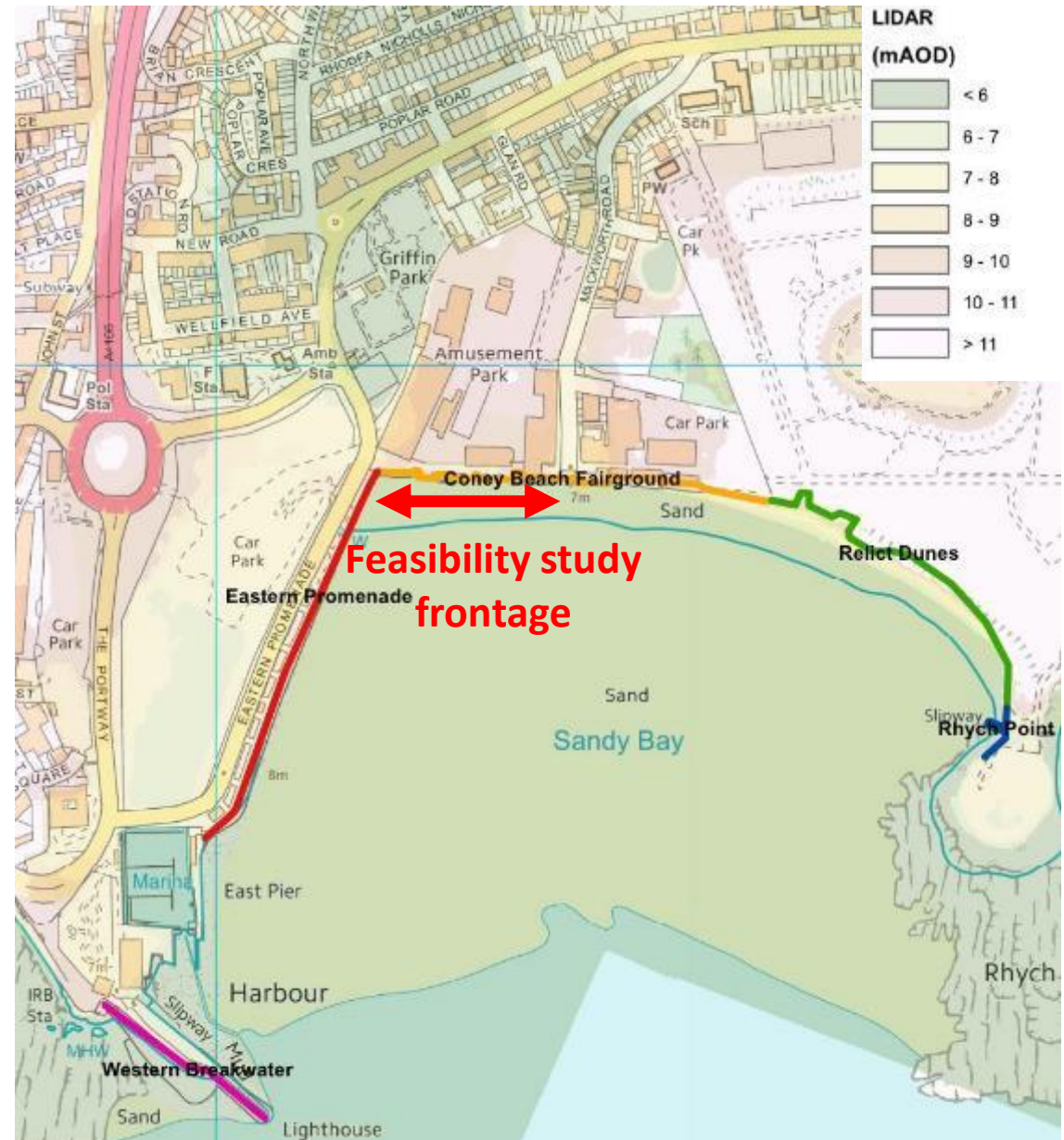


Figure 1: Location plan of Sandy Bay and Feasibility Study Frontage. Background image taken from the OBC (Arup, 2017)

Location and Outline Business Case

Sandy Bay is a 700m wide south southwest facing coastal embayment extending from Rhych Point to the Western Breakwater in-filled by a shallow gradient sandy beach. The Bay is surrounded by a mix of commercial and residential development, with the town centre to the immediate west and the Trecco Bay holiday park to the east.

The 182m long **Western Breakwater** significantly influences coastal risk in Sandy Bay, with the West side of the bay relatively sheltered from the most extreme wave activity and beach levels generally stable throughout the bay. If the breakwater were to fail, a retreat of the shoreline position throughout Sandy Bay would be expected. The breakwater structure requires regular maintenance; an example of storm damage includes a partial collapse in 1973. In its lee is the recently renovated harbour marina and RNLI slipway.

The 400m long **Eastern Promenade** is a masonry seawall and parapet constructed in the 1860s to form the inner harbour wall.

The central section is backed by **Coney Beach Fairground** with various private seawalls, revetments and steep stepped access points. Midway along is the Mackworth Road slipway.

To the east is a **relict dune system** in front of a sparsely vegetated former campsite. **Rhych Point** headland is a small limestone outcrop, with access slipway.

Outline Business Case summary

The 2017 OBC sought approval for the design development and consenting to

manage flood and coastal erosion risk at Sandy Bay, Porthcawl. The preferred option will also deliver wider benefits to enhance the regionally important tourist destination, safeguard a strategic regeneration opportunity and enhance relict dune protected habitat. The OBC was prepared as part of the Welsh Government's CRMP.

OBC objectives:

- To reduce the threat of coastal flood and erosion risk to people and their property by holding the line at Sandy Bay and Eastern Promenade in accordance with SMP2 policy, whilst supporting tourism and providing greater opportunities for amenity and regeneration.
- To maintain, and where possible enhance, natural, historic, visual and built environments through good design and mitigation. Promote sustainable management of the relict dunes, a priority habitat to be maintained and enhanced, whilst improving access via realignment of the Wales Coast Path to increase connectivity with coastal landscapes and improve social and recreational cohesion
- To ensure navigation and marine activities can continue to grow.
- To ensure an affordable and deliverable whole life option through a partnership approach and contributions.

OBC preferred option phasing:

- Phase 1 comprises works necessary to address the risk of coastal flooding and largely within BCBC land ownership and

can therefore be constructed relatively simply with fewer stakeholder interfaces. The programme is achievable within the proposed timescale of the Coastal Risk Management Planning framework.

- Phase 2 comprised works subject to land agreements and carries higher delivery risk owing to external dependencies. The Coney Beach Fairground frontage is currently occupied by various private properties and utilities. Consultation and agreement with the landowners is required. The OBC excluded Phase 2 works to allow BCBC to progress measures to reduce the risk of delivery, aligning with the wider regeneration timetable. Design was assumed in 2027 and construction in 2028.

Phase 1 consists:

- Western Breakwater: maintenance to ensure its long term structural integrity.
- Eastern Promenade: crest raising and strengthening of the existing parapet wall to reduce overtopping, and provision of a set-back floodwall to reduce inundation. This is in combination with land raising to minimise visual impact, as required.
- Relict Dunes: monitoring and minor management to conserve and enhance the relict dunes in their current stable and re-naturalised state.
- Rhych Point: provision of rock armour revetment to protect the headland's neck.

Phase 2 of the preferred option consisted provision of a sea wall and terraced revetment structure to replace the existing defences and provide a crest level to reduce overtopping to an acceptable rate.

History and Coastal Defence Assets

Brief Chronology

Porthcawl's harbour was constructed to the east of the study area in the 1830s and extended in the 1860s, with a railway linking it to the iron and coal mining communities of the valleys before closing in 1907. After the First World War, the town expanded as a popular seaside resort. Initially the harbour was used as a Salt Lake amenity before being infilled in the 1940s.

Coney Beach funfair developed from the 1920s. Maps dating 1943 show the extent of the amusement park. To the east, the shoreline consists of relict dunes recovering following the closure of a caravan park in 1998, and Water Chute demolished in 2000. To the west the Eastern Promenade largely dates from 1860s.



Poor condition private assets

The existing defence structures along the Coney Beach comprise a variety of privately owned structures, including revetments, rock armour, vertical walls and the walls of kiosks and businesses. The 'defacto defence' also includes kiosk/building wall.

The OBC highlighted the defences are in a poor condition.

- As-built, survey and maintenance information is not available. It appears there has been little recent maintenance.
- There is evidence of scour at the toe. The structures are being undermined. There is a risk of localised collapse or slumping following failure.
- There is evidence of potential voids underneath the existing promenade.
- The structural capacity of the parapet at Mackworth Place is undefined and appears not designed for wave action during storm conditions.
- The varying crest level, from 8.1 mAOD in the west to around 11 mAOD, with a low spot at Mackworth Road prone to coastal/ tidal flood inundation.
- Vertical walls result in wave reflections, locally reducing the beach level and damage to the adjacent slipway's stone sets.

The status quo or enhanced repair of the existing structure was discounted by the OBC due to cost/risk.

Figure 2: Sandy Bay in 1929 (overleaf), 1919-1925 (top), undated and present day (bottom), note scour collapse right)



Credit: Porthcawl Museum



Credit: Porthcawl Museum





Credit Brain Batters



Credit Porthcawl Museum



Credit Brain Batters

Strategic regeneration

As one of four Strategic Regeneration Growth Areas (Local Development Plan – COM1) in the region, Sandy Bay has the potential to be a significant investment opportunity.

Coastal protection infrastructure is necessary to comply with planning policy and will safeguard a 100-acre brownfield site for its lifetime. Coastal risk management proposals will enhance the development viability and safeguard part of the regeneration development.

2007 Supplementary Planning Guidance aims included to:

- realise the potential of Porthcawl's Waterfront, centre and environs, as a focus for residents, visitors, shoppers and workers (Porthcawl represents a major regional tourism asset);
- retain and reinforce the positive attributes of the area and enhance its attractiveness; provide a flexible, but guiding, framework for both public and private investment;
- establish planning guidance that will assist in establishing a consensus for change; and
- provide for the safe and easy movement of people and goods to and within the town by foot, cycle and motor vehicles, while minimising the environmental impact of vehicular movements

November 2018 BCBC Cabinet Report updates on the status of the strategic regeneration:

The original plan, as set out within the adopted Supplementary Planning Guidance, envisaged a large superstore located on Hillsboro Car Park that would have necessitated the stopping-up of the Portway to create the required land area. Fundamental changes in the foodstore market since that time have led to the demand being reduced from a 50,000 sq ft store to a smaller scale store. As a result there is no longer an associated requirement for the Portway to be closed. This has allowed for a rethink on the optimum location of the smaller store and the principal car park for the town centre. Following an assessment of options, the current strategy is based on the store being located at the northern end of Salt Lake, and retention of Hillsboro as the primary town centre car park.

One of the key requirements to unlock development of the whole Salt Lake site is coastal protection works to mitigate flood risk. Without these, the majority of the housing parcels cannot be developed, and attracting leisure facilities at the southern end of the site may also be more problematic. It was originally envisaged that the coastal works would be taken forward and funded by the site developers. However, following the launch of a Wales-wide coastal defence programme, officers have been working

closely with Welsh Government (WG) on flood mitigation proposals for the Porthcawl waterfront. An outline business case has been approved by WG and detailed designs are now being progressed. A final bid will be submitted to WG in Autumn 2019, which, if successful, would result in 75% funding via the Local Government Borrowing Initiative (LGBI) towards these works.

‘The regeneration of the waterfront is a key element in the future development of Porthcawl as a premier seaside resort.

This will be achieved through a combination of quality design of buildings and the surrounding environment, comprising residential, leisure, cultural, tourism and retail uses.

Central to this will be a revitalised harbour area incorporating the reuse of historic buildings, new leisure facilities and a fully refurbished harbour set within a prestigious and vibrant waterfront.’

Porthcawl Waterfront Supplementary Planning Guidance document, 2007



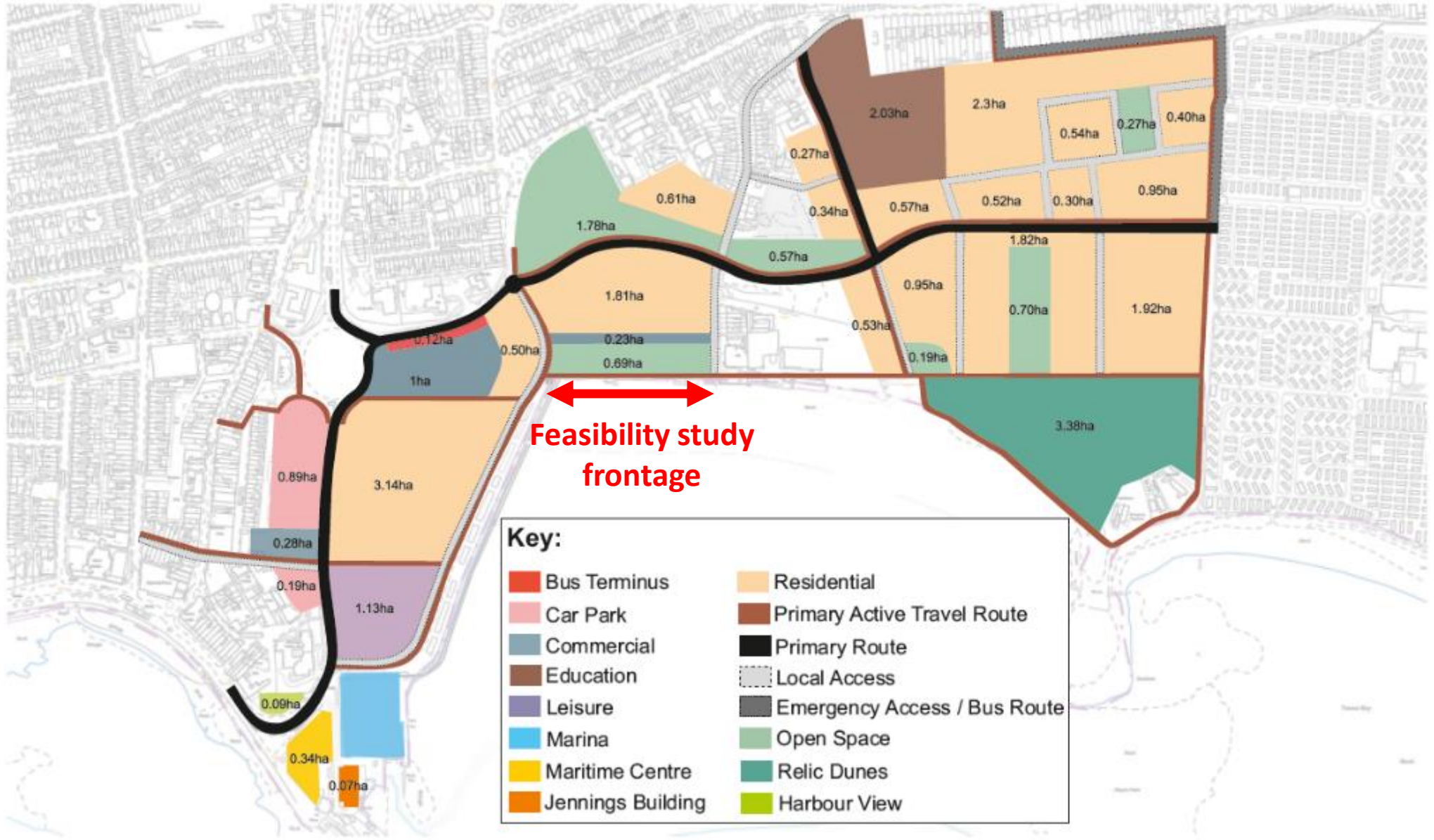


Figure 3: Current iteration of masterplan with Feasibility Study frontage highlighted (subject to change)

Policy and Coastal Risk

Shoreline Policy

The Shoreline Management Plan policy for Sandy Bay is to 'Hold the Line' for the next 100 years *through maintaining and upgrading existing defences... subject to the availability of public funding... and obtaining the necessary consents, licences and approvals.*

Coastal Processes

The west of the bay is relatively sheltered from the most extreme wave activity and beach levels are generally stable throughout the bay. If the breakwater were to fail, a retreat of the shoreline position throughout Sandy Bay would be expected.

The Relict Dunes to the east are considered to be stable, having re-naturalised from a previously poor state. They will be safeguarded from development and Phase 1 includes management measures. The dunes are at risk of blowout and increasing attack at the toe during storms due to sea level rise. Erosion is likely throughout storm and surge events however the intertidal zone will recover to its former profile. Undercutting of the dune system is not considered to be high risk, provided dune stabilisation continues although the frequency of scarping events is likely to increase with sea level rise. The dunes would be vulnerable if the Western Breakwater were to fail.

Coastal Flooding

The crest levels of the private defence structures along the Coney Beach Fairground are not adequate in places. However the

extent of predicted flooding only extends about 100m northwards along Mackworth Road. Flooding is limited to adjacent properties at the southern end of Mackworth Road. During a 1 in 200 year event five businesses are at risk of flooding. This increases to 18 businesses and 16 residential properties were the Western Breakwater to fail (Figure 5). With sea levels expected to rise by an assumed 1.11m between 2020 and 2120, flood risk to the area will increase.

Mackworth Road along the Coney Beach frontage is a low spot at risk of wave overtopping and extreme tidal levels. Previous modelling suggested a pathway north to the New Road flood cell. However OBC modelling (FCERM climate change allowances as of January 2017, now superseded) found flood water is limited from running northwards by a highpoint in the road.

The area benefiting from the phase 1 works has been derived for the 1 in 200 year event for 2118 climate based on the more precautionary FCA climate change allowances (CL-03-16). Note that for this event, sea levels are sufficient for water to flows from Coney Beach northwards along Mackworth Road for about 400m and across to Glan Road.

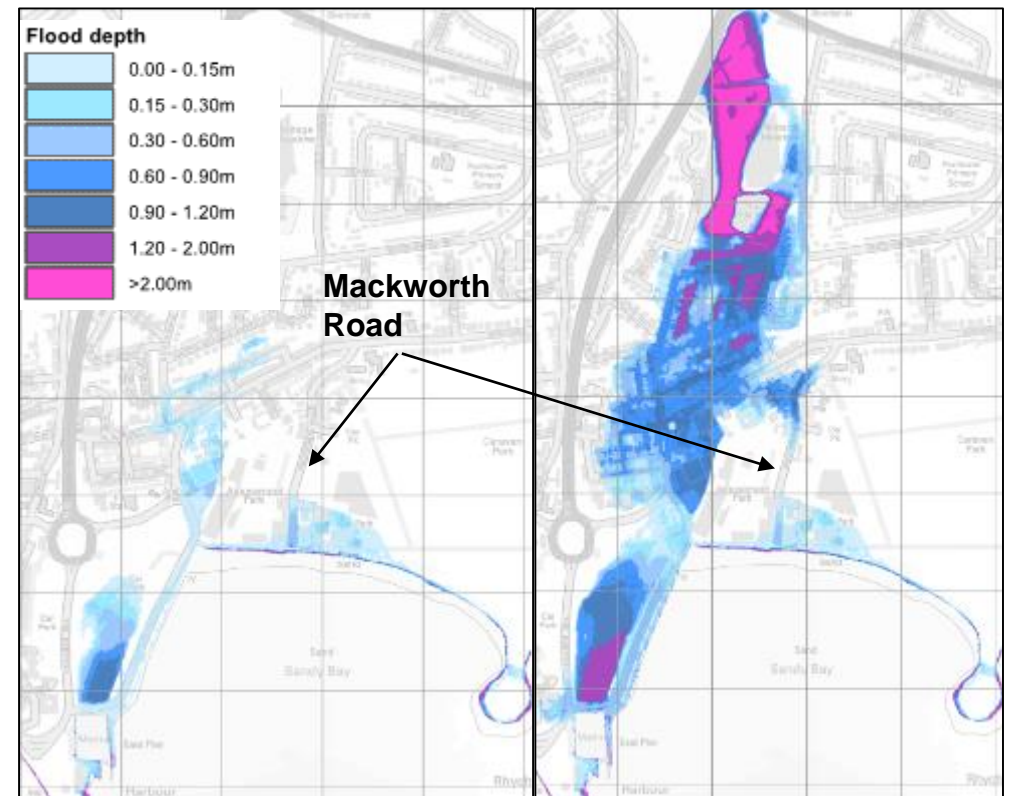
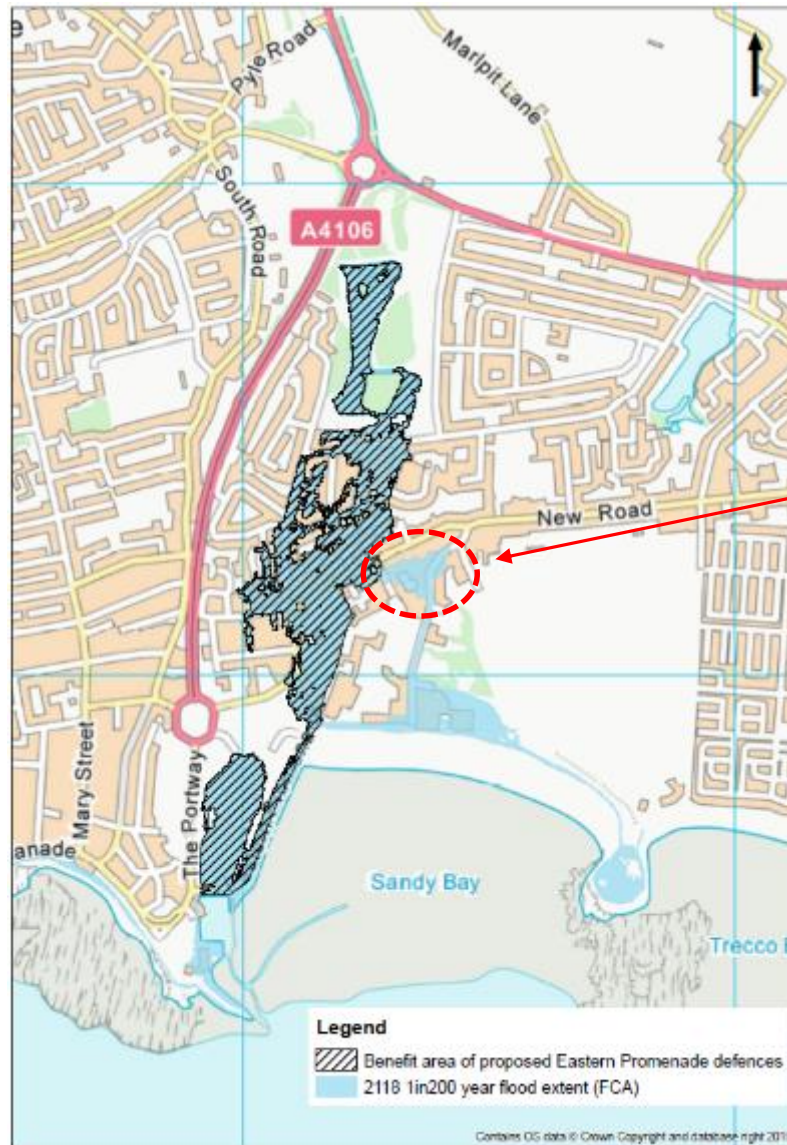


Figure 4: (top and overleaf) 3 January 2014 storm surge along Coney Beach Frontage.

Figure 5: Results of a predictive flood extent for a 1 in 200 annual flood event comparing a 'do-minimum' scenario (left) and in the 'do-nothing' scenario without the Western Breakwater (right). Image taken from the OBC (Arup, 2017).

Flood Risk



The area of flooding at the north end of Mackworth Road is outside of the LDP site and therefore reducing flood risk in this area is not a driver for this study.

Figure 6: Flood map showing flood extent of 1in200 year event in 2118 (FCA climate change allowance) and showing benefit area of proposed Eastern Promenade defences

2 Optioneering



Credit: BCBC

Outline Business Case Optioneering summary

Through consultation with BCBC, Arup, ABPmer and Atkins, an original long list of options were appraised for each area of Sandy Bay (Western Breakwater, Eastern Promenade, Coney Beach Fairground, Relict Dunes and Rhych Point). The existing structural condition, environmental issues, coastal processes, constructability and the estimated lifetime costs for the 100 year period were considered.

The baselines for comparison were:

- The **do-nothing case** assumed no maintenance carried out, resulting in failure of the Western Breakwater during a storm. This would increase the coastal risk along Coney Beach front and the probability of the private defences failing.
- The **do-minimum case** assumed considerable maintenance of the Western

Breakwater and patch repairs of the private defences.

The following were conclusions were drawn:

- **Breaching existing defences** and **offshore structures** were dismissed as they do not fulfil the SMP2.
- **Temporary defences** were dismissed based on the high cost of defending this length of beach.
- **Groynes** and **beach nourishment/management** were rejected because of the limited lateral sand drift and absence of significant drawdown trend.
- A **setback floodwall** to reduce the existing defences would be cost-effective to reduce overtopping but would limit development opportunities. There would also be a residual risk of erosion and costs would be increased due to

necessary mains diversions

- A **stepped revetment** would provide stepped access to the amenity beach. High cost and would require a wide footprint. Rock armour to protect the footing would limit access. Since landward encroachment was not permitted this would lead to required diversion of existing utilities.
- Use of **gabions** placed in lieu of a revetment was considered less desirable as it has a shorter design life and is likely to have a negative impact on the amenity beach. However, gabions provide a low-cost erosion protection alternative for consideration.
- A **sea wall (vertical sheet pile or concrete re-curve)** has the potential to significantly reduce overtopping.

Mitigation would be required to ensure the reflected waves did not cause scour. Buildings/kiosks would have to removed and access would be limited.

The **preferred engineering option for Coney Beach was a terraced revetment leading to a sea wall**. This combination allowed the desired crest level required to reduce overtopping to an acceptable limit to be achieved with a smaller footprint than the stepped revetment alone would allow, thus reducing the environmental impact. It required diversion of both strategic DCWW assets running along the beach, at a preliminary budget estimate cost of £2.2m.

However revised constraints allow consideration of options which avoid the requirement for utilities diversion(s).



Constraints

The following constraints influence the feasibility of delivering each of the options considered owing to their impact on cost, local environment and stakeholder acceptability.

Shoreline Management Plan

Coney Beach Frontage proposals should accord with 'hold the line' policy.

Strategic Growth

The option should support the strategic growth and meet planning policy requirements (TAN15 and TAN14).

Utilities

Coney Beach Frontage should consider minimising utility diversion requirements to reduce costs. Particularly west of Mackworth Road where multiple utilities are located (see Constraint 1).

Amenity Access

The existing Coney Beach promenade is substandard, with changes in gradient and narrow sections. The Wales Coast Path is diverted inland along New Road. Beach access comprises five steep flights of steps and Mackworth Road slipway does not meet inclusive mobility guidance.

Proposals must maintain and enhance access and amenity, including provision for Disability Discrimination Act compliant beach access ramps and supporting the Active Travel Route along the frontage (from LDP masterplan).

Contamination

Historic land uses present a contamination risk. Desk studies highlighted old railway land indicates

risk of encountering hydrocarbons, metals, herbicides and solvents are common contaminants. The Inner Dock and coal tips indicate potential contamination. Made ground encountered beneath Eastern Promenade is expected to be found beneath Coney Beach Pleasure Park and likely to be remains from surrounding industry. Investigations are required. Proposals should minimise contamination risk.

Existing properties not altered as part of LDP

The options should minimise disturbance to the businesses/properties to the east of Mackworth Road. This area remains unchanged in the LDP with the expectation of the Active Travel Route travelling through the frontage (see Constraint 2).

Impact on Adjacent Frontages

The option developed should have no negative impact on the adjacent frontages, for this study this refers to coastal processes.

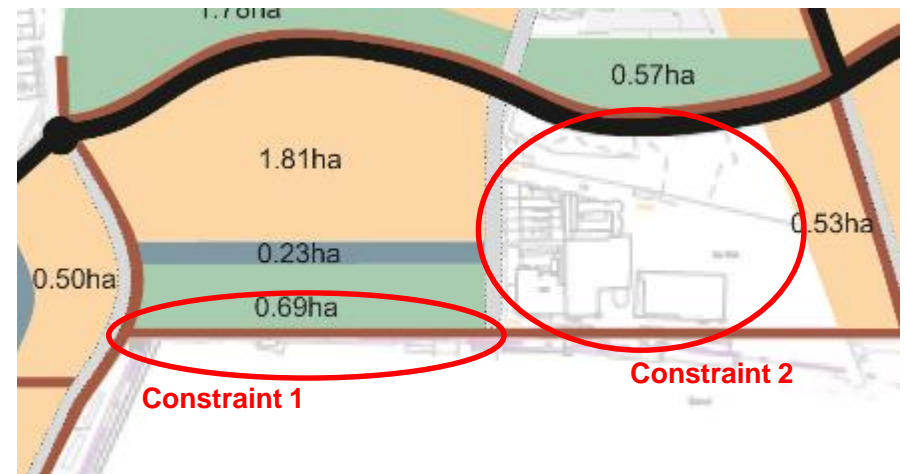


Figure 7: Key optioneering constraints

Utility Constraints and Environmental Considerations

Significant utilities constrain proposals, see plan in Appendix 1. In summary:

1. Dŵr Cymru Welsh Water (DCWW) 400mm dia. sewer rising main runs down Eastern Promenade and along the Coney Beach frontage on the beach. Preliminary diversion costs estimated at £1.2 million in OBC. Anticipated DCWW would require a significant easement corridor due to the asset's pressurised nature.
2. A 750mm dia. sewer runs down Mackworth Road and along the frontage in the beach. The pipe acts as an overflow to Mackworth CSO. Preliminary diversion costs were estimated at £1 million in OBC.
3. A low pressure WWU gas main runs along the Coney Beach promenade.
4. A BT underground cable runs along the Coney Beach frontage promenade.
5. A surface water pipe is recorded in the Fairground, discharging east to the BCBC Wilderness Lake culvert.

Note that this study has not engaged with utility asset owners and no surveys have been completed to prove the location of the assets.

BCBC instructed that this study should assume that:

- **Pumped rising main cannot be diverted and should not be impacted.**
- **Other utilities shall be diverted or decommissioned in advance of works to the Coney Beach coastal defences, and are not constraints.**

See Drawing 0002 in Appendix 1 for utilities plan.

Environmental considerations

The Kenfig / Cynffig Special Area of Conservation (SAC) and Merthyr Mawr Site of Special Scientific Interest (SSSI) is located approximately 1.3km east of Sandy Bay, whilst the Kenfig SSSI (and additional section of Kenfig SAC) is located approximately 4km to the northwest. The Merthyr Mawr Warren National Nature Reserve is located approximately 1.8km east of Sandy Bay within the Kenfig SAC and Merthyr Mawr SSSI boundary.

The site is fronted by intertidal sand with hard substrate to the west and north. To the east of Sandy Bay the existing sea defences grade into relict sand dunes dominated by a range

of typical dune species, leading to the locally notified Rhych Point Site of Importance for Nature Conservation (SINC).

The Porthcawl Conservation Area surrounds Porthcawl Harbour and extends westwards and includes a number of Listed Buildings including the harbour walls (including the Eastern Promenade as a curtilage structure) and Western Breakwater.

The study area is not located within any statutory landscape designated areas, although is located within two visual and sensory LANDMAP aspect areas: Porthcawl (moderate value) and Kenfig Sands (outstanding).



Figure 8: Local Environmental Constraints (OBC, 2017)

Defence Crest Level

Crest level comparison between Eastern Promenade and Coney Beach

The Eastern Promenade benefits from the sheltering effect of the Western Breakwater against the most severe wave climate from the SW direction (see Figure 9).

The waves impact the Eastern Promenade at a more oblique angle than at the Coney Beach frontage. Therefore the crest level of defences at Coney Beach, to achieve the same overtopping volumes at the Eastern Promenade, may have to be increased.

The Detailed Design of the Eastern Promenade set the crest levels of the new parapet defence, based on overtopping assessment, at generally 9.0m AOD and up to 9.3m AOD in the northern corner. This limited the overtopping to 1 l/m/s for a 1:200 year event in 2120 (criteria for safety of pedestrians behind defence from EurOtop 2018).

For the purposes of the feasibility study a required crest height along the Coney Beach frontage has been assumed as 9.5m AOD. This is slightly higher than the crest height designed at the Eastern Promenade to reflect the less sheltered wave climate.

Potentially a lower crest height could be adopted on the frontline defence if there are other means of dissipating wave energy such as a revetment, or accepting a lower standard of protection. However, in this last case there would likely be a requirement for setback defences and/or drainage behind the frontline defence.

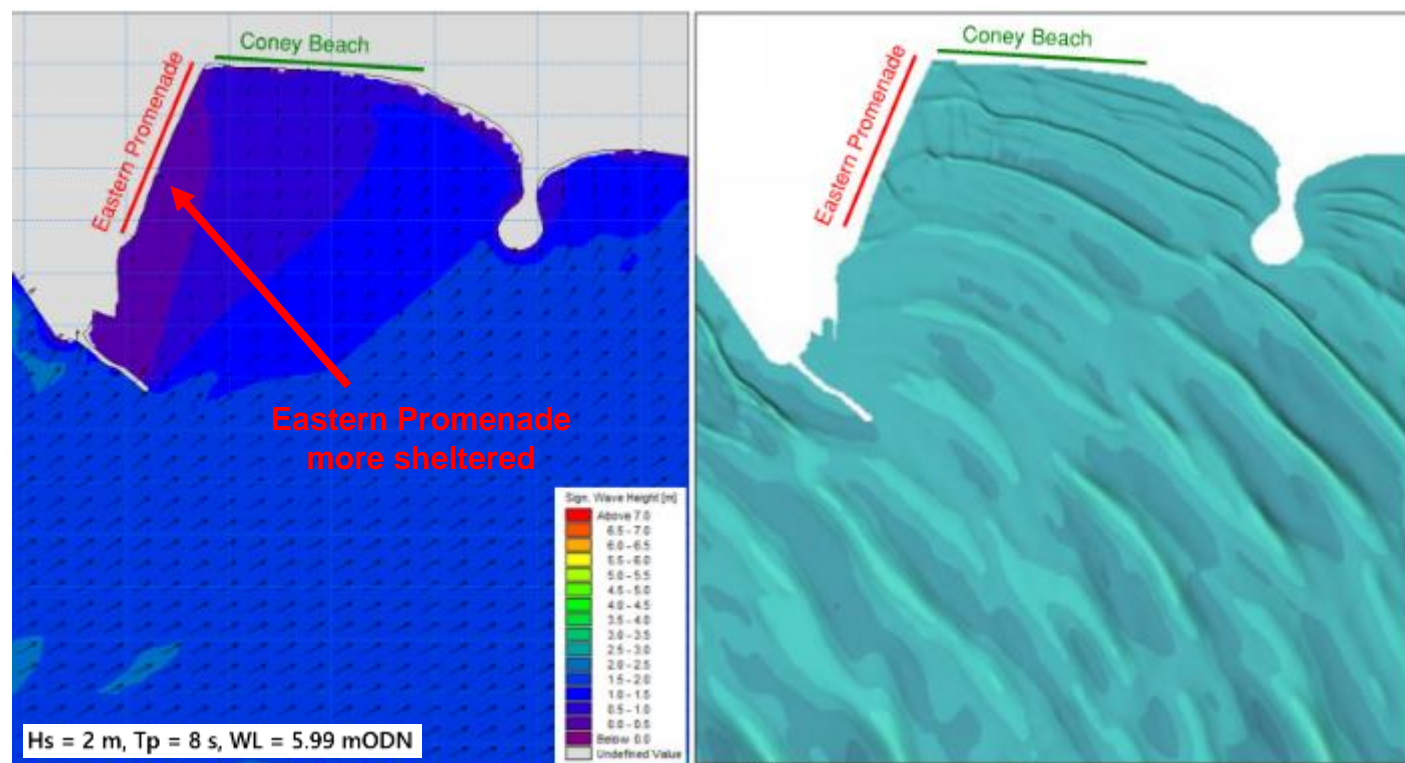


Figure 9: Extracts from wave modelling

Drivers and Sub-frontages

Coney Beach optioneering drivers:

- Reduce coastal flood risk and manage erosion risk, in line with the 2017 Outline Business Case preferred option but minimising delivery cost.
- Safeguard the LDP frontage from localised private defences failure.
- Improve accessibility to the amenity of Sandy Bay beach.
- Support the proposed LDP. This includes enhancing the promenade/Active Travel Route along the promenade.

Coney Beach sub-frontages:

Optioneering will consider Coney Beach Frontage as three sub-frontages with the following distinctive characteristics (maintaining consistency with approach used in previous work):

- **Sub-frontage 1:** defences along Coney Beach Fairground. A high ground level behind the defences reduces flood inundation.
- **Sub-frontage 2:** defences along the low point identified at Mackworth Road. Integration with local buildings required.
- **Sub-frontage 3:** defences to the East of the low point at Mackworth Road up to the tie into the Relict Dunes, includes some undefended coastline.

Note that although sub-frontage 3 and part of 2 extend outside of the Feasibility Study frontage their interface with the study frontage still requires consideration (the study frontage should not be considered in isolation).

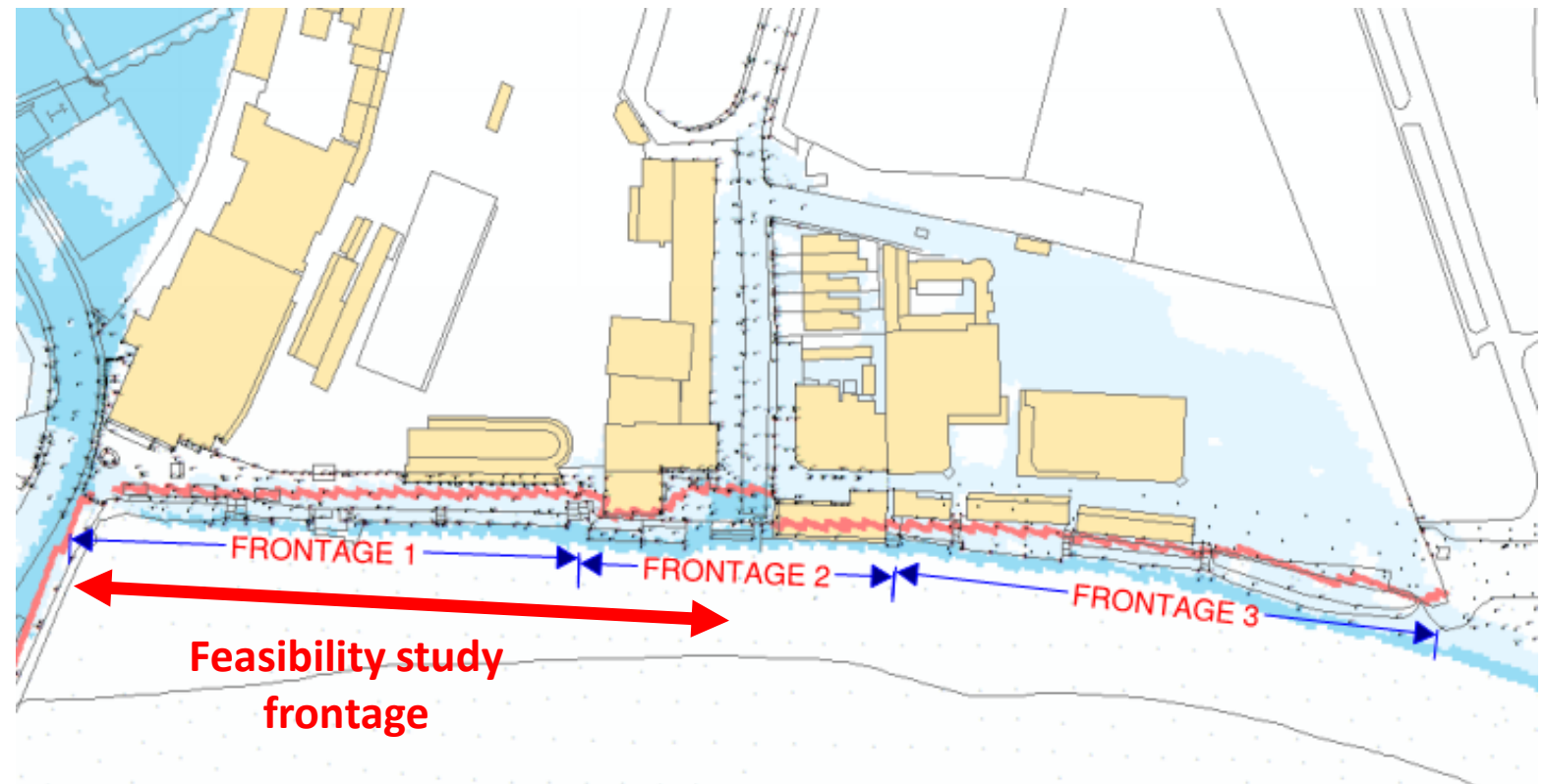


Figure 10: The Sandy Bay frontage separated into three sub-frontages for more dedicated option development (sub-frontage divisions continued from previous work) and with the Feasibility study frontage indicated.

Choice of options and assessment

This feasibility study develops the short-listed options identified in previous study

The work undertaken by Arup in November 2018 undertook a long-list appraisal of options for the Coney Beach Fairground frontage (Figure 11).

This feasibility study builds upon this work by further developing the shortlisted options, revisiting the long-list appraisal is not included in the scope of this work.

Options discounted at long-list stage following a multi-criteria assessment include: walkway, continued patch repairs, managed realignment, advance the line, beach nourishment, groyne and offshore structures.

Multi-criteria assessment of short-listed options

In order to compare the short-listed options they have been assessed against a number of criteria including:

- Cost;
- Erosion protection;
- Accessibility and amenity of beach;
- Enhancement of the promenade and Active Travel Route;
- Support and safeguarding of the proposed strategic regeneration.

Option	Reduce flood and manage erosion risk (OBC/SMP) whilst minimising cost.	Safeguard the frontage from localised private defences failure.	Improve accessibility to the amenity of Sandy Bay beach.	Enhance the promenade.	Support and safeguard the proposed strategic regeneration.	Suggested option shortlist status
Walk away						
Business as usual (Patch and Repair)						
Business As Usual Plus (enhanced Patch Repair)	Residual life likely low. Surveys/design pending.					
Managed Realignment						
Advance the Line						
Revetments	May avoid utilities if encroach landwards.					All
Sea Wall	May avoid utilities. High capital cost. Minimum land take		Beach access challenging.	May reduce promenade views without mitigation.		2 & 3
Earth / Vegetated Embankments	May avoid utilities. High land take					1
Gabions (placed in front of existing structure)	May avoid utilities. Medium cost and land take. Low design life.		Beach access challenging.	May reduce promenade views without mitigation.		1 & 3
Concrete Bagwork						
Temporary/demountable defences						2 (part)
Property Level Protection						2 (part)
Beach Nourishment						
Groynes						
Beach Management/Recycling						
Offshore Structures						

Shortlisted options considered in feasibility study

PLP not considered as does not support future development

Figure 11: Extract from Phase 2 work by Arup 2018, annotated to highlight short-listed options being considered in Feasibility Study

Costing Approach

Costs have been developed primarily to facilitate comparison between options. They also provide an indicative high-level estimate of the cost of options. It should be noted that the accuracy of the cost estimate will improve as the engineering work develops and currently this is at a very early stage.

Guidance applied

The approach to cost estimation has applied guidance from the Environment Agency's Long Term Costing Tool (2015). This provides unit rate data for capital and maintenance costs of different types of coastal protection.

Whole life costs have been developed using a 50 year appraisal period. Enabling costs, capital costs and maintenance costs have been considered.

As appropriate for this feasibility level of design costs have been based on typical unit rates for different assets types and sketches of the options have been used to quantify elements of the works.

Present value costs have been calculated based on discount rates from HM Treasury's Green Book. Non-discounted rates are also presented and referred to as 'Cash' costs.

For the purposes of this costing the it is assumed the scheme will be constructed in 2020, i.e. this is Year 0 when the enabling and capital costs will occur.

Where rates have been taken from past

guidance they have been 'up-lifted' to 2020 using Bank of England's inflation calculator.

Optimism bias

Optimism bias has been included at 60% of the total costs. The Environment Agency recommends the 60% is applied at a strategy design stage to account for appraisers being overly optimistic in early assessment of project costs in comparison to the final values (Welsh Government FCERM Business Case Guidance, 2018).

Enabling costs

Enabling costs have been included as 20% of the capital costs. Enabling costs are included to allow for items such as appraisal, design, surveys, project management, consents and consultation. This proportion is based on recommendations in the Environment Agency Coastal Protection Guidance, 2015.

Preliminary costs

Preliminary costs have been included as an additional 20% uplift to the capital cost (are not included in EA Long Term Costing Tool rates). Preliminary costs include items such as: establishment of contactors site offices, mobilisation of construction equipment, contractors profit, contractors site management team, insurances.

Exclusions

The costs exclude the following:

- Services diversions;

- Public realm improvements behind defences;
- Decommissioning cost of proposed structures at end of life / appraisal period.
- Estates, compensation and land assembly costs.
- Extensive removal of structures and buildings (see limitations).
- The modification of existing structures adjacent to the proposed coastal works and new transition structures, as well as access stairs and ramps, is excluded from the costing. It is assumed this cost will be captured in the optimism bias applied.
- For the revetment option there would be a significant amount of demolition of existing structures required. Whilst the capital costs in the EA long term cost database are expected to include costs from schemes involving some demolition of existing structures, there is no indication of the extent of this activity (i.e. significance of scheme/proportion of price of demolition).

Presentation of costs

Costs presented in this report have been rounded. Where costs are in the millions they have been rounded to the nearest £100k, where in the hundreds of thousands to the nearest £10k, where in the tens of thousands to the nearest £1k.

A summary of costs is presented in Appendix 2.

Limitations

- Some of the options involve piling which has been allowed for in the costs. Piling is a specialist activity with prices potential varying significantly depending on site ground conditions. This high level assessment provides an indication of costs, more cost certainty for the activity will be achieved as the design progresses.
- Economies of scale is accounted for varyingly depending on the level of information in the EA cost database. For example, the rock armour costs reduce for larger volumes, however the seawall costs to not reduce in £/m for longer lengths.

Sub-frontage 1 – Options



Sub-frontage 1 Options – Overview

Crest level of promenade: 8.4 – 9.1m AOD
(typically 8.8m AOD)

Length: 135m

Existing development: Coney beach fairground and kiosks

LDP intention: Open space extending approximately 40m back from existing defences, with Primary Active Travel Route along seafront

Challenges:

- Existing utility assets
- Poor condition of existing defences
- Mixture of existing defence types

Opportunities:

- Moving promenade landwards from existing alignment to avoid interference with DCCW assets (change from approach at OBC)
- Public realm improvement
- Consistent approach along frontage

Options developed (for appraisal):

- Terraced revetment (high capital cost, large footprint)
- Seawall (high capital cost, small footprint)
- 'Soft' engineering approach



Figure 12: Photo of Sub-frontage 1 (imagery ©2020 Google Maps)



Figure 13: Aerial view of Sub-frontage 1 (imagery ©2020 Google Maps)

Sub-frontage 1 Options – Terraced Revetment

- High capital cost, large footprint.
- Reinforced concrete revetment. Seaward extent aligned with existing defences – to avoid diversion and negative impacts on DCWW assets.
- Extent and need for parapet wall require further studies.

Pros

- Public realm improvement, linking beach to open space in LDP.
- Revetment can be designed to improve access, incorporating ramps.
- Greater connection between people and the beach.

Cons

- Diversion of low pressure gas pipe (although potentially applies to all options).
- Large footprint encroaches into 'open space' in LDP.

The 13m width (localised land raising) terraced revetment option has been progressed as it does not require parapet/setback walls. Additional walls would constrain interface with developable hinterland behind defence. It should be noted that the safety of the Active Travel Route adjoining the revetment structure would have to be reviewed, particularly for use by cyclists, if progressed to determine the requirement for edge protection.

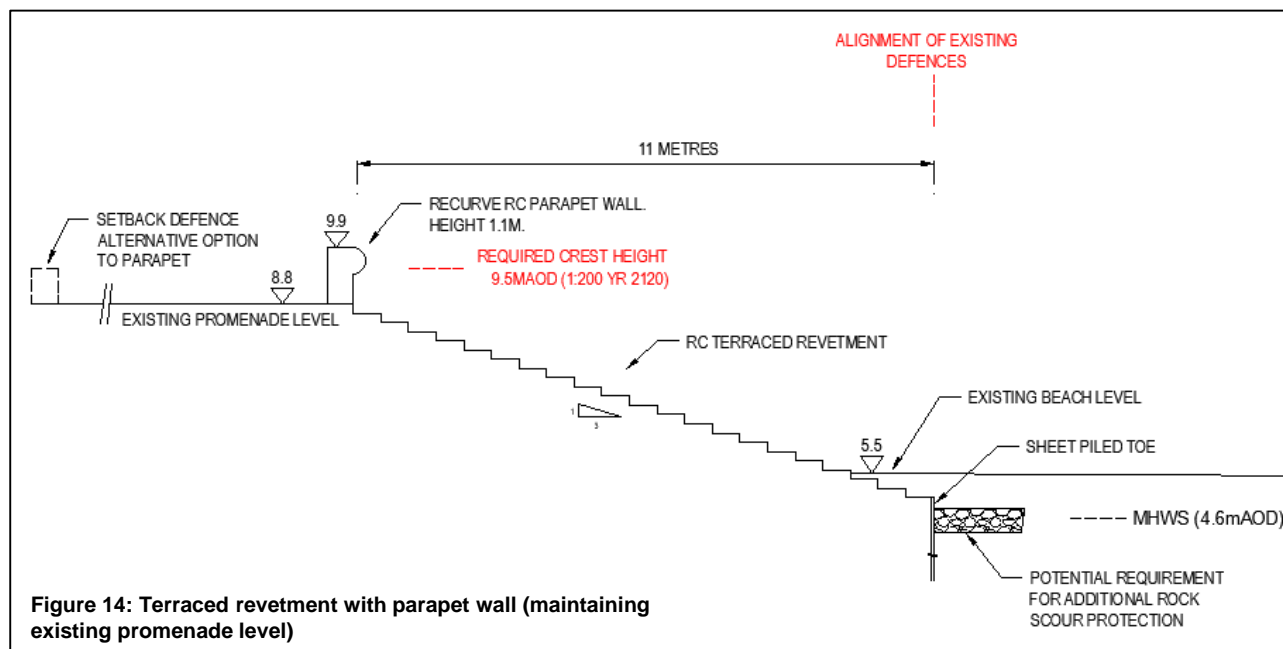


Figure 14: Terraced revetment with parapet wall (maintaining existing promenade level)

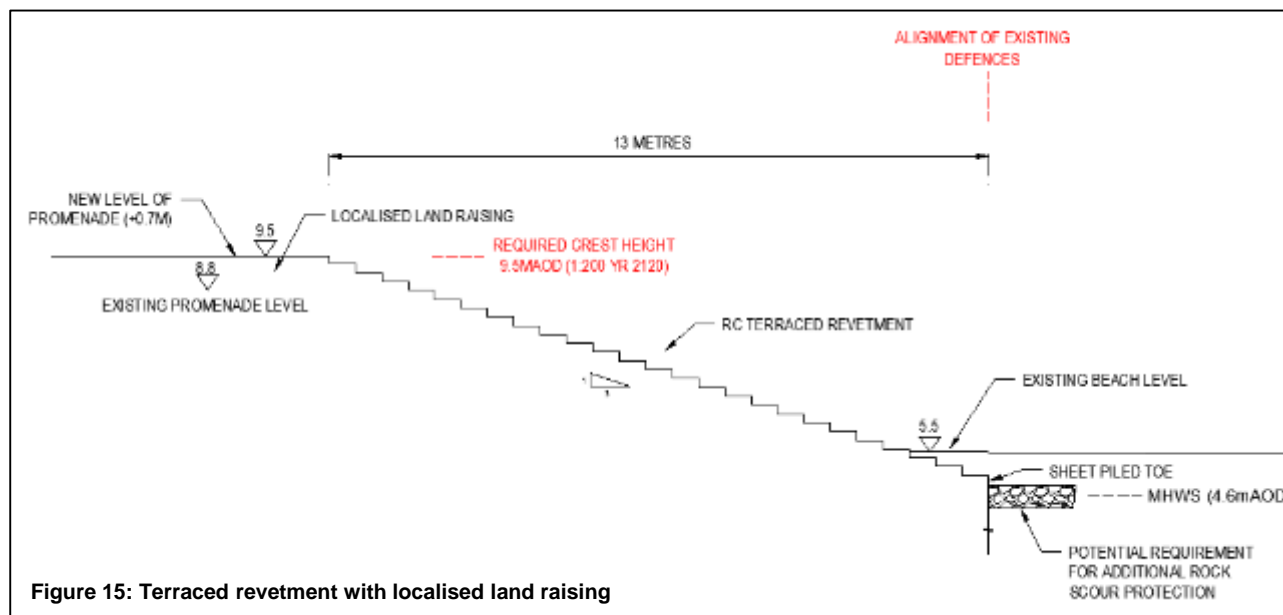


Figure 15: Terraced revetment with localised land raising

Sub-frontage 1 Options – Terraced Revetment – Plan view

- The preliminary revetment option has a width of approximately 13 metres. The defence will be aligned on the alignment of the existing defence, i.e. no additional encroachment onto the beach from proposed footprint
- Many of the existing defences are already revetment structures, steeper than the proposed option, with widths of approximately 5m.
- Similar or reduced wave reflection compared to existing structures is unlikely to alter negatively coastal processes in Sandy Bay, but further studies are required for confirmation.
- **Therefore, there would be an encroachment landward of the existing alignment of approximately 10 metres.** The active travel route will have to be realigned.



Figure 16: Width of revetment displayed on plan views (extract of LDP and aerial) (imagery ©2020 Google Maps)

Sub-frontage 1 Options – Terraced Revetment – Utility Diversions

- Maintaining alignment of existing defences means revetment would extend back into existing promenade – **requiring diversion of BT cable and gas main.**
- It is assumed that diversion or removal of the BT cable and gas main will be part of the overall land regeneration scheme and are not a driver for the current scope (i.e. not considered as constraints of the terraced revetment option).

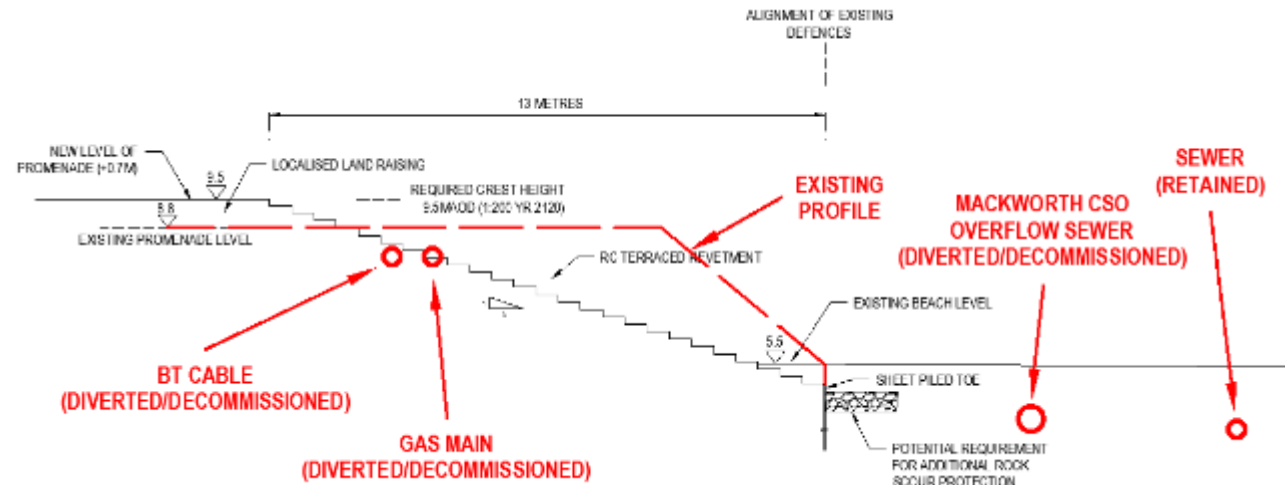


Figure 17: Indicative revetment section showing existing profile and utilities

Sub-frontage 1 Options – Terraced Revetment – Examples



Dundee proposed design



Margate



Lisbon



Blackpool

Figure 18: Terraced revetment examples

Sub-frontage 1 Options – Seawall

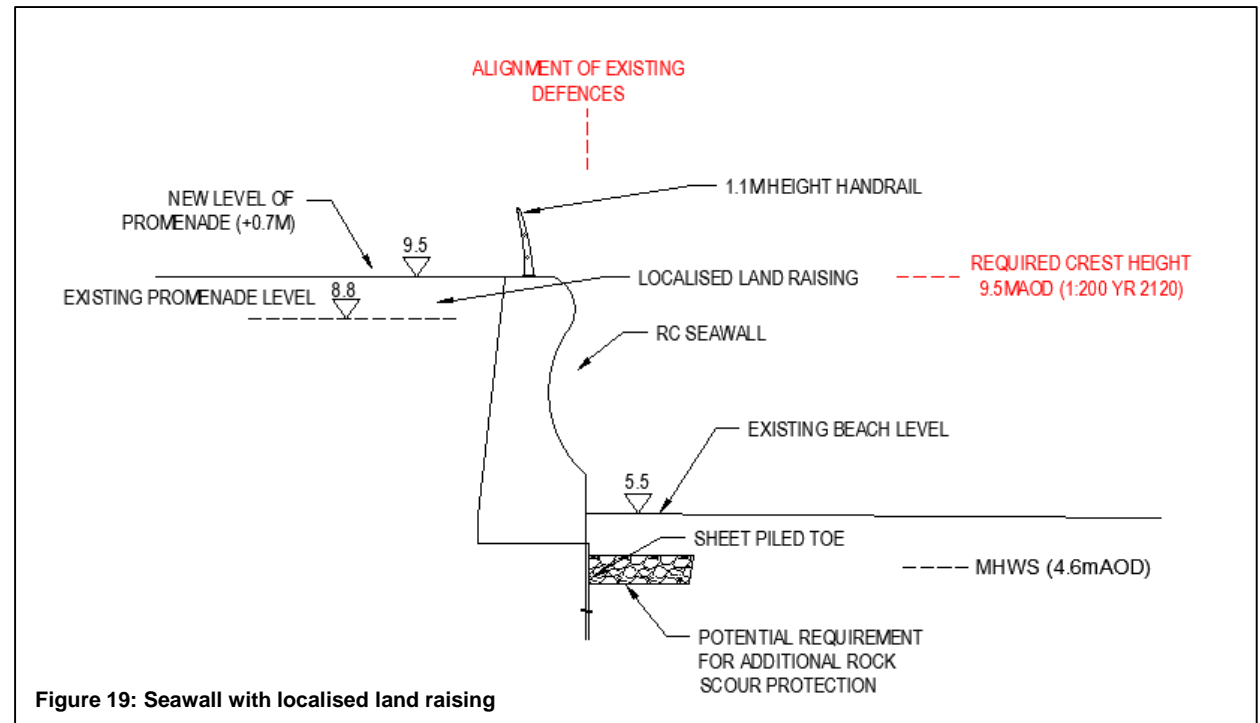
- High capital cost, small footprint.
- Reinforced concrete seawall. Constructed on alignment of existing defences.

Pros

- Low footprint, more open space.
- Potentially avoid low pressure gas pipe diversion.
- Vertical walls are typically more effective at reducing overtopping volumes, therefore required crest height of structure likely to be lower (can only be determined through overtopping assessment, beyond scope of this study).

Cons

- No improvement of beach access without extraover extensive ramps/steps.
- Increased or similar wave reflection to current conditions causing lowering of beach in storm events.



Sub-frontage 1 Options – ‘Soft’ Approach

- Removal of hard defences and creation of artificial area of sand dunes or grassed embankment with scour protection at toe i.e. rock armour or gabions.

Pros

- More natural approach.
- Less capital cost.

Cons

- Potentially significant land loss (see Figure 20 and 21).
- Uncertainty about dune behaviour in this area will require long term monitoring.
- Could lead to outflanking of adjacent defences, including Eastern Promenade and 3rd party defences to the east.
- With high footfall unlikely to stabilise.



Figure 20: Sketch of dune approach (developed at previous stage)

Sub-frontage 1

Options – ‘Soft’ Approach – Coastal erosion risk

- Coney Beach frontage protrudes beyond the theoretical natural beach alignment which is derived based on the fact that natural seabed/beach levels tend to become parallel to the predominant wave direction.
- It can be seen that the western end of the frontage is aligned the most seaward of the natural beach alignment. Therefore, if Sub-frontage 1 was naturalized like the Relict Dunes, erosion would be expected to be higher in this area than the rest of the frontage.
- Erosion is not considered to be so problematic at the Relict Dunes area because the foot/toe of the dunes is at higher levels and therefore less impacted by wave action in both frequency and magnitude .
- **A naturalized approach may work in the short term, however in the long term to protect the proposed development a hard defence is likely to be required.**

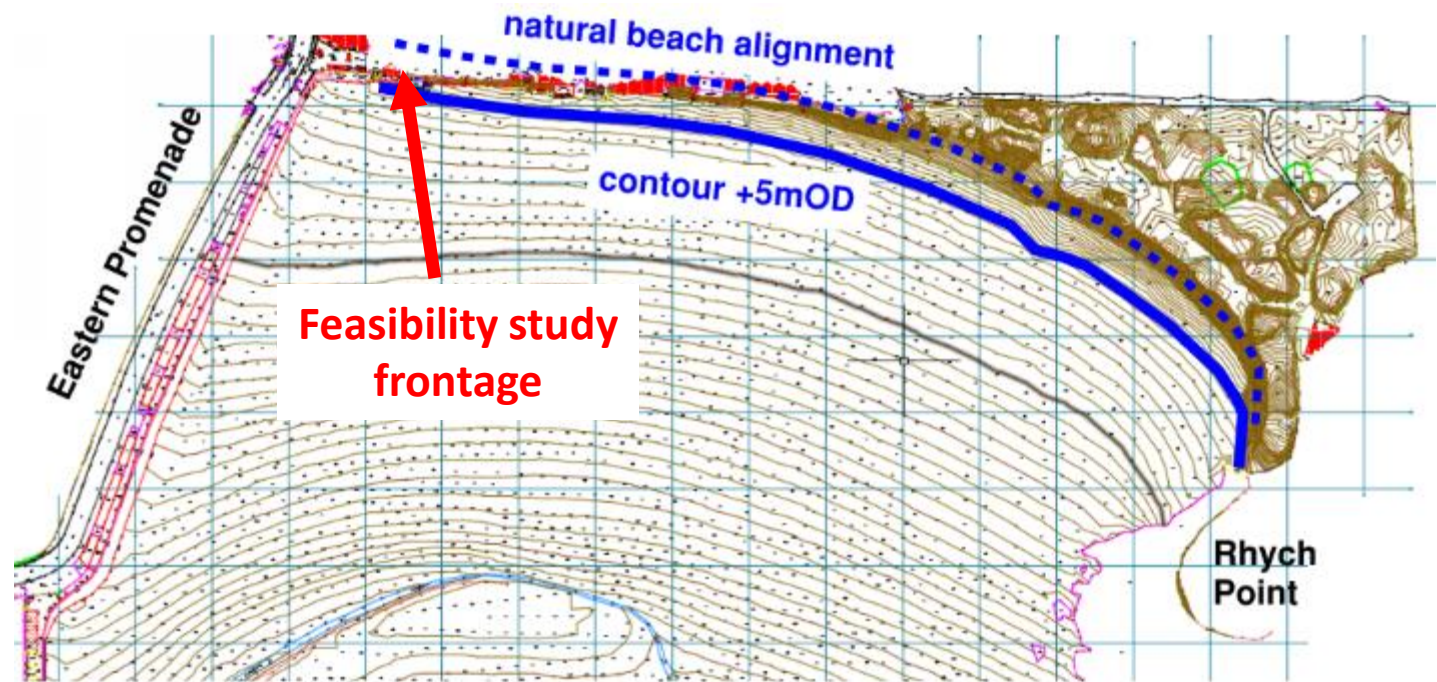


Figure 21: Beach level contour plan with theoretical natural beach alignment against existing built environment of Coney Beach Frontage

Sub-frontage 1 Comparative assessment of options

Scoring
Meets driver
Could meet
Fails driver

Table 1: Sub-frontage 1 multi-criteria assessment

Option	Cost	Safeguard the frontage from erosion.	Improve accessibility to the amenity of Sandy Bay beach.	Enhance the promenade.	Support and safeguard the proposed strategic regeneration.
Terraced revetment	High capital. Low maintenance.	Minimises risk of erosion	Potential to greatly improve access to beach.	Wide promenade and direct connection to the beach	Yes
Seawall	High capital. Low maintenance.	Minimises risk of erosion	Beach access little improvement over existing.	Parapet option potentially lead to reduced views.	Yes
“Soft” approach	Less capital cost. Higher maintenance cost. Long term uncertainty.	Erosion risk high in medium to long term.	Technically challenging if dune system created.	Promenade becomes walkway with defined width and path	Uncertainty in the long term.

* There is a lack of cost information in the EA Long Term Costing Tool for impermeable revetments, therefore for this option the costs of the seawall have been adopted with a 20% uplift to capital and enabling costs to recognise an additional cost based on engineering judgement and previous project experience.

Table 2: Sub-frontage 1 indicative costs (total costs rounded to nearest £100k)

Option	Cash Cost (Non-discounted)				Present Value Cost (Discounted)			
	Enabling Cost Cash	Capital Cost Cash	Maintenance Cost Cash	Total Cash Cost	Enabling Cost PV	Capital Cost PV	Maintenance Cost PV	Total PV Cost
Terraced revetment (135m)*	£480,000	£2,600,000	£12,000	£3,100,000	£480,000	£2,600,000	£6,000	£3,100,000
Seawall (135m)	£430,000	£2,200,000	£12,000	£2,600,000	£430,000	£2,200,000	£6,000	£2,600,000
“Soft” approach	n/a							

Sub-frontage 2 – Options



Sub-frontage 2 Options – Overview

Crest level of promenade: 7.2 – 9.1mAOD (Mackworth Road low spot)

Length: 90m

Existing development: Coney Beach Fairground and kiosks west of Mackworth Road, retail east of road

LDP intention: Open space west of road, east of road no change to use but Primary Active Travel Route continues along seafront (landward of properties where necessary). Mackworth Road used for local access.

Challenges:

- Low point on Mackworth Road
- Existing buildings to be retained i.e. Wimpy, some directly positioned on frontline
- Access needs to be maintained on Mackworth Road – makes setback walls challenging without use of ‘active’ defence systems i.e. floodgates
- Cannot raise road due to interface with existing properties east of Mackworth Road
- Land ownership – Mackworth Road and land further east under different ownership to LDP area.

Opportunities:

- Active Travel Route needs to feel continuous across Mackworth Road.

Options developed (for appraisal):

- Frontline wall / continue revetment to match Sub-frontage 1
- Lower frontline wall with setback demountables and flood gates
- Erosion protection



Figure 22: Aerial view of Sub-frontage 2 (imagery ©2020 Google Maps)

Sub-frontage 2

Options – Mackworth Road low spot

- Mackworth road is the primary flood pathway along the frontage due to the low ground level in this location.
- The low ground level in this area means a significant increase in defence level from the existing situation is required to provide a crest height of 9.5m AOD.

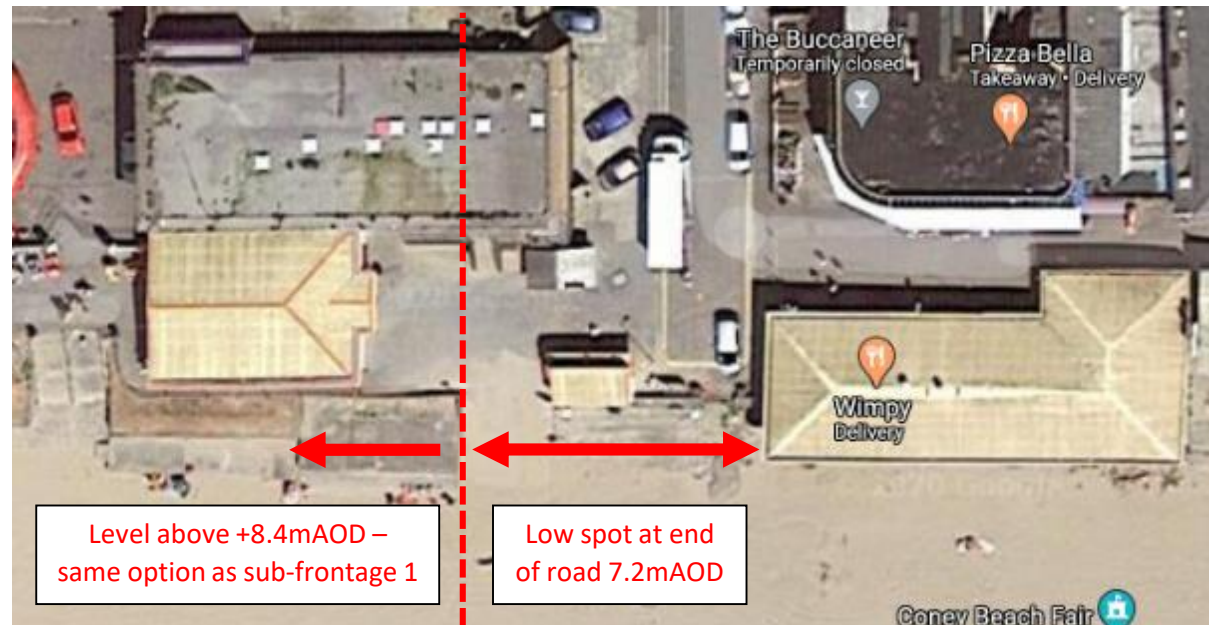


Figure 23: Location of area with reduced ground levels in Sub-frontage 2 (imagery ©2020 Google Maps)



Figure 24: Photo of end of Mackworth Road (imagery ©2020 Google Maps)

Sub-frontage 2

Options – Frontline wall / continue revetment to match Sub-frontage 1

- Sheet piled wall with cladding on landward side. Across end of Mackworth Road and then continues around Wimpy building.
- Due to large height difference between existing ground level and new defence no access to beach through this point, access diverted to Sub-frontage 1.

Pros

- Landward of wall remains unchanged.
- Provides flood protection with no need for setback walls or active defences (flood gates).
- Piling preferred to RC wall because of risk of undermining existing building – would require more offset.

Cons

- Vibration from piling and Wimpy building, will be some forward encroachment towards beach to install piles.
- Change appearance of end of road significantly, could be overbearing.
- Question over requirement to protect Wimpy building – acting as private defence.

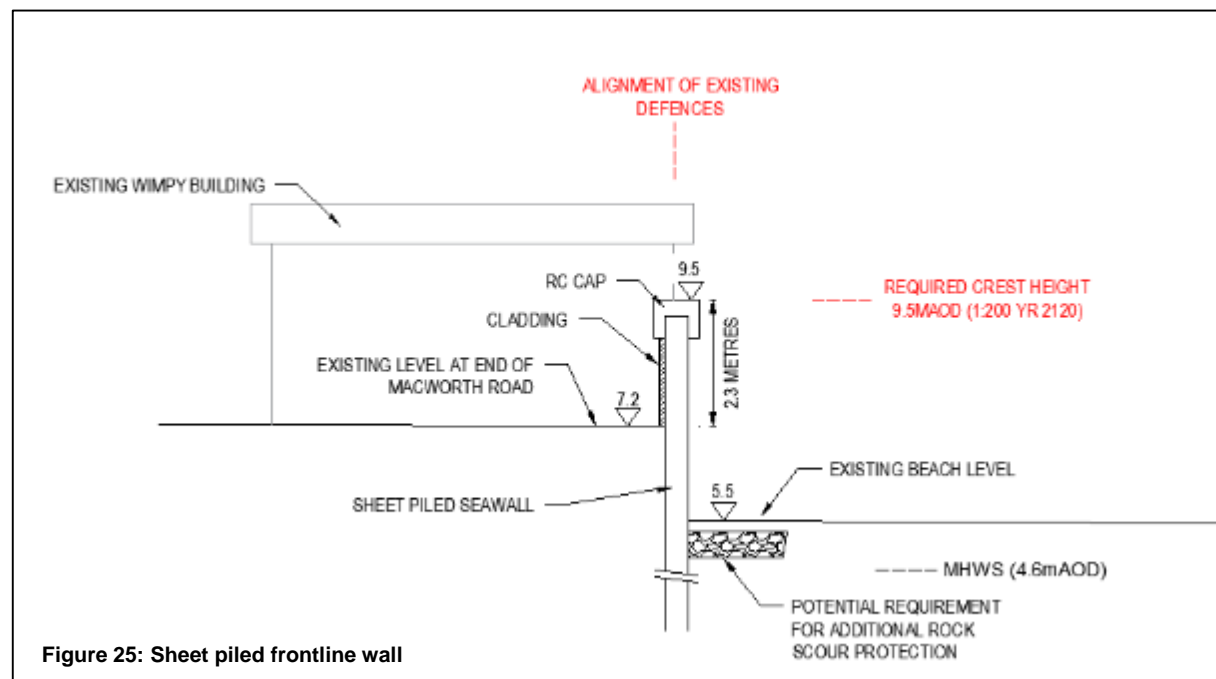


Figure 26: Plan view of frontline wall potential alignment (imagery ©2020 Google Maps)

Sub-frontage 2

Options – Lower frontline wall with setback demountables and flood gates

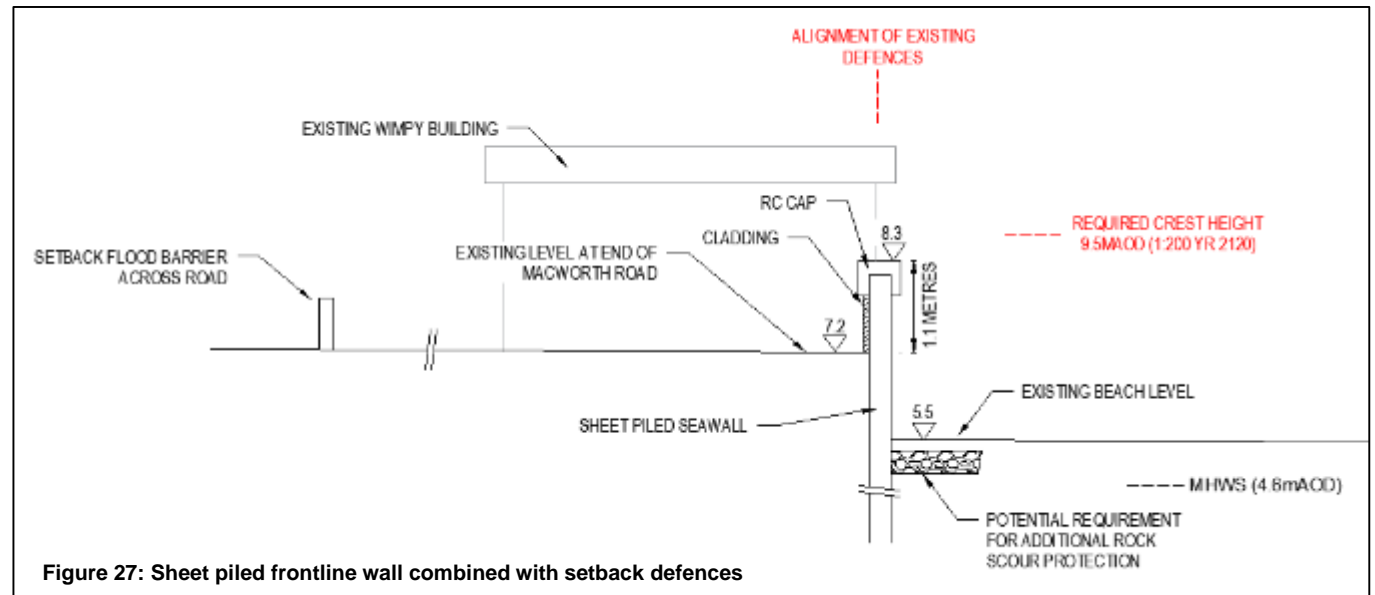
- Combine frontline sheet piled wall with setback defences. This provides the opportunity to reduce the crest level of the frontline defence.
- Setback defences create additional area which can be 'allowed' to flood and can hold flood water until it can drain back to sea.
- See Figure 28 for concept arrangement of setback defences.

Pros

- Reduced height of frontline wall means people can still view sea from end of road. Less impact – not a big visual change from existing.
- Piling preferred to RC wall because of risk of undermining existing building – would require more offset.

Cons

- 'Active' flood defence system which requires deployment. Carries risk of not being deployed on time – responsible party for operating must be identified.
- Vibration from piling and Wimpy building, will be some forward encroachment towards beach to install piles.
- Setback defence – utilities in road.



Sub-frontage 2

Options – Lower frontline wall with setback demountables and flood gates

- Setback wall to be demountable barrier system or ‘flip-up’ flood barrier system across Mackworth Road.
- Minimal footprint when not on use.
- Systems have long design life and can be deployed with 2no. Operatives.
- Note that the road cannot be raised as an alternative measure due to the interface with existing properties to the east (outside of LDP site).

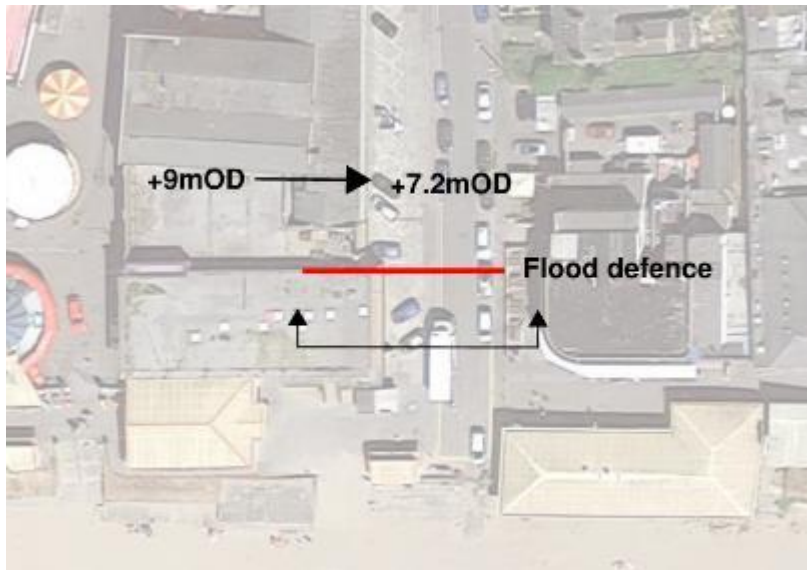


Figure 28: Location of setback defence across opening on east of Mackworth Road

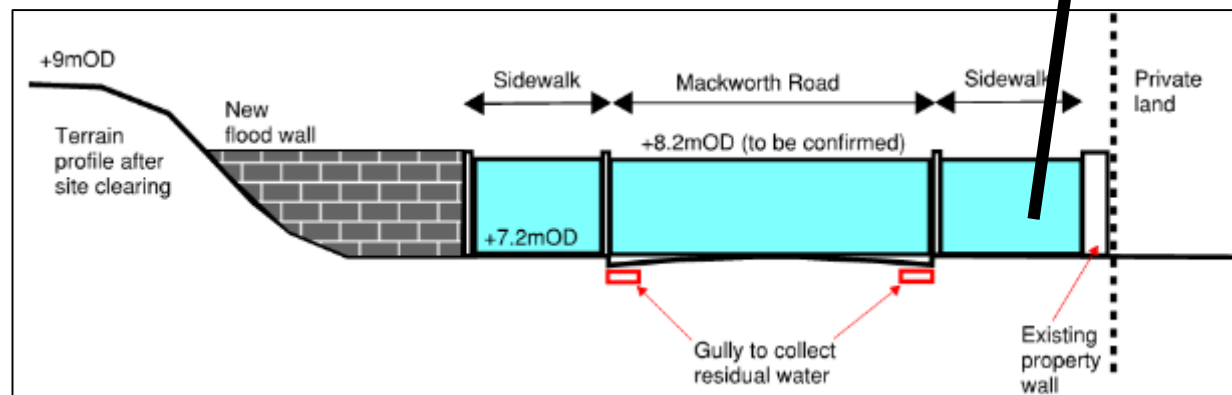


Figure 29: Concept of setback defence across Mackworth Road

Sub-frontage 2

Options – Lower frontline wall with setback demountables and flood gates

- To west of Mackworth road the high ground will contain the flood water.
- To the east the existing walls will be made use of, raising where necessary.
- A sliding flood barrier can be installed across the opening next to Wimpy to contain flood water.

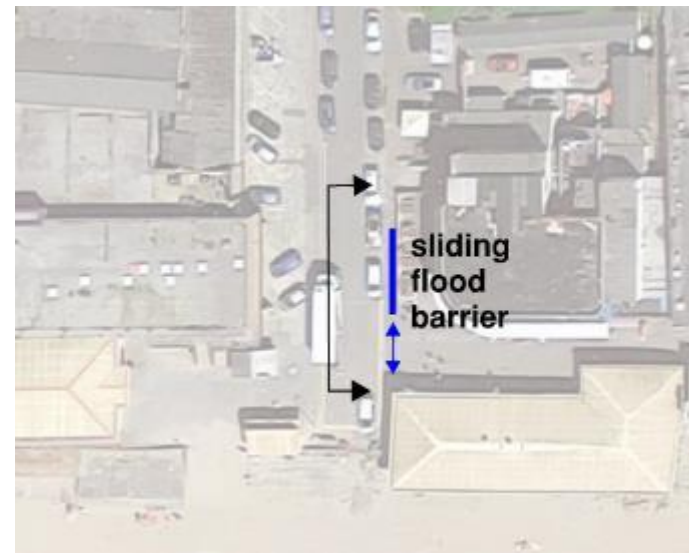


Figure 30: Location of sliding barrier across opening on east of Mackworth Road

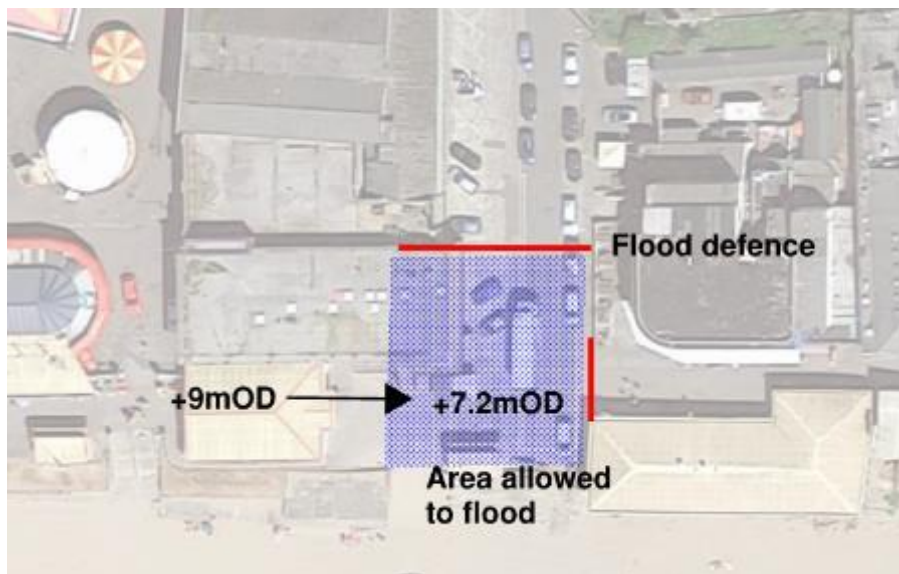


Figure 31: Plan of area 'allowed' to flood with setback defences



Figure 32: Concept of setback defence across opening on east of Mackworth Road (imagery ©2020 Google Maps)

Sub-frontage 2 Options – Erosion protection

- Should no requirement for an option to address flood risk in this Sub-frontage be identified, the risk of erosion still remains.
- Any coastal protection structure built to the west of Mackworth road must transition to the existing frontage. There is a need to ensure the proposed structure (i.e. revetment or seawall) is not outflanked. There is also a need to manage any potential change in coastal processes that the revetment might have that might negatively impact the adjacent frontage to the east.
- Erosion protection type could be rock armour, gabions, sheet pile toe – flexible system better to adapt to change over time.
- Rock armour has a major benefit over other erosion protection systems in that it is flexible and can be relocated over time to manage the interface – it has been assumed to be used in this area.

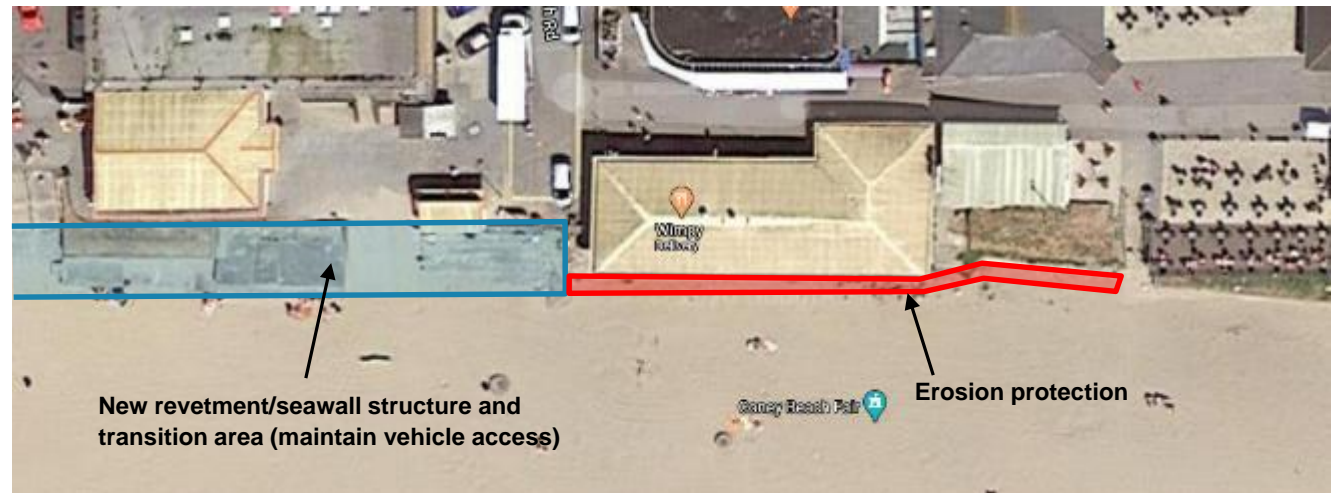


Figure 33: Plan view of erosion protection option (imagery ©2020 Google Maps)

Scoring
Meets driver
Could meet
Fails driver

Sub-frontage 2

Comparative assessment of options

Table 3: Sub-frontage 2 multi-criteria assessment

Option	Cost	Safeguard the frontage from erosion.	Improve accessibility to the amenity of Sandy Bay beach.	Enhance the promenade.	Support and safeguard the proposed strategic regeneration.
Frontline wall / continue revetment to match Sub-frontage 1	High capital. Low maintenance.	Prevents erosion.	Limits access at end of road, but access nearby.	Overbearing, obstruction of views.	
Lower frontline wall with setback demountables and flood gates	High capital. Low maintenance.	Prevents erosion.	Beach access can be provided.	Maintains views.	
Erosion protection	Relatively lower cost.	Prevents erosion.	Will limit amenity use of beach.	No change.	Manages risk of coastal protection to west being outflanked. No flood risk reduction.

Table 4: Sub-frontage 2 indicative costs (total costs rounded to nearest £100k, nearest £10k for erosion protection)

Option	Cash Cost (Non-discounted)				Present Value Cost (Discounted)			
	Enabling Cost Cash	Capital Cost Cash	Maintenance Cost Cash	Total Cash Cost	Enabling Cost PV	Capital Cost PV	Maintenance Cost PV	Total PV Cost
Frontline wall / continue revetment to match Sub-frontage 1 (90m)	£220,000	£1,100,000	£12,000	£1,300,000	£220,000	£1,100,000	£6,000	£1,300,000
Lower frontline wall with setback demountables and flood gates (90m)	£220,000	£1,100,000	£170,000 *	£1,500,000	£220,000	£1,100,000	£83,000	£1,400,000
Erosion protection (54m)	£46,000	£230,000	£110,000	£380,000	£46,000	£230,000	£54,000	£330,000

*The option including setback defences has higher maintenance costs due to the active defences (flood gate and demountable barrier) and the need for inspections, mobilisation and training to operate these defences.

Sub-frontage 3 – Options



Sub-frontage 3 Options – Overview

Crest level of promenade: 8.7 – 11.5mAOD (east side lowest nr Wimpy and then rises moving east)

Length: 160m

Existing development: Retail along frontline

LDP intention: Active travel route continues along seafront. To east of car park residential zone, relict dunes in front.

Challenges:

- Mixture of existing defence types

Opportunities:

- Defences here are generally in better condition than elsewhere along frontage.
- Properties setback (relative to Wimpy)
- Beach level generally higher in front of defences than further west (Sub-frontage 1&2), however erosion management required should defences exceed design life with risk of failure, slumping and collapse.
- Ground levels of hinterland are above 9.5mAOD so overtopping can be managed through localised drainage.

Options developed (for appraisal):

- Localised erosion protection
- Full erosion protection



Figure 34: Aerial view of Sub-frontage 3 showing raised ground level (imagery ©2020 Google Maps)

Sub-frontage 3 Options – Key Drivers

- The crest levels in Sub-frontage 3 should be adequate to limit overtopping to acceptable levels (above 9.5m AOD).
- There are existing private defences along the frontage and the LDP indicates no proposed development in this area.
- Therefore the key driver for this frontage for the LDP is the interface with Sub-frontage 2.
- There is a need to prevent the outflanking of the LDP frontage in the long term (if Sub-frontage 3 was allowed to erode).
- The other consideration is the need to ensure there are no negative coastal processes impacts on Sub-frontage 3 due to the works on the LDP frontage i.e. increased erosion.



Figure 35: Aerial view of Sub-frontage 3 showing raised ground level (imagery ©2020 Google Maps)

Sub-frontage 3 Options – Erosion Protection

Approach 1 – Install localised rock armour erosion protection (35m) to manage outflanking to Sub-frontage 2

- This approach would be to manage the interface with the Sub-frontage 2 flood defence as Sub-frontage 3 erodes over time.
- Rock armour would be installed at the eastern end of the Sub-frontage 2 defence.
- Erosion protection type could be rock armour, gabions, sheet pile toe – flexible system better to adapt to change over time.
- Rock armour has a major benefit over other erosion protection systems in that it is flexible and can be relocated over time to manage the interface.

Pros

- Low cost option.

Cons

- Long term erosion will cause protection to have to be expanded to defend against outflanking.

Approach 2 – Install rock armour revetment erosion protection (150m) across all Sub-frontage 3

- This approach would be to install a rock armour revetment across all of Sub-frontage 3. To tie-in to the Sub-frontage 2 defence to the west and the Relict Dunes to the east.
- Prevent erosion and protect the properties and car park in Sub-frontage 3.
- Erosion protection type could be rock armour, gabions, sheet pile toe.

Pros

- Supports “Hold the Line” policy.
- Protects all Sub-frontage from erosion.

Cons

- Erosion protection footprint would potentially extend onto beach and reduce recreation value.
- Would replace private defences that are currently effective.
- Potentially creates interface issue with Relict Dunes.



Figure 36: Location of rock armour in Approach 1 (imagery ©2020 Google Maps)



Figure 37: Location of rock armour in Approach 2 (imagery ©2020 Google Maps)

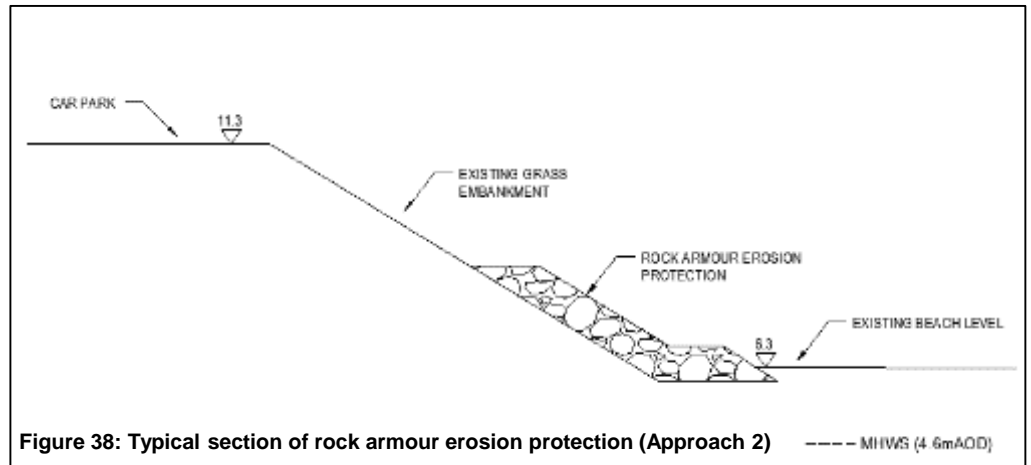


Figure 38: Typical section of rock armour erosion protection (Approach 2) --- MHWS (4.6m AOD)

Sub-frontage 3 Comparative assessment of options

Scoring
Meets driver
Could meet
Fails driver

Table 5: Sub-frontage 3 multi-criteria assessment

Option	Cost	Safeguard the frontage from erosion.	Improve accessibility to the amenity of Sandy Bay beach.	Enhance the promenade.	Support and safeguard the proposed strategic regeneration.
Localised erosion protection	Relatively low cost – but higher maintenance cost (outflanking of erosion protection).	Protects regeneration area only.	Beach access challenging.	Protects regeneration area only.	Depends on requirement to protect area from erosion (coastal processes).
Full erosion protection	High capital.	Prevents erosion.	Beach access challenging. Potential loss of amenity area.	Protects active travel route behind.	Depends on requirement to protect area from erosion (coastal processes).

Table 6: Sub-frontage 3 indicative costs (total costs rounded to nearest £10k)

Option	Cash Cost (Non-discounted)				Present Value Cost (Discounted)			
	Enabling Cost Cash	Capital Cost Cash	Maintenance Cost Cash	Total Cash Cost	Enabling Cost PV	Capital Cost PV	Maintenance Cost PV	Total PV Cost
Localised erosion protection (rock armour assumed – 35m)	£30,000	£150,000	£72,000	£250,000	£30,000	£150,000	£35,000	£210,000
Full erosion protection (rock armour assumed – 150m)	£62,000	£310,000	£150,000	£520,000	£62,000	£310,000	£73,000	£440,000

3 Preferred Option



Credit: BCBC

Preferred Option Selection

Following initial option development and multi-criteria assessment an Options Workshop was held with BCBC and key stakeholders on 22nd June 2020.

The objective of this workshop was to review the options and agree on a preferred option to be progressed.

The preferred option and the key reasons for selection are set out in this section.

Appendix 1 contains drawings including a General Arrangement of the Preferred Option.

Terraced revetment structure (158m), assumed with localised ground raising behind structure to provide required standard of protection. Extending from west end of frontage to where ground level changes west of Mackworth Road.

Reasons for selection:

- There is a need to maintain access at the end of Mackworth Road for beach cleaning. Mackworth Road is currently considered the primary access route to the beach.
- The area on the east side of Mackworth Road is not part of this LDP, therefore there is no need to increase standard of flood protection in this area.
- Localised ground raising option preferred to parapet option to maintain views and for better access opportunities to the beach.
- Proposed works must have no negative flood impact on area of east of Mackworth Road. Making use of the existing change in ground levels west of Mackworth Road to tie-in the flood defence reduces this risk.
- There is no driver to increase the Standard of Protection along Mackworth Road for the LDP. The tie-in using the existing ground levels prevents the flood pathway from the south end of Mackworth Road going west towards the LDP and contains the flood water to Mackworth Road and further east.

- There is potential for future strategic regeneration plans to improve the flood protection along Mackworth Road and to the area to the east, however this is not required to support the proposed LDP.

Rock armour erosion protection (54m) along frontage adjacent east of the terraced revetment.

Reasons for selection:

- The transition between the revetment and frontage to the east must be managed.
- Erosion protection will protect the revetment structure from being outflanked if private defences are not maintained.
- The LDP coastal protection must have no negative impact on adjacent frontages. There is a risk that the proposed defences could alter coastal processes and increase erosion rate to adjacent frontages. This is thought unlikely due to the existing hard defences along the LDP frontage, however at this stage a conservative approach has been adopted. Therefore an allowance is made to install erosion protection to manage the transition from the proposed revetment.
- It is assumed that the private defences in Sub-frontage 3 will continued to be maintained.

Preferred Option Costs

Table 7: Preferred Option indicative costs

Element of Preferred Option	Cash Cost (Non-discounted)				Present Value Cost (Discounted)			
	Enabling Cost Cash	Capital Cost Cash	Maintenance Cost Cash	Total Cash Cost	Enabling Cost PV	Capital Cost PV	Maintenance Cost PV	Total PV Cost
Terraced revetment (158m)	£610,000	£3,000,000	£12,000	£3,700,000	£610,000	£3,000,000	£6,000	£3,600,000
Rock armour erosion protection (54m)	£46,000	£230,000	£110,000	£380,000	£46,000	£230,000	£54,000	£330,000
Preferred Option Total	£650,000	£3,300,000	£120,000	£4,100,000	£650,000	£3,300,000	£60,000	£3,900,000

This compares against the Outline Business Case budget allowance for the full frontage of £430,000 enabling and £3,000,000 construction **excluding** optimism bias.

Both exclude costs of service diversions; public realm improvements; estates, compensation and land assembly; removal of structures and buildings; modification of existing structures adjacent to the proposed coastal works and new transition structures, as well as access stairs and ramps..

Project Delivery Risks

Table 8 sets out risks associated with project delivery (of the coastal protection works) and highlights mitigation strategies that have been applied or are recommended in the future.

Table 8: Project delivery risks

Risk	Risk Description	Mitigation Strategy
Utilities and existing structures.	No surveys or utilities provider engagement has been undertaken as part of the feasibility study.	Assumed for purposes of feasibility study that new structures can be constructed on alignment of existing defences without diversion of the DCCW rising main being required. Engagement recommended at future stages to understand working restrictions around asset. Intrusive and non-intrusive surveys are recommended to inform design.
Coastal processes	No coastal processes work has been undertaken to understand the impact of the proposed works on adjacent frontages. PAR studies indicate that Sandy Bay coastal processes are stable under current configuration.	A conservative approach has applied at this stage of the design to allow for erosion protection in the currently undefended parts of Sub-frontage 3. The nature of the coastal protection at Sub-frontage 1 is slightly different from existing but at both sub-frontages the proposed works are not anticipated to generate a negative impact on coastal processes. However, coastal processes study is recommended at future design stages to understand impact on adjacent undefended frontages and more widely in Sandy Bay.
Design of coastal defences including crest height of flood defence	Following concept design, detailed surveys, modelling and design are required. The crest height of flood defence structures needs to be established in order to assess feasibility of different options. No overtopping assessment has taken place along the Coney Beach frontage to calculate required crest heights for different standard of protections.	Arup have previously undertaken detailed overtopping assessment work for BCBC at the Eastern Promenade to limit the overtopping to an acceptable limit for pedestrians behind the defence in a 1:200 year event in 2120 (separate project). Based on this, a crest height has been assumed for the feasibility study. Given the high-level nature of the feasibility study this is seen appropriate for this stage of work but due to the difference in nature of the coastal defence structure, further structures are recommended at future design stages to establish a crest level that meets the performance requirements with greater confidence.
Mackworth Road and landownership	Mackworth road has a number of constraints – it is under different land ownership than the LDP site, alterations will affect existing properties to the east, it is at a lower level than the proposed defences to the west meaning that the transition/interface is more complex.	At this high level stage the preferred option has been developed to minimise impact to this area. The transition between the proposed revetment structure and Mackworth road will be a key aspect of the design and should be developed as the design progresses.
Third-party interfaces	Studies and engagement required in advance of consenting and agreements.	Design, engagement and consenting planned during subsequent stages.

Conclusion

This Outline Feasibility Study has been carried out for the coastal frontage of the Coney Beach development site to inform the Local Development Plan submission. The study aims to identify a feasible concept approach to flood and erosion protection to support the strategic regeneration.

The frontage has been split into sub-units defined by different characteristics and options developed for each. The option development built on the short-listed options identified in 2018.

Short-listed options have been developed and options assessed against a wide range of criteria. High-level cost estimates of the options have been undertaken for comparison purposes.

A workshop held with BCBC and key stakeholders in June 2020 shared emerging option appraisal work and supported the selection of a preferred option for the purposes of the LDP submission.

The preferred option is a terraced revetment across the Coney Beach frontage, ending to the west of Mackworth Road. The revetment will provide flood and erosion protection for the development area. Whilst the terraced revetment has been identified as the preferred option at this stage it is acknowledged that a seawall along this frontage could also be a suitable option, as it performs reasonably well when considered against the multi criteria assessed. Additional mitigation measures could be necessary to address accessibility to the amenity of Sandy Bay beach and maintaining the visual connectivity of the promenade with the beach.

Further east, the preferred option is for the revetment to transition to an unchanged frontage, with rock armour erosion protection allowed to manage the risk of changes to coastal processes, this requirement will be reviewed at later design stages.

The transition between revetment and reinforced existing frontage will require replacement of the existing vehicle ramp. The constrained area at the south of Mackworth Road will continue to be at risk of coastal flooding although the option of a sea walls combined with set back defences and gates has been identified. The case for this intervention is considered weak and it is not required to progress redevelopment of the former funfair 'plateau', elevated above 9.5mAOD to the west. Works to this frontage could be progressed separately at a later stage.

A preliminary general arrangement of the protection has been prepared. The estimated total cost of the preferred option is approximately £4M. This excludes costs of service diversions; public realm improvements; estates, compensation and land assembly; removal of structures and buildings; modification of existing structures adjacent to the proposed coastal works and new transition structures, as well as access stairs and ramps.

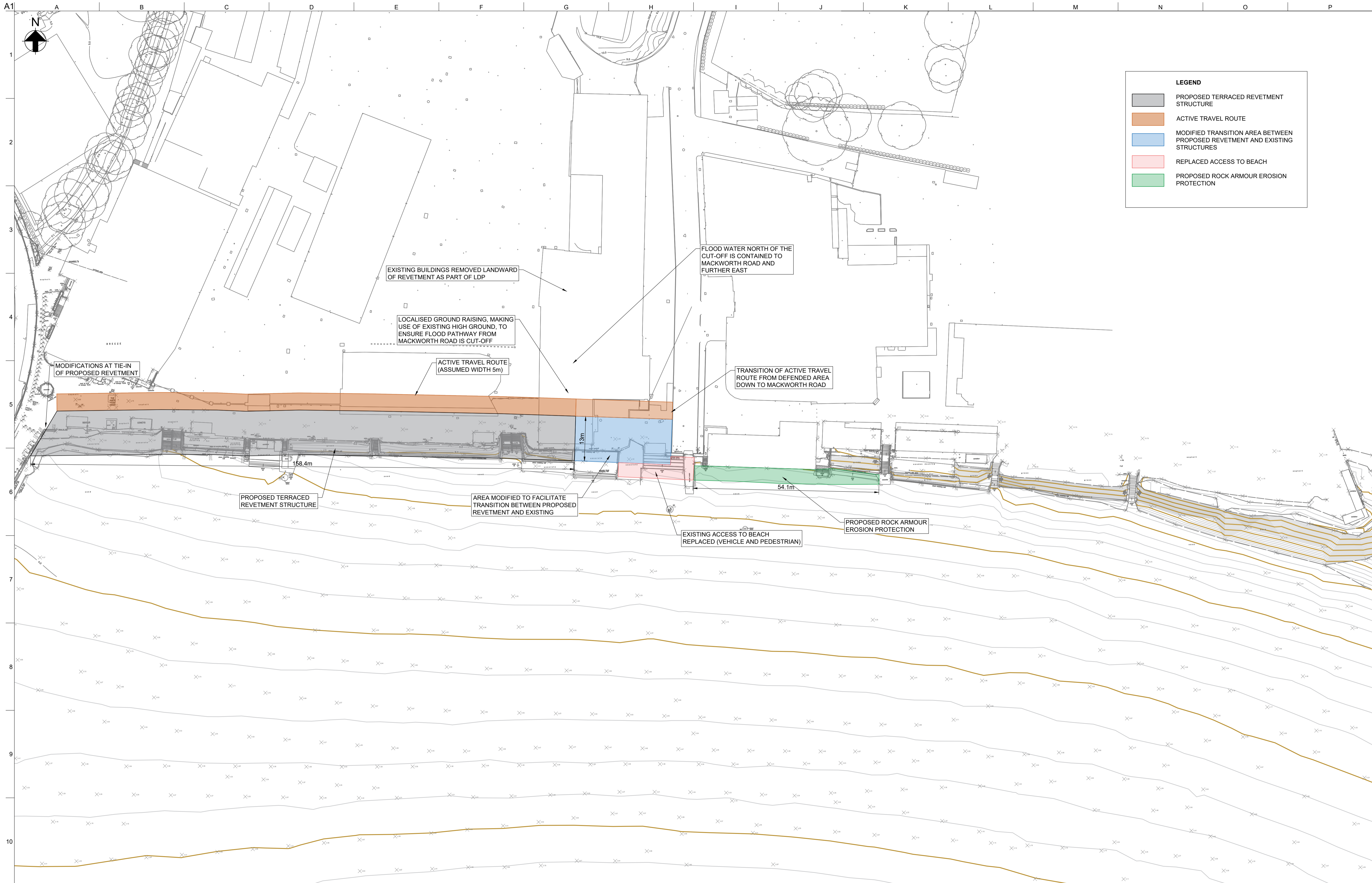
Table 9: Key assumptions used in feasibility study to support LDP

Assumption	Description
Protected area	The land fronting the LDP site along the Coney Beach Fairground frontage (Feasibility Study Frontage) requires protection from flood and erosion risk. Coastal flood and erosion risk to Mackworth Road and the area to the east is not a driver for this scheme, however there must be no negative impact on this area. Likewise, the area to the north of Mackworth road identified to flood using the latest FCA climate change allowances (Figure 6) is outside of the LDP site and risk reduction in this area is not a consideration in this study.
Costing	Costs have been developed primarily to facilitate comparison between options. The accuracy of cost estimate will improve as the engineering work develops and currently this is at a very early stage. The approach applied has been from the Environment Agency's Long Term Costing Tool, this provides unit rate data for different types of coastal protection and has been used to develop high level indicative cost estimates.
Utilities	There are a number of existing utilities at the western end of the Coney beach Fairground frontage. It has been agreed with BCBC that options should consider that the pumped rising main cannot be diverted and should not be impacted. Other utilities (low pressure gas, BT cable and Mackworth CSO overflow sewer) are assumed to be diverted or decommissioned in advance of works to the Coney Beach coastal defences and therefore are not constraints.

Glossary of Terms

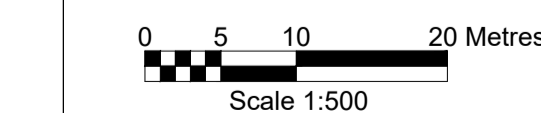
Term or acronym	Definition or meaning
Arup	Ove Arup and Partners Limited
BCBC	Bridgend County Borough Council
CD	Chart Datum
CRMP	Coastal Risk Management Programme
DCWW	Dŵr Cymru Welsh Water
ECC	Engineering Construction Contract
ECI	Early Contractor Involvement
FCERM	Flood and Coastal Erosion Risk Management
FBC	Full Business Case
HAT	Highest Astronomical Tide
LDP	Local Development Plan
LiDAR	Light Detection And Ranging
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
mOD	meters relative to Ordnance Datum Newlyn
NEC	New Engineering Contract
OBC	Outline Business Case
PSC	Professional Services Contract
PV	Present Value
PWLB	Public Works Loan Board
SMP2	Shoreline Management Plan Second Edition

Appendix 1 – Drawings



LEGEND

- PROPOSED TERRACED REVETMENT STRUCTURE
- ACTIVE TRAVEL ROUTE
- MODIFIED TRANSITION AREA BETWEEN PROPOSED REVETMENT AND EXISTING STRUCTURES
- REPLACED ACCESS TO BEACH
- PROPOSED ROCK ARMOUR EROSION PROTECTION



Issue	Date	By	Chkd	Appd

Issue	Date	By	Chkd	Appd
P01	03/07/20	SG	RC	HJR

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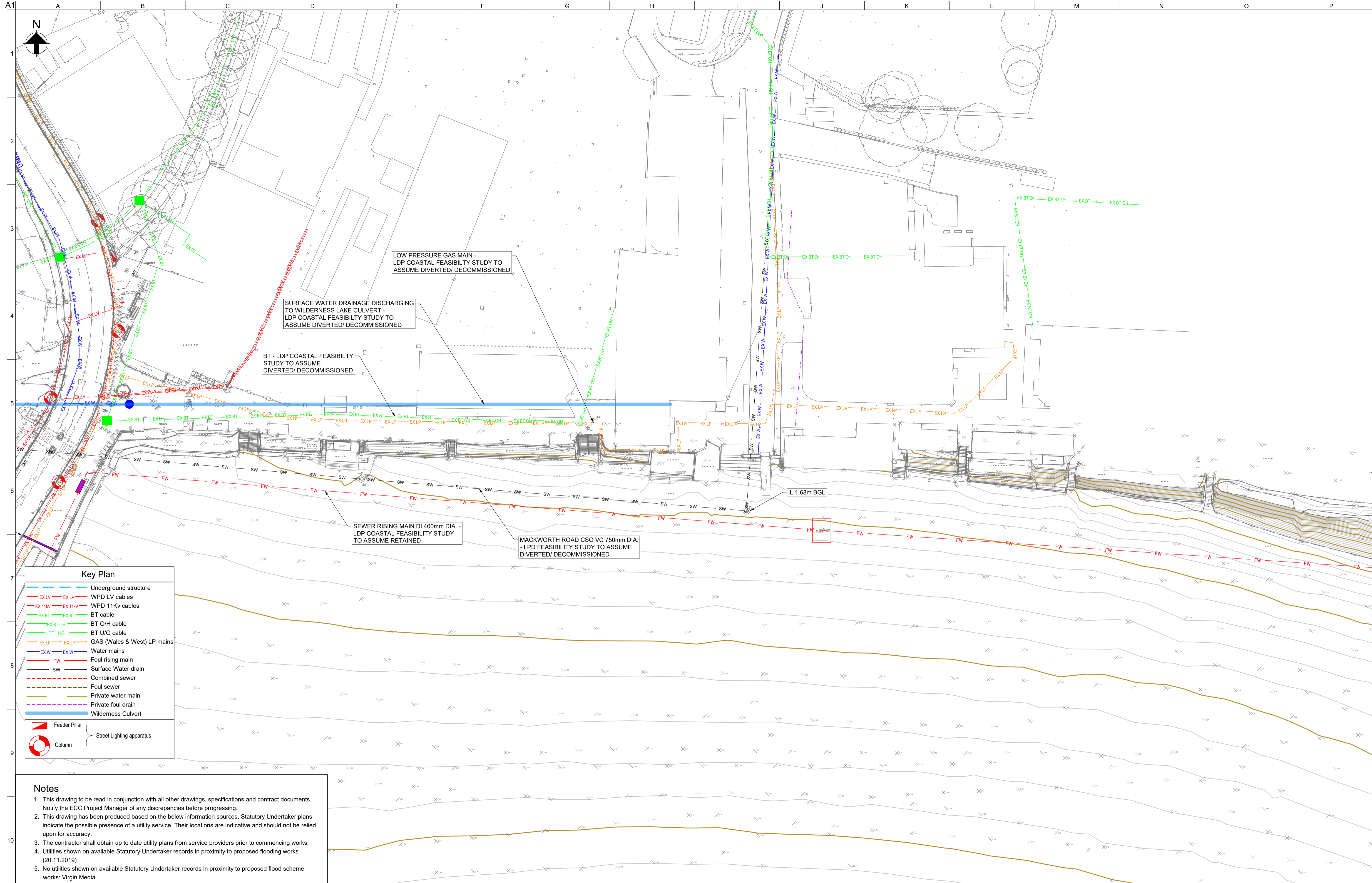
Job Title
Coney Beach
LDP Feasibility Study

Drawing Title
Coney Beach,
Preliminary General Arrangement

Scale at A1	1:500
Discipline	Utilities
Job No	264874
Drawing Status	Information
Drawing No	264874-ARP-XX-EP-DR-CX-0001
Issue	P01

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LOW PRESSURE GAS MAIN - LDP COASTAL FEASIBILITY STUDY TO ASSUME DIVERTED/ DECOMMISSIONED

SURFACE WATER DRAINAGE DISCHARGING TO WILDERNESS LAKE CULVERT - LDP COASTAL FEASIBILITY STUDY TO ASSUME DIVERTED/ DECOMMISSIONED

BT - LDP COASTAL FEASIBILITY STUDY TO ASSUME DIVERTED/ DECOMMISSIONED

SEWER RISING MAIN DI 400mm DIA. - LDP COASTAL FEASIBILITY STUDY TO ASSUME RETAINED

MACKWORTH ROAD CSO VC 750mm DIA. - LDP FEASIBILITY STUDY TO ASSUME DIVERTED/ DECOMMISSIONED

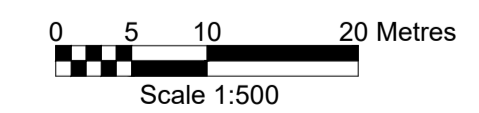
IL 1.68m BGL

Key Plan

- Underground structure
- EX LV WPD LV cables
- EX 11kV WPD 11kV cables
- EX BT BT cable
- EX BT OH BT O/H cable
- BT UG BT U/G cable
- EX LP GAS (Wales & West) LP mains
- EX W Water mains
- FW Foul rising main
- SW Surface Water drain
- - - Combined sewer
- - - Foul sewer
- - - Private water main
- - - Private foul drain
- Wilderness Culvert

■ Feeder Pillar
○ Column } Street Lighting apparatus

- Notes**
- This drawing to be read in conjunction with all other drawings, specifications and contract documents. Notify the ECC Project Manager of any discrepancies before progressing.
 - This drawing has been produced based on the below information sources. Statutory Undertaker plans indicate the possible presence of a utility service, Their locations are indicative and should not be relied upon for accuracy.
 - The contractor shall obtain up to date utility plans from service providers prior to commencing works.
 - Utilities shown on available Statutory Undertaker records in proximity to proposed flooding works (20.11.2019)
 - No utilities shown on available Statutory Undertaker records in proximity to proposed flood scheme works: Virgin Media.



Issue	Date	By	Chkd	Appd
P01	03/07/20	SG	RC	HJR

Information

Issue	Date	By	Chkd	Appd

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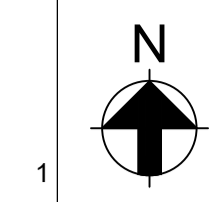
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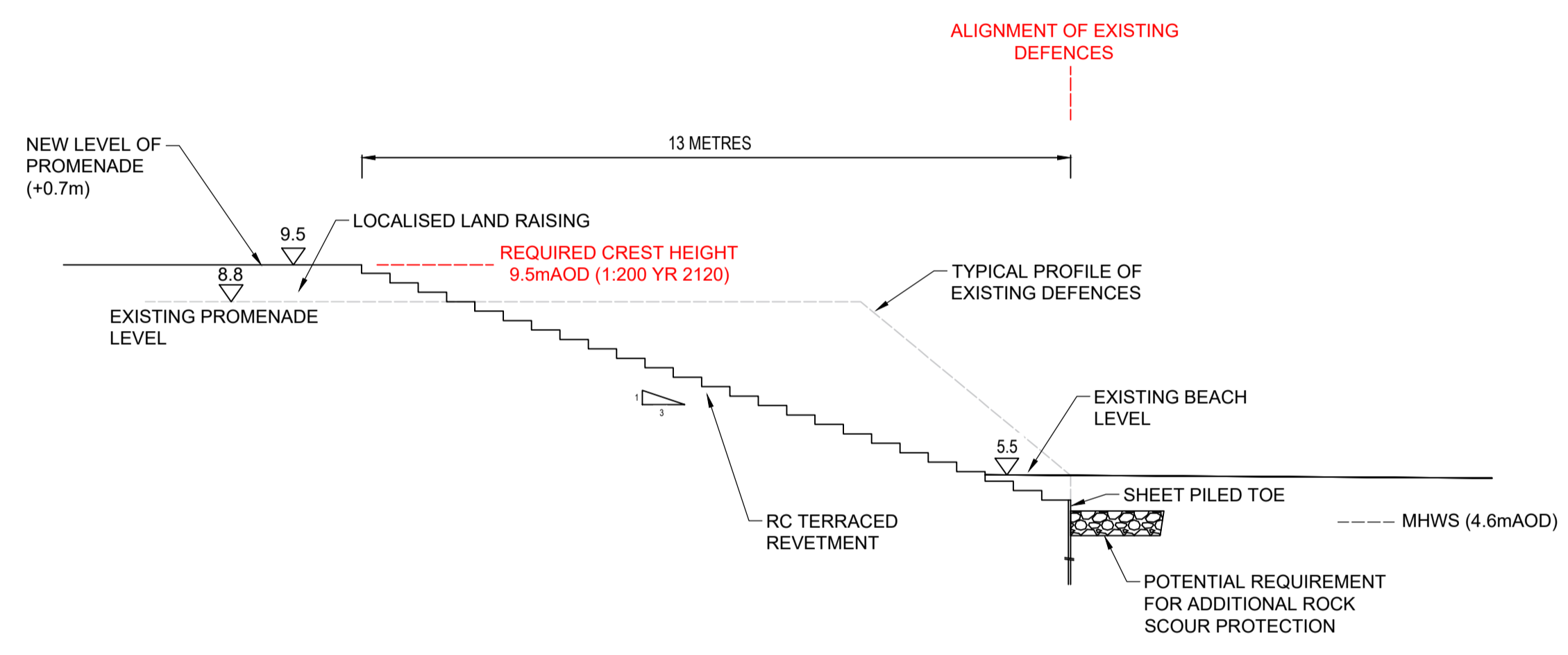
Job Title
Coney Beach
LDP Feasibility Study

Drawing Title
Coney Beach,
Existing Utilities Layout

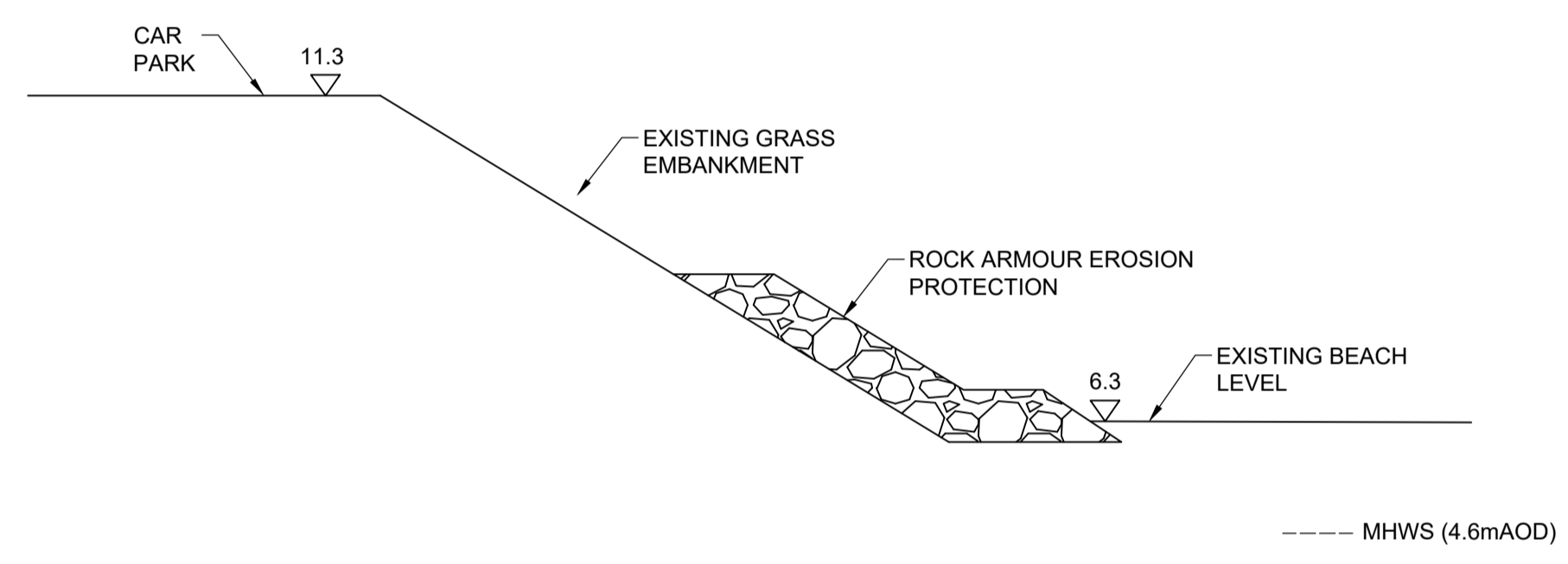
Scale at A1	1:500
Discipline	Utilities
Job No	264874
Drawing No	264874-ARP-XX-EP-DR-CX-0002
Information	Issue
	P01



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INDICATIVE SKETCH CROSS SECTION OF PROPOSED TERRACED REVETMENT



INDICATIVE SKETCH CROSS SECTION OF PROPOSED ROCK ARMOUR EROSION PROTECTION

Issue	Date	By	Chkd	Appd

Issue	Date	By	Chkd	Appd
P01	03/07/20	LTG	RC	HJR

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Job Title
Coney Beach
LDP Feasibility Study

Drawing Title
Coney Beach,
Preliminary Cross Sections

Scale at A1	1:100
Discipline	Utilities
Job No	264874
Drawing No	264874-ARP-XX-EP-DR-CX-0003
Drawing Status	Information
Issue	P01

Appendix 2 – Cost Summary

Project:	Coney Beach Fairground Frontage - Feasibility Study	ARUP
Project no.:	264874	
Calculation title:	Whole-life option costing	
Rev:	01	
Date:	03/07/2020	

Project information

Scope

This cost assessment has been developed to estimate the whole life costs of the options developed as part of the Coney Beach Fairground Frontage Feasibility Study. For the purpose of allowing comparison between the cost of options and also to provide a high-level indicative costs of the preferred option developed.

Notes and Assumptions

- Costs are based on the sketches of options shown in the study workshop on 22/06/2020.
- Design life of the scheme has been assumed to be 50 years, this provides a baseline for comparison purposes.
- Costs have been developed based on high-level benchmarking against similar projects and cost estimation guidance from the Environment Agency for coastal structures: 'Cost estimation for coastal protection - summary of evidence' (2015) and 'Long term costing tool for flood and coastal risk management' (2015).
- It is assumed the scheme will be constructed in 2020 (Year 0).
- Where costs have been taken from past guidance/projects costs have been 'up-lifted' to 2020 using Bank of England's inflation calculator. Note the costs presented in the EA Long Term Costing tool are typically based on 2011 values.
- Costs include Enabling costs, Capital costs and Maintenance costs (including inspection and maintenance operations).
- 'Optimism bias' has been included at 60% of the sum of the total costs. The Environment Agency recommends 60% is applied at an strategy design stage to account for appraisers being overly optimistic in early assessment of project costs in comparison to the final values (FCERM-AG).
- Enabling costs have been included at 20% of the capital cost. This is included to allow for appraisal/design/surveys/supervision/PM/consents/consultation. This is based on a conservative approach (accounting for early design stage) considering the proportion of Environment Agency and Local Authority schemes (Local Authority 17% and Environment Agency 20% for all schemes. Cost estimation for coastal protection guidance, Environment Agency, 2015).
- Preliminary costs are not included in the rates presented in the EA Long Term costing database, therefore they have been included by uplifting the capital costs by 20%.
- Costs are only included for the coastal protection works. Public realm improvements and utilities diversion costs have not been included in the costs.
- Maintenance costs are applied from year 1-49 at the same value i.e. there is no attempt to increase maintenance cost as the structure ages, this is in accordance with the EA guidance for cost estimates at the feasibility stage.
- Discount rates applied for Present Value costs applied in accordance with HM Treasury's Green Book. Non-discounted costs are also referred to as 'Cash' costs.
- Reinforced concrete structures (seawall and terraced revetment) and rock armour revetment are assumed to have a 50 year design life.

Exclusions

- Service diversions.
- Decommissioning cost of proposed structures at end of 50 year appraisal period.
- Public realm improvements behind defences.
- Estates, compensation and land assembly costs.
- Extensive removal of structures and buildings.
- The modification of existing structures adjacent to the proposed coastal works and new transition structures, as well as access stairs and ramps, is excluded from the costing. It is assumed this cost will be captured in the optimism bias applied.

Limitations

- Some of the options involve piling. Piling is a specialist activity with prices potential varying significantly depending on site ground conditions. This high level assessment provides an indication of costs, more cost certainty for the activity will be achieved as the design progresses.
- Economies of scale is accounted for varyingly depending on the level of information in the EA cost database. For example, the rock armour costs reduce for larger volumes, however the seawall costs do not reduce in £/m for longer lengths.
- For the revetment option there would be a significant amount of demolition of existing structures required. Whilst the capital costs in the EA long term cost database are expected to include costs from schemes involving some demolition of existing structures, there is no indication of the extent of this activity (i.e. significance of scheme/proportion of price of demolition).

Project:	Coney Beach Fairground Frontage - Feasibility Study
Project no.:	264874
Calculation title:	Whole-life option costing
Rev:	01
Date:	03/07/2020

ARUP

Summary of Costs

Costs presented are for a 50 year appraisal period.

The Total Costs in the table below have been rounded to the nearest £100k where the value is in the millions, and to the nearest £10k where the value is in the hundreds of thousands.

Frontage	Option	Cash Cost (£)				PV Cost (£)			
		Enabling Cost Cash	Capital Cost Cash	Maintenance Cost Cash	Total Cash Cost	Enabling Cost PV	Capital Cost PV	Maintenance Cost PV	Total PV Cost
Sub-frontage 1	Seawall (135m)	£432,449	£2,162,246	£11,682	£2,600,000	£432,449	£2,162,246	£5,601	£2,600,000
	Terraced revetment (135m)	£475,694	£2,594,696	£11,682	£3,100,000	£475,694	£2,594,696	£5,601	£3,100,000
Sub-frontage 2	Frontline wall / continue revetment to match Sub-frontage 1 (90m)	£219,352	£1,096,762	£11,682	£1,300,000	£219,352	£1,096,762	£5,601	£1,300,000
	Lower frontline wall with setback demountables and flood gates (90m)	£219,352	£1,096,762	£172,715	£1,500,000	£219,352	£1,096,762	£82,816	£1,400,000
	Erosion protection (54m)	£45,562	£227,808	£111,626	£380,000	£45,562	£227,808	£53,524	£330,000
Sub-frontage 3	Localised erosion protection (rock revetment - 35m)	£29,561	£147,804	£72,424	£250,000	£29,561	£147,804	£34,727	£210,000
	Full erosion protection (rock revetment - 150m)	£61,760	£308,801	£151,313	£520,000	£61,760	£308,801	£72,554	£440,000

Frontage	Option	Cash Cost (£)				PV Cost (£)			
		Enabling Cost Cash	Capital Cost Cash	Maintenance Cost Cash	Total Cash Cost	Enabling Cost PV	Capital Cost PV	Maintenance Cost PV	Total PV Cost
Preferred Option	Terraced revetment (158m)	£607,351	£3,036,755	£11,682	£3,700,000	£607,351	£3,036,755	£5,601	£3,600,000
	Rock armour erosion protection (54m)	£45,562	£227,808	£111,626	£380,000	£45,562	£227,808	£53,524	£330,000
	Preferred Option Total	£650,000	£3,300,000	£120,000	£4,100,000	£650,000	£3,300,000	£60,000	£3,900,000

