

Colwyn Bay Waterfront Project Phase 3 – Phasing Review



Draft Report for Stakeholder Distribution August 2019

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Colwyn Bay Waterfront Project

Phase 3 – Phasing Review

August 2019

CEUK Project Ref: 03/1810

Document History Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date
1	0	Draft for Client Comment	11/04/19
2	1	Final Draft for Client Comment	12/06/19
3	2	Draft Report for Stakeholder Distribution	29/08/19

Draft

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Metadata

Addressee	Conwy County Borough Council
Audience	Council Officers
Contributor(s)	Coastal Engineering UK Ltd
Coverage	Colwyn Bay
Creator	Coastal Engineering UK Ltd
Date	Created: 2019-02-25 Draft Report Issued: 2019-04-11 Final Draft Issued: 2019-06-12 Draft Report for Stakeholder Distribution Issued: 2019-08-29
Description	Report to review and update potential phasing arrangements for the 3 rd phase of coastal defence and promenade regeneration improvements at Colwyn Bay
Format	Text, medium=digital file
Identifier	03/1810
Keywords	Colwyn Bay, Waterfront, Coastal Defence, Promenade
Language	English
Location	Conwy County Borough Council, Environment Roads & Facilities, Council Offices, Conway Road, Mochdre, Colwyn Bay, LL28 5AB
Mandate	Council Order
Publisher	Conwy County Borough Council
Relation	Colwyn Bay Waterfront Development
Rights	Copyright: Conwy County Borough Council
Status	Draft
Subject	Colwyn Bay Waterfront Coastal Defence Works
Title	Colwyn Bay Waterfront Project: Phase 3 – Phasing Review
Type	Text/report
Date of metadata update	29/08/2019

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EXECUTIVE SUMMARY

This report was commissioned by Conwy County Borough Council (CCBC) to investigate and review options for implementing the third phase of the proposed Colwyn Bay Waterfront Project (CBWP) and to examine potential arrangements to move the project forward with regard to partnering with key stakeholders to deliver the project.

The Colwyn Bay Waterfront project was conceived in 2007 as a result of a strategic assessment of options for future flood and coastal erosion risk management and comprises the provision of improved coastal defence and associated waterfront regeneration, spread over three phases.

Construction commenced in 2011 and to date the Phase 1 coastal defence and waterfront regeneration works, and Phase 2a waterfront regeneration works, comprising construction of a new shoreline promontory at Porth Eirias, importation of approximately 500,000m³ of sand beach recharge, sea wall improvements and the provision of improved shoreline infrastructure, have been completed at a total cost of £28.6 million.

In late 2018 Welsh Government approval was given, to proceed with the detailed design of the Phase 2b beach recharge and associated works at an estimated cost of £14 million. This work is programmed for construction in 2020-21.

The proposed Phase 3 works comprise raising the promenade and constructing approximately 1200 metres of linear rock revetment coastal defence between Porth Eirias and Cliff Gardens, Old Colwyn at a current estimated cost of £35 million, which includes a 30% contingency/estimate bias/risk allowance.

The Phase 3 frontage comprises a near vertical masonry sea wall that dates from the early 1900s that abuts a generally sandy foreshore. The beach in front of the wall is vulnerable to erosion during storms that has required construction of additional toe works in the past to prevent undermining of the wall. Recently, across approximately half of the frontage length an emergency rock toe has been installed following storms to combat erosion and improve wall stability. Immediately landward of the wall is a part paved/part tarmac surfaced dual usage (pedestrian and cycle path) promenade, which adjoins the public highway. To landward of the promenade and highway is the Chester to Holyhead railway line, which is located some 10-15 metres above the highway supported on an embankment. A masonry wall demarcates railway property from the public highway across the entire length. Landward of the railway is the A55 dual carriageway trunk road.

The crest level of the sea wall across the frontage is low being less than 0.5 metres above the highest predicted astronomical tide level in places. Accordingly, when spring tides combine with onshore westerly to northerly winds, overtopping takes place causing potential disruption and damage to infrastructure, closure of the promenade and diversion of traffic. During autumn and winter seasons when there are consecutive days of high tides and onshore winds, or when repairs are required following storm damage, the promenade can remain closed for a few days or longer at a time.

Assessment of the condition and stability of the existing sea wall identifies the wall to be in poor condition with numerous defects and where there are no significant toe defences the beach in front is at continued risk of erosion leading to loss of support to the wall and an immediate threat of damage and failure.

Conwy County Borough Council currently manage the coastal defences and the risk to hinterland assets and the general public by:

- Regular monitoring of beach topography;
- Use of NRW flood warning systems to close the public highway to vehicles and pedestrians;
- Proactive maintenance of railings, sea wall and promenade identified during quarterly coastal defence asset inspections by Authority staff;
- Reactive maintenance to damaged railings, sea wall and promenade surfacing following storms.

In the near future however, it is highly likely that a decision will have to be made as to whether to carry out repairs and should the decision be that repairs will not sustain the defences further then a decision to permanently shut the promenade, with the associated consequences for users would have to be made.

If no further work is carried out to maintain the defences then the overall consequences would be:

- Regular overtopping of defences causing damage to the sea wall structures and promenade surfacing, exposing fill material, requiring closure of promenade access to pedestrians, cycles and vehicles (including emergency services);
- Failure of defences arising from storm damage, with damage spreading rapidly longshore;
- Loss of utilities' services buried beneath the promenade;
- Loss of boundary wall and erosion of the embankment and bridges supporting the railway leading to closure of the railway; and
- Loss of access/egress to the A55 from the promenade; and
- Loss of the A55. The area where there is the greatest risk to this will be at the eastern end where the bridge supports are immediately to landward of the railway bridge.

If the sea wall were to fail during a storm then this would render the services located under the promenade unusable immediately. Also, the toe weight to the railway embankment that is currently retained by the sea wall would be compromised with the potential for rotational failure of the railway embankment that would immediately threaten the operation of the railway.

The local impacts of the above scenario would be to cause widespread traffic chaos in the Colwyn Bay area which would, as well as causing significant disruption to the local population, adversely affect the response times of the emergency services. In addition, there would be potential wider local, regional and national impacts.

Both the Chester to Holyhead railway and the A55 are of regional and national importance in the conveyancing of both freight and passengers to/within North Wales, both commercially and from a commuter/tourism/amenity perspective.

Both of these pieces of infrastructure provide a significant link between the UK and the Republic of Ireland, with Holyhead the 3rd ranked port in Wales for tonnage of freight handled. In 2012 there were over 8,000 average daily HGV/LGV traffic movements on the A55 near Colwyn Bay and over 6,000 on the same road to the west near Bangor, contributing approximately 20% of all traffic movements on the A55.

The Chester to Holyhead railway provides an important route for passengers with hourly direct or connecting services to/from London Euston via Chester as well as commuter routes connecting the North Wales coast to the urban conurbations of Liverpool and Manchester particularly and disruption to this service would have a major impact on people who use the rail services.

Tourism is a major factor in the economy of North Wales and tourists coming into the area predominantly use the railway or the A55. In 2017, the Conwy Borough attracted 6.71 million tourism day visitors with associated annual expenditure of over £200 million. More than 60% of this expenditure is associated with the wider Llandudno, Colwyn Bay and Conwy area, all of which require access to be gained through Colwyn Bay.

The primary stakeholders with an interest in the Phase 3 frontage are:

- Conwy County Borough Council as Lead Coastal and Flood Risk Management and Highway Authority;
- Sustrans, whose National Cycle Route 5, runs along the promenade directly behind the defences;
- Dŵr Cymru Welsh Water (DCWW) and Scottish Power Systems, whose utilities' assets are directly protected by the coastal defences;
- Network Rail, whose Chester to Holyhead railway is located immediately to landward of the coastal defence line; and
- The Welsh Government Network Management Division, who have responsibility for the A55 trunk road.

Conwy County Borough Council have received 75% grant aid from Welsh Government's predecessor to its current Coastal Risk Management Programme. For this phase however WG have identified that no funding will be available from this source, as the works do not provide direct protection to residential and business properties, which is the key indicator used in prioritising Welsh Government's Flood & Coastal Erosion Risk Management (FCERM) spending, suggesting that those public and private bodies that receive direct benefit from the defences should contribute to the cost.

Of the above key stakeholders DCWW have contributed in the past to the costs of making good the existing defences, when a void appeared in the promenade close to their services. Network Rail have engaged in previous discussions and have indicated that whilst they see it as CCBC's responsibility to maintain the coastal defences, in the event that this function ceased, they would not allow for long term disruption to their network. Welsh Government Network Management Division have indicated that they do not currently envisage any significant impact on the A55 at present should the sea defences fail "due to the fact that the rail track provided a buffer".

In economic terms if there was no collaboration between the interested parties the following is envisaged:

- Permanent closure of the promenade and highway to pedestrian and vehicular traffic at an estimated cost of about £30,000 per annum to the Local Authority;
- Modification to highway signage and implementation of a permanent vehicular diversion route through Colwyn Bay, cost unknown but estimated to be of the order of £20-30,000 per annum;
- Construction of terminal works at the interface with already completed sections of the Colwyn Bay Waterfront to safeguard the investment made here. Estimated to cost £3-5 million.
- Diversion of part of the National Cycle Route 5 through the centre of Colwyn Bay with the associated risks and costs (new signage, routing etc.) this would entail;
- Permanent diversion of Dŵr Cymru Welsh Water services at a high level estimated cost of £4-5 million;
- Abandonment of low voltage electricity supply at a cost of £5000 to Scottish Power; and
- Provision of temporary and subsequently permanent protection to the railway embankment at a cost to Network Rail, estimated by this study, to be of the order of £20-30 million, to ensure the long term operation of the railway is maintained. This approach would, it is expected, lead to some short term disruption to services e.g. requiring the provision of rail replacement bus services, whilst such measures were put in place.

At face value, the response from the Welsh Government Network Management Division suggests that they do not see there being any requirement on them to invest in protection works to their infrastructure, however that would only be the case if Network Rail carried out works to protect their asset. If they didn't then ultimately there would be a risk to the Trunk Road network, which could potentially cost conservatively up to £30 million to manage.

Under a collaborative approach it is appropriate that contributions made by individual stakeholders would not exceed the estimated costs that the stakeholder would incur if no works were promoted.

Without funding support from Welsh Government promotion of the scheme would require the remaining individual public and private bodies to contribute the full costs of the works, currently estimated to be approximately £35 million.

If the scheme were eligible under CRMP then Conwy County Borough Council would have to fund 25% of the cost. This would equate to £7-8 million, which roughly equates to the estimated direct costs they would incur in the event that the existing defences were allowed to deteriorate and fail. Based on the estimates provided a DCWW contribution would be of the order of £5 million, leaving a shortfall of £22-23 million to be found from other sources, primarily Network Rail and potentially Welsh Government Network Management Division.

Welsh Government have to date been involved in promoting dialogue between interested parties and the AM for Clwyd West has proposed that a summit of interested parties be convened to move things forward. Dŵr Cymru Welsh Water have co-operated with Conwy CBC in carrying out maintenance due to storm damage and have indicated a willingness to co-operate in developing proposals further, however the value of their infrastructure alone combined with potential Council contributions would only provide a third of the expenditure required and a significant financial burden potentially falls on Network Rail and the Welsh Government Network Management Division.

At the present time there appears to be a lack of willingness by both these parties to engage on this matter and this needs to be the focus in the short term. In Network Rail's case the consequences of inaction or willingness to co-operate could lead to costs and/or damage on potentially a similar scale to that which occurred at Towyn 30 years ago.

The longer it takes to develop a way forward the greater the risk of catastrophic failure of the current defences. The frontage is at risk of overtopping and therefore promenade closure and potential damage on every spring tide

period, particularly if onshore west to north west winds occur concurrently. Accordingly, there is only a finite time (probably less than 5 years based on condition assessments of the existing defences and likely storm frequency) that the Council are going to be able to continue their current policy of "make do and amend" and decide that this approach is no longer sustainable financially. In such a case the decision would have to be made to close the promenade permanently and nature would take its course requiring the other stakeholders to adopt their own action plans to protect their infrastructure.

The immediate risk of damage could be reduced by construction of a rock toe along that section of frontage where one doesn't exist, over approximately 40% of the length, at an estimated cost of £2.0 million, which would contribute to safeguarding the integrity of the existing defences, where they are currently weakest and would also reduce the overtopping taking place across this part of the frontage. This would buy some time to develop arrangements for permanent improvements.

However, this only represents a short-term solution, that does not address the longer-term risk to infrastructure across the frontage, although the rock imported would be available to be re-used in the proposed works when they are implemented.

Notwithstanding the benefits that implementing this option in the short term would have, it is important that adopting this approach is not allowed to lead to complacency amongst potential partners/collaborators, assuming that the proposed Option 3 works would then not need to be implemented. This would have a perceived negative affect on Colwyn Bay, by not delivering fully on the objectives for the Waterfront Project, that were set out at the outset, and therefore not fully delivering the wider benefits identified for the overall Colwyn Bay frontage.

Accordingly it is suggested that development of a collaborative approach between Conwy CBC, Welsh Government, Network Rail, the Welsh Government Network Management Division and Dŵr Cymru Welsh Water to a point where there is a binding agreement to contribute to the Option 3 works is made, albeit at a date in the future that is mutually acceptable to all parties, before there is a commitment by Conwy CBC to implement the stop gap works, should those funds be available.

GLOSSARY OF TERMS AND ABBREVIATIONS

A55	North Wales Expressway National Trunk Road
APE or (APO)	Annual Probability of Exceedance or (Annual Probability of Occurrence) in relation to tide levels
CBWP	Colwyn Bay Waterfront Project
CCBC	Conwy County Borough Council
CEUK	Coastal Engineering UK Ltd
CRMP	(Welsh Government's) Coastal Risk Management Programme
DCWW	Dŵr Cymru Welsh Water
FCERM	Flood and Coastal Erosion Risk Management
Highest Astronomical Tide - (HAT)	The highest tide level predicted to occur under any combination of astronomical conditions.
HRW	HR Wallingford
Mean High Water Spring Tide - (MHWST)	The average height of high waters occurring at the time of spring tides.
NMWTRA	North and Mid Wales Trunk Road Agency
NR	Network Rail
NRW	Natural Resources Wales
ODN	The vertical height or level of a feature or tide level relative to the Ordnance Datum, Newlyn
Overtopping	The passage of water over the crest level of a shoreline structure or natural feature
Return Period	The average predicted time period over which an event of given magnitude will occur e.g. 1 in 20 years. Usually used in relation to the occurrence of specific still water levels or wave heights and periods.
Rock armour	Quarried stone commonly used in coastal defence works
SMP	Shoreline Management Plan
Spring Tide	Tides of highest range occurring twice a month, when the moon is new or full.
SP	Scottish Power
SRA	Strategic Regeneration Area
Topography	The arrangement of the natural and artificial physical features of an area e.g. beach or dunes.
UKCP	United Kingdom Climate Projections
WCB	Whole Circling Bearing. The angle in relation to north, clockwise from north.
WG	Welsh Government
Wave Height	The vertical distance between the peak and trough of a wave
Wave Period	The time taken for successive peaks or troughs in a wave train to pass a fixed point

1. INTRODUCTION & BACKGROUND

The report presented here has been commissioned by Conwy County Borough Council (CCBC) to investigate and review options for implementing the third phase of the proposed Colwyn Bay Waterfront Project (CBWP), which commenced in 2011, and to examine potential arrangements to move the project forward with regard to partnering with key stakeholders to deliver the project.

The report comprises the following sections:

- Background to the development of the CBWP and progress to date;
- Definition of the current conditions applying across the Phase 3 frontage;
- Definition and examination of potential options for constructing the proposed works for the Phase 3 frontage;
- A Public Services Impact Review, re-assessing the physical and economic implications of failure of the existing sea wall in the event that works are not carried out based on specific information provided by service providers whose infrastructure is currently protected by the existing coastal defences;
- Examination of arrangements for collaboration and suggested way forward to deliver the project.

A location plan showing the Waterfront frontage (in red box) is provided in Figure 1.

1.1 BACKGROUND

The Colwyn Bay coastline between Rhos Point and Tan Penmaen Head is approximately 3.5 km in length. Defences were constructed for much of the coastline in the late nineteenth century and in general comprised vertical seawalls in either masonry or concrete.

As a result, during the 20th century, the frontage experienced a gradual lowering of beach levels in front of the defences requiring ongoing maintenance and repairs to the toe of the defences to ensure their integrity and stability. Groynes that were constructed in response to beach lowering, to retain the wide sand beach, ultimately failed or became redundant due to a lack of ongoing maintenance. As a result, the foreshore was typically a shallow gradient, variably thin, sandy beach overlaying fluvio-glacial sands, gravel and glacial tills. To the rear of the foreshore adjacent to the seawalls, there was some sand, shingle and cobbles that were the remains of the original shingle ridge on which the defences had been built and which now formed a narrow upper beach in places.

In the late 20th century specific localised works were carried out to extend the life of the existing sea walls and control movement of the beach. This included a 650m rock revetment along the worst affected stretch of seawall constructed in 1987, and a series of low level rock groynes in 1990.

Since the 1990's routine maintenance of the existing structures was carried out to extend their residual life. This has included patch repair of the concrete and masonry walls as well as the addition of protective rock toes and revetment facings in some areas. Emergency works, comprising the addition of further piled and rock toes, were also carried out in several locations along the seawalls, notably at Old Colwyn, in response to the rapid lowering of beach levels following severe storms.

The Colwyn Bay Waterfront project was conceived in 2007 as a result of the Strategic assessment of options for future flood and coastal erosion risk management (Conwy CBC, October 2007).

It was identified at an early stage of the strategic assessment process that merely improving the ageing linear defences alongside improved promenade facilities would not attract people back to Colwyn Bay, as such an approach would not fully address the issue of low beach levels. There was therefore a local determination, with public support, to investigate more innovative solutions and use the improvements to the coastal defences as a catalyst for wider regeneration of Colwyn Bay.

In 2008, the Welsh Government designated the North Wales coast as a Strategic Regeneration Area (SRA). Subsequently, in early 2009, and to give focus and direction to regeneration in Colwyn Bay, Conwy County Borough Council established the Bay Life+ programme which provided the framework for development of the Colwyn Bay Waterfront Project to combine the renewal of coastal defences with

regeneration improvements to the promenade, creating a modern, sustainable and attractive waterfront, which would be an asset to the local community and an attraction for visitors - "*Integrating coastal protection with regeneration delivering innovative solutions and value for money*".

Realising the project relies on obtaining funding from different sources and an integrated approach to funding management through development of a clear vision and programme of for delivery that enables the Council to draw upon different funding as necessary, as the scheme progresses through different phases

Concurrently with development of the Bay Life+ programme, the Council commissioned further studies to establish detailed proposals for elements of the waterfront project, which identified three phases of works, as follows:

- Phase 1: Construction of a terminal rock groyne, the raising of 100 metres of promenade and construction of rock revetment to provide a shoreline promontory, opposite Eirias Park – subsequently denoted Porth Eirias. Also, the importation of approximately 500,000m³ of sand to artificially recharge the beach over approximately 1km of frontage between Porth Eirias and Marine Drive. Associated with this, Phase 1 comprised the erection of a new waterfront building at Porth Eirias and promenade/sea wall regeneration works along this stretch of frontage;
- Phase 2: Comprising the importation of a further 500,000m³ of sand recharge between Marine Drive and Rhos-on-Sea, including modification of the terminal rock groyne on the south side of the harbour and regeneration works to the promenade behind the existing sea wall; and
- Phase 3: Works to raise the promenade and construct approximately 1200 metres of linear rock revetment coastal defence between Porth Eirias and Cliff Gardens, Old Colwyn.

To date the Phase 1 coastal defence and waterfront regeneration works and Phase 2 waterfront regeneration works have been completed at a total cost of £28.6 million.

In late 2018 Welsh Government approval was given, to proceed with the detailed design of the Phase 2b beach recharge and associated works at an estimated cost of £14 million. This work is programmed for construction in 2020-21.

The current estimate for the cost of the Phase 3 works is approximately £34 million, which includes a 30% contingency/estimate bias allowance. There are at present a number of uncertainties relating to conditions behind the existing sea wall that require investigation, the results of which may impact on current cost estimates.



Figure 1: General Location Plan

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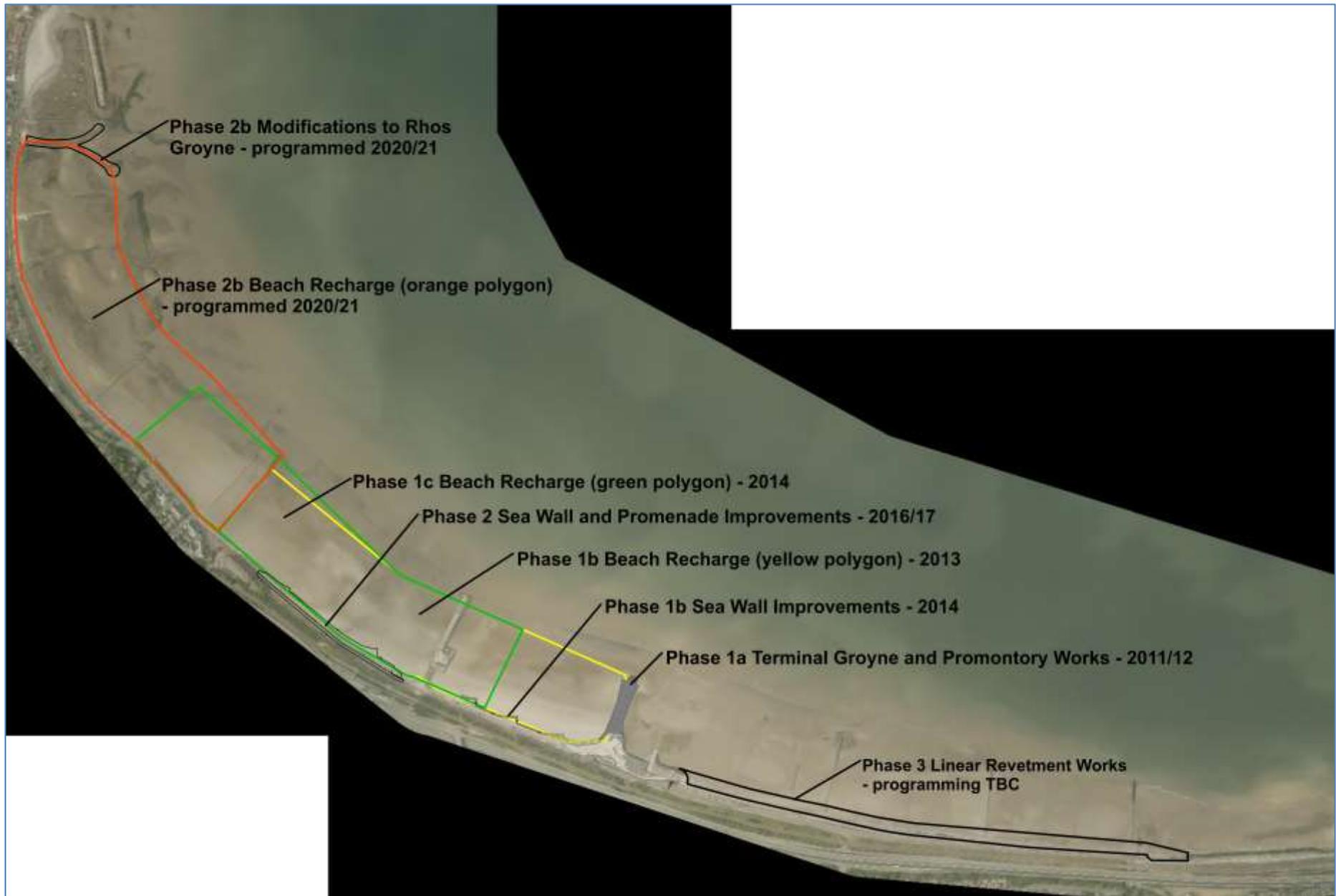


Figure 2: Colwyn Bay Waterfront – Phasing Arrangements (Completed and Future Proposed)

2. PHASE 3 CONDITIONS APPLYING

2.1 EXISTING FRONTAGE DESCRIPTION

The Colwyn Bay Waterfront Phase 3 frontage covers approximately 1km of coastline within the limits shown in Figure 3.

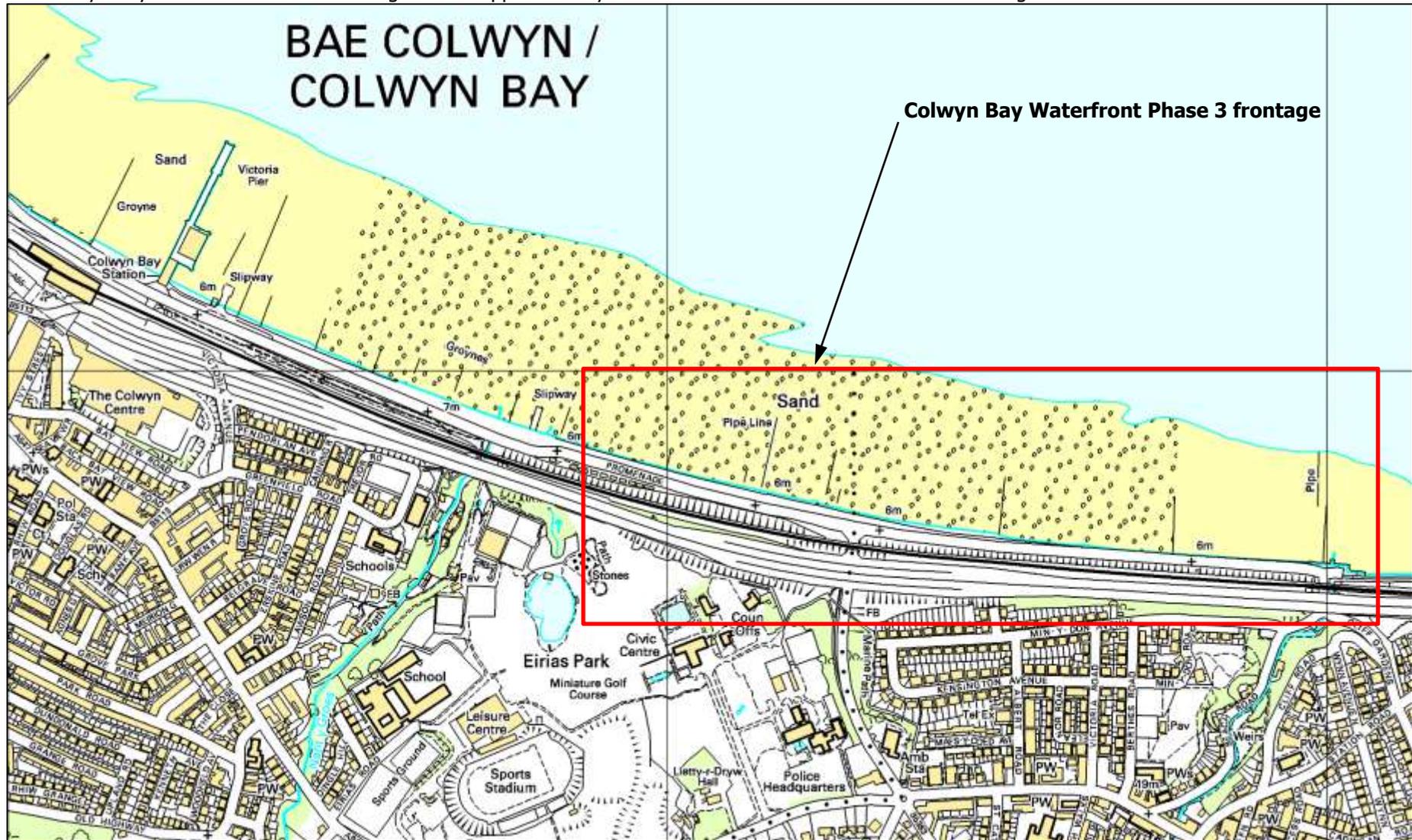


Figure 3: Phase 3 Frontage Plan

(Note Phase 1 works not shown on background mapping, reproduced from the Ordnance Survey Mapping with the permission of the Controller of H.M.S.O. Crown Copyright. Conwy County Borough Council, 100023380, 2019)

The frontage comprises a near vertical masonry sea wall that abuts a generally sandy foreshore, locally mixed, particularly along the toe of the wall, with natural gravels. Across the first 200 metres of frontage the wall has a recurved section running along the crest, at an elevation of approximately 6.1m above Ordnance Datum Newlyn (ODN). The promenade behind is approximately 1.0m lower. Over the remainder of the frontage there is no recurve and the crest level is the same as the promenade (varying 5.1-5.9m, average 5.5m ODN).

The toe of the sea wall has been protected from erosion and undermining by a variety of constructions. Across the first 650 metres west to east, rock armour has been placed directly in front of the wall. Over the remainder the toe has been protected either by reinforced concrete aprons or steel sheet piling.

Immediately landward of the wall is a part paved/part tarmac surfaced dual usage (pedestrian and cycle path) promenade, which adjoins a public highway. Moving west to east, the public highway increases in height to meet the incoming link road from Old Colwyn (Rotary Way) and provide access to the A55 (Junction 22) before dropping down to the same level as the top of the sea wall over the remainder of the length.

To landward of the promenade and highway is the Chester to Holyhead railway line, which is located some 10-15 metres above the highway supported on an embankment. A masonry wall demarcates railway property from the public highway across the entire length. Landward of the railway is the A55 dual carriageway trunk road.

Photographs showing the general arrangement of current coastal defence and promenade/highway infrastructure is provided in Figure 4, running west to east along the sea wall (ref a-i) and east to west along the promenade (ref j-n).

Figure 4: Photographs of Existing Coastal Defences and Promenade





(e)



(f)



(g)



(h)



(i)



(j)



(k)



(l)



(m)



(n)

2.2 **HISTORICAL EVOLUTION**

Examination of historical OS Mapping, carried out for the Colwyn Bay Waterfront Phase 1 Ground Investigation Preliminary Desk Studies Report (Grontmij, August 2010), identifies the following key points in relation to the Colwyn Bay Waterfront Phase 3 frontage:

- Construction of the Chester to Holyhead railway pre-dates the construction of any promenade or coastal defence works across the frontage. The 1878 mapping shows the railway running along an embankment on its current alignment;
- Construction of the promenade had commenced by 1898 and by this time a promenade existed across the majority of the frontage from Penrhos College in the west, to the current location of Rotary Way.
- The promenade was extended eastwards to its current eastern most extents during the first decade of the 20th century and was shown to be complete on the historical map from 1911.
- In places, the promenade appears to have been constructed to the seaward side of the high water mark of medium tides on areas that were formerly beach, indicating that land was reclaimed from the sea. The location and near vertical profile of the wall were contributory factors to the lowering of beach levels in front of the defences that subsequently occurred and the consequent increased exposure conditions that have applied across the frontage to the present day;
- Timber groynes were constructed across the frontage in the 1950's in an effort to stabilize beach levels.

It is not known if the current wall section is the original wall section but the construction suggests it could well be. HR Wallingford's (HRW) Colwyn Borough Sea Defence Review (HR Wallingford, October 1991) identifies that the recurve section at the western end was added in the 1950s and that the first instance of undermining occurred in the 1930s requiring concrete toe extensions and sheet piles which are still visible today (ref Figure 4 (g), (h)). In 1990, a series of longer low level rock groynes were constructed to replace some of the timber groynes between Rhos-on-Sea and Old Colwyn to encourage beach stabilisation and in addition rock armour toe protection was placed in discrete sections. Contemporarily, the following changes have been made:

- Following a storm in February 2005, a new section of sheet pile and concrete toe was installed to the west of the steps between Rotary Way and Beach Rd/Cliff Gardens ((ref Figure 4 (e)), following reductions in beach levels of about 1 metre;
- Following similar beach losses during a further storm in March 2010, rock armour was installed along the toe over approximately 150 metres immediately east of the steps between Rotary Way and Beach Rd/Cliff Gardens (ref Figure 4 (d));

As part of the Phase 1b Waterfront works in 2013, the rock armour toe protection across the eastern half of the Phase 3 frontage was reconstructed to a uniform profile – a 3.5-metre-wide crest at 4.0m ODN and a 1 in 2.5 slope to seaward, utilising existing rock supplemented by imported material as necessary (ref Figure 4 (a)-(d)) and Figure 5.

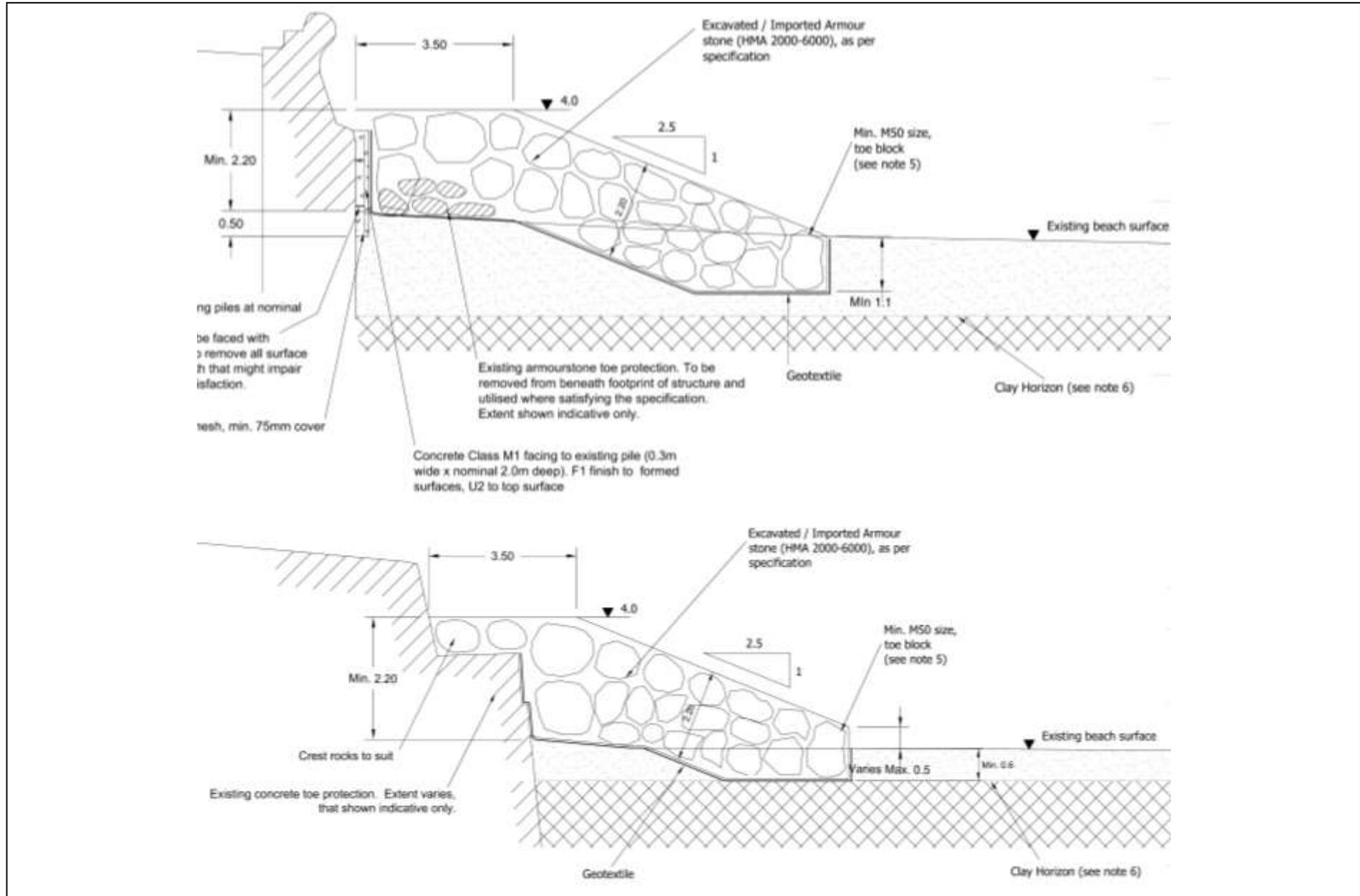


Figure 5: Typical Cross Sections through Existing Rock Armour Protection to Sea Wall

2.3 **CURRENT BEHAVIOUR AND IMPACTS**

The 1991 Colwyn Borough Sea Defence Review identified that "Overtopping, which occurs regularly when onshore winds coincide with spring tides, results in large quantities of shingle and cobbles being thrown over the wall. The road...is closed up to a dozen times a year for several days at a time while the shingle is cleaned back onto the beach".

As identified in section 2.1, the level of the sea wall, where there are existing railings, varies in the range +5.1-5.9m ODN. To put this in context the Mean High Water Spring Tide (MHWST) Level is +4.0m ODN and the predicted Highest Astronomical Tide (HAT) level is +4.6m ODN. Accordingly, on HAT there is only between 0.5 and 1.3 metres of freeboard between the tide level and the top of the wall, even without considering the action of waves.

Current estimates of extreme tide levels for Colwyn Bay (Environment Agency, February 2011), base date 2008, were the predicted astronomical tide level is increased due to meteorological influences e.g. low air pressure, provides the following:

- Tide level with an estimated 10% probability of occurrence in any year = 5.15m ODN;
- Tide level with an estimated 2% probability of occurrence in any year = 5.35m ODN;
- Tide level with an estimated 0.5% probability of occurrence in any year = 5.49m ODN;

In addition to the above wave conditions defined as part of the Colwyn Bay Waterfront modelling studies (Royal Haskoning, July 2010), identified that on a HAT tide, waves approaching the shoreline could, due to low beach levels applying, be up to 3.0 metres in height.

Furthermore, with sea levels predicted to rise in the future, due to anticipated climate change, medium estimates of predictions are that the above tide levels will be at least 0.3 metres higher by the middle of the century and 0.7 metres higher by the end of the century (UK Climate Projections User Interface, 2019). Accordingly, under these scenarios, by the end of the 21st century the tide will reach at or about the crest of the wall on each spring tide i.e. every 2 weeks and the wall along the toe of the railway embankment would be impacted by waves rather than water that overtops the sea wall, as at present.

The impact of present day conditions is shown in visual and recorded evidence from more recent storm events - February 2005, March 2007, March 2010, December 2013, December 2016, December 2017, February/March 2018, January 2019 etc, which confirms the overtopping behaviour identified by HRW but also identifies the following as taking place:

- Damage/Loss of Railings;
- Damage to promenade/highway surfacing and removal of fill behind sea wall;
- Damage to boundary wall and erosion at toe of railway embankment;
- Lowering of beach levels in front of the wall;
- Undermining of sea wall and
- Removal of facing blocks to the sea wall.

These impacts are shown in Figure 6. Typical behaviour during a storm can be seen by clicking on the following link [Old-Colwyn-Promenade-Storm](#).

Figure 6: Examples of Current Behaviour



Typical overtopping on spring tide (March 2013)



Damage to railings



Damage to promenade surfacing



Damage to NR boundary wall and embankment



Reduction in beach levels in front of wall



Sea Wall Undermining



Loss of Blocks to Sea Wall

2.4 RISK ASSESSMENT

2.4.1 Assets Protected

The current sea wall provides protection to the following assets located in the hinterland:

1. The pedestrian promenade and designated cycle path, which is part of the National Cycle Network Route 5;
2. The public highway, linking Old Colwyn to Rhos-on-Sea;
3. The Chester to Holyhead railway embankment and line;
4. The A55 trunk highway; and
5. Utilities services buried underneath the promenade or highway surfacing.

The relative location of assets (1) to (4) is shown in Figure 7.

Information obtained from Utilities service providers has identified the following with regard to services that are located underneath the promenade and highway.

- There are a number of Dŵr Cymru Welsh Water (DCWW) underground sewerage services running beneath the promenade and highway along the frontage:
 - A 450mm dia. vitrified clay combined sewer that feeds into a 600mm dia. concrete sewer at location SH86785702. This runs under the highway along the entire Phase 3 length;
 - A 900mm dia. concrete combined sewer that feeds into a 1500mm dia. sewer at location SH86781900. This runs under the seaward promenade/cycle path along the entire Phase 3 length before turning landward at location SH85788895 and feeding into the above 600 dia. pipe. At location SH86786702 it moves from the landward edge of the promenade to closer to the sea wall;
 - A surface water service from the highway crosses under the promenade and outfalls through the sea wall at location SH86785711
 - A 450mm dia. concrete foul service runs down Rotary Way and connects into the 600mm dia. concrete combined sewer at the junction with the promenade highway;
 - A 900mm dia. concrete surface water service runs parallel to the foul sewer down Rotary Way before turning west at the junction with the promenade highway. From here there are three separate services located parallel to the two combined sewers:
 1. A 900mm dia. concrete pipe runs parallel (on the seaward side) to the 600mm dia. combined to location SH86781780 before turning seaward and outfalling through the sea wall;
 2. An 1800mm dia. concrete pipe crosses the 600mm dia. combined then runs parallel (on the landward side) before joining the 600mm dia. combined; and
 3. A 1200mm dia. concrete pipe runs parallel (on the seaward side) to the 900mm surface water service (ref 1) before crossing it and then also joining the 600mm dia. combined
 - A 300mm dia. vitrified clay foul service runs diagonally SE to NW under the A55 and railway embankment before joining the 600mm dia. combined service at location SH86780801.
- There is a Low Voltage underground Scottish Power (SP) service running along the landward promenade footpath to just west of Rotary Way where it crosses over to the seaward footpath for the remainder of the frontage before moving inland under the railway embankment and A55 at Beach Rd/Cliff Gardens. In addition, there is a spur about halfway between Rotary Way and Beach Rd/Cliff Gardens that runs under the railway embankment and A55 connecting to the housing estate at Min-Y-Don;
- There are street lighting and illuminated signs located along the frontage, which are fed from the SP service, which are the responsibility of Conwy CBC;
- There are no Openreach services located underneath the promenade and highway;
- There are no Gas services located underneath the promenade and highway;

Plans showing the arrangement of the SP and DCWW services are provided in Appendix I. The depths of these services are presently unknown.



Figure 7: Location of Assets Protected

2.4.2 Existing Conditions

Sea Wall

As identified in Section 2.1 above the existing masonry block wall forms the main body of the coastal defence. There is presently no specific information relating to the exact construction of the wall but it is reasonable to assume that the wall is of a similar construction to others built in the locality at the same time (ref Figure 8).

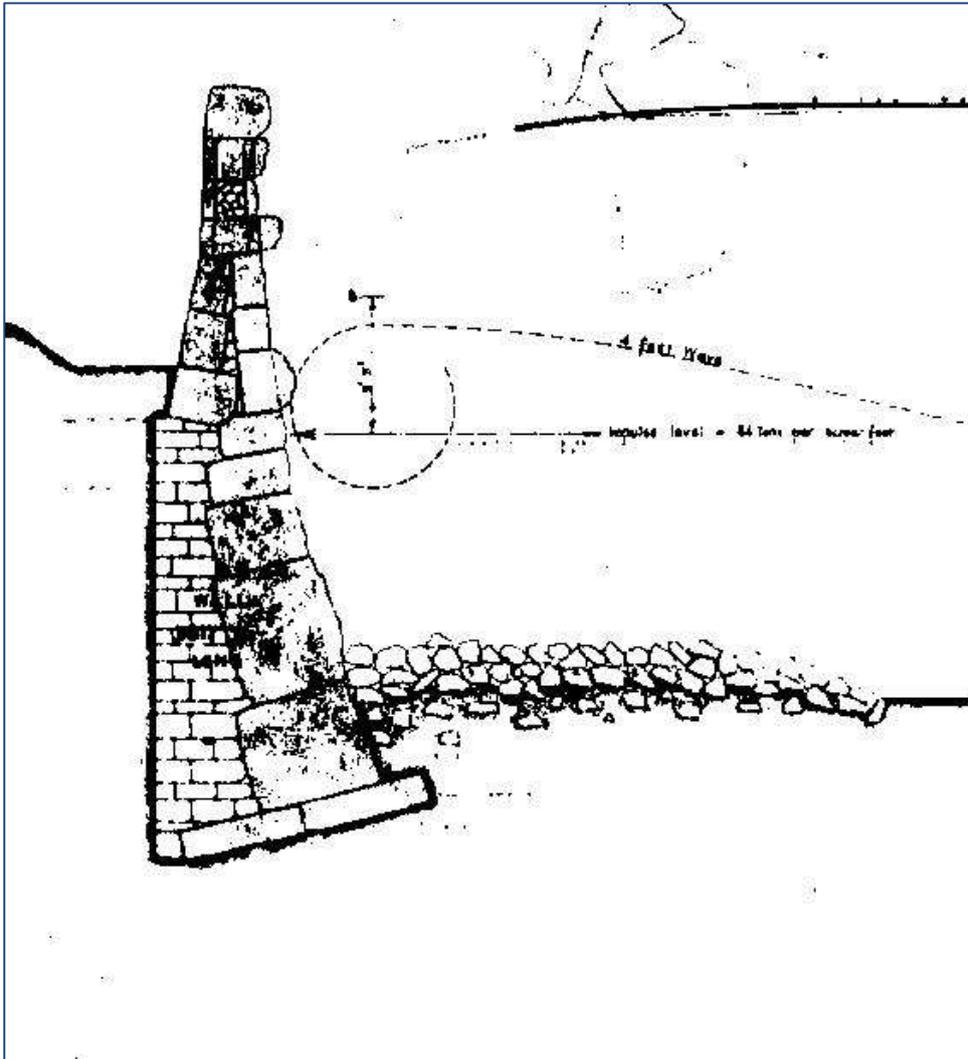


Figure 8: Typical late 19th/early 20th century Masonry Wall Construction (ex LMSR)

In 2010, prior to commencement of Phase 1 of the Colwyn Bay Waterfront Project, a structural condition assessment of the existing walls was undertaken (Mott MacDonald, September 2010). Overall this identified the existing walls along the Phase 3 frontage as being generally in poor condition with numerous defects noted.

With regard to structural stability, the report identified the following:

- Undermining of seawalls foundations is more likely due to falling beach level providing less scour protection to the seawall base. This will not only increase the risk of the actual wall collapsing but also could cause the road or footpaths along the promenade to collapse, because the backfill material from behind the wall could be washed out;
- The passive resistance of the seawall is being reduced by toe erosion; therefore the seawalls susceptibility to sliding failure has increased;

- The retained height is increased by toe erosion; therefore the lateral earth pressure acting on the seawall has increased due to the height being squared, thus the moments are significantly amplified due to the lever arm increasing. Therefore, the seawalls overall susceptibility to overturning failure is significantly greater.
- Where steel sheet piles have been installed with an upper portion of concrete encasement. Once the beach level falls below the upper concrete encasement, then the rate of steel degradation will be higher than originally considered because the steel is exposed to direct cyclic wetting by sea water with tidal fluctuation and is subjected to direct abrasion by foreshore particles driven into contact with the steel by tide and wave currents.
- Where steel sheet piles have been installed for additional sliding resistance and scour protection, once the beach level has fallen below the underside of the concrete foundation, the sheet piles are induced to additional lateral earth pressure and bending moments. This will increase the stresses in the steel piles, possibly above the intended recommended working stresses, which will also accelerate the corrosion rate.

Additionally, toe erosion has had a detrimental effect on the sea defending capacity of the seawall due to the following reasons:

- The falling beach level has exposed a greater vertical extent of wall which can be impacted from direct wave action. Therefore, the risk of instability has increased because the total load has escalated.
- Toe erosion could lead to the backfill material behind the seawall being washed out. This would compromise the passive resistance of the seawall to withstand wave action; therefore, the risk of collapse would be increased.
- If toe erosion has also lowered the slope of the approaching beach, the dissipation of energy from the waves will have decreased, which will have increased the wave force on the seawall. Additionally, the greater reflective extent of wall will cause further accelerate toe erosion.

As identified in section 2.2, since then formal rock armour has been placed across the western half of the phase 3 frontage, which provides additional passive resistance in front of the wall, dissipates some of the wave energy decreasing loading on the wall and provides a better interface between the defences and the beach, reducing scour at the toe.

Notwithstanding the above there is still a significant length of wall at the eastern end, where the risks to wall integrity identified in 2010 remain.

Ground Conditions

Behind the wall past ground investigations provide some information as to the likely conditions that exist. Two borehole records have been identified.

Firstly, a borehole recorded in 1973, prior to construction of the A55 junction at Rotary Way, in the location of what is now the westerly ramp up to the junction but what was then in the landward verge behind the promenade highway. This identified below the topsoil of the verge, approximately 3.5 metres of brown sand and fine gravel with bands of clay to +2.5m ODN. Below this was a further 4.5 metres of red-brown sand with a trace of gravel. The borehole terminated at approximately -2m ODN.

In 2010, as part of the ground investigation works for Phase 1, a borehole was sunk in the promenade behind the sea wall, approximately 160 metres west of the Phase 1/Phase 3 boundary. This identified below the tarmac surfacing, approximately 4 metres of made ground to +1.34m ODN, comprising dark brown sandy gravel with low cobble and boulder content. Below this was a further 4 metres of medium dense dark brown silty sand to -2.6m ODN, 0.2 metres of brown gravel and 4 metres of dense orange brown very silty gravelly sand brown, to -4.8m ODN. Below this was 3.4 metres of very stiff thickly laminated dark brown slightly sandy gravelly clay, overlying the mudstone bedrock at -8.2m ODN.

Also, in 2010, a Groundcheck® geophysical survey of approximately 220 metres of promenade between Rotary Way and the next set of beach access steps to the east (Zetica Ltd, May 2010). The objective of

the survey was to locate areas of potential voiding and loosely compacted fill within the sea wall, associated with washout of material from the base of the wall during the storms in March 2010.

The survey identified a number of localised anomalies that were potentially indicative of wash out of fill materials from the base of the sea wall. The most significant areas of disturbance were identified within the area adjacent to what was then the western end of the rock toe support, centred on grid reference 286446E, 378750N and within the central area of the site centred on grid reference 286501E, 378744N. The survey results are summarised in Figure 9.

The report recommended that a selection of the identified anomalies be investigated further through a targeted drilling or trial pitting program and identified suggested exploratory positions.

In summary, boulder clay is visible from time on the beach directly in front of the defences, notably after storms when the mobile sediments have been stripped away by wave action. Based on the above evidence it is likely that these are just lenses of clay rather than clay horizon.

Overall the backing to the wall comprises a mixture of made ground and glacial material, with evidence that there may be intermittent voids present. If the sea wall was to fail or damage of the surfacing led to exposure of this made ground, exposure to on-going tide and wave action would, it is suggested, lead to rapid erosion.

Draft

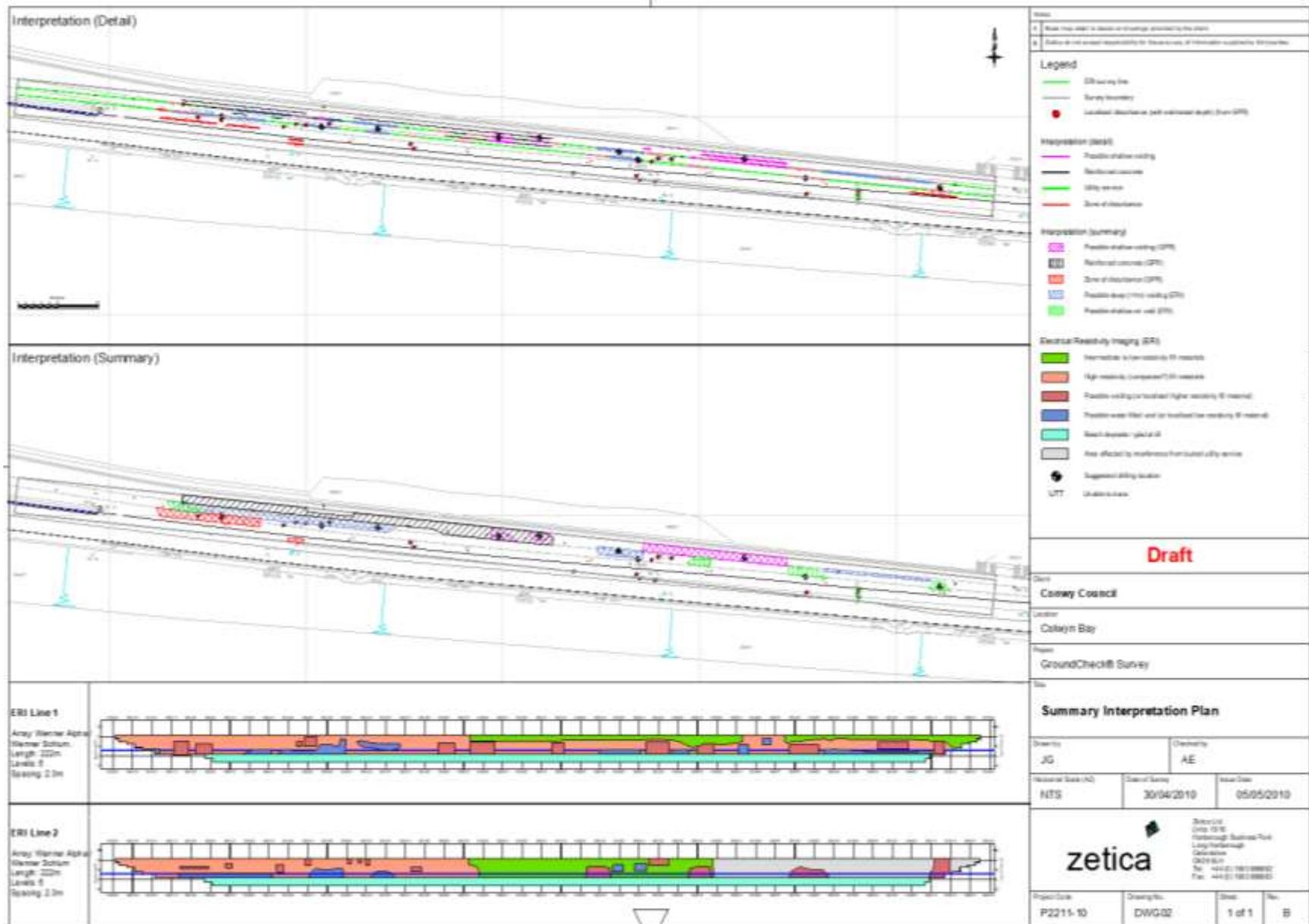


Figure 9: Groundcheck Survey Summary Results
 (Zetica Drawing P2211-10DWG02-B -Summary Interpretation Plan)

2.4.3 Future Behaviour

Assessment of what would happen to the sea wall in the absence of any further investment in the coastal defences forms part of the overall project appraisal and development of the business case for investment presented to Welsh Government, in support of grant aid.

Two baseline conditions are examined in this respect:

1. The 'Walkaway' scenario, formerly known as 'Do-Nothing', in which no further capital or maintenance investment is carried out on the defences; and
2. The 'Business as Usual' or minimum investment scenario, in which the Council continues its current management regime. In this case it would involve regular monitoring and reactive maintenance, of the sea wall and promenade, generally following storm damage.

Effectively the second of these is just an option that delays the onset of Option 1, by effectively applying a 'sticking plaster' to the defences until such time that the approach is unsustainable in economic or operational terms.

It is against these two cases that options for increased investment are judged.

For the Colwyn Bay Waterfront project, the investment case has been made and accepted on a bay wide basis, not a phase by phase basis.

Following completion of the Colwyn Bay Coastal Defence Strategy in 2007, a preliminary project Appraisal was produced (Coastal Engineering, August 2008) which identified, from then available information, what would happen in the event of no further investment in the coastal defences at Colwyn Bay. Table 2.1, reproduced below identifies the predicted timeline of effects, assessed at the time.

Term	Years	Predicted Behaviour
Immediate	2007-2012	<ul style="list-style-type: none"> • Overtopping of defences causing damage to structures and temporary closure of the promenade to traffic
Short	2013-2027	<ul style="list-style-type: none"> • Overtopping of defences causing damage to structures and temporary closure of the promenade to traffic • Initial failure of the defences leading to immediate closure of the promenade to traffic from Toad Hall to Beach Road, Old Colwyn (years 10-20)
Medium	2028-2057	<ul style="list-style-type: none"> • Continued overtopping of intact defences • Erosion of embankment supporting the railway and closure of the railway (year 30-40) • Gradual longshore and inshore spread of recession leading to failure of more lengths of defences • Potential loss of a number of properties along the front between the Pier and Cayley Promenade (year 40-50) • Probable detachment of the pier from the shoreline (year 50)
Long	2058-2107	<ul style="list-style-type: none"> • Continued overtopping of intact defences • Loss of the A55 (year 50-60) • Further longshore and inshore spread of recession leading to failure of more lengths of defences • Loss of a number of properties in the centre of Colwyn Bay and along the front between the Pier and Cayley Promenade (year 50-100)

In 2010, utilising additional data collected, including the structural condition assessment, the preliminary PAR was updated as part of the formal submission to Welsh Government for Grant Aid (Mott MacDonald, October 2010) with the following future behaviour assessment provided:

"The recession lines from the Draft PAR have been updated on the basis of a greater understanding of the frontage developed from new studies including the SMP2, modelling reports and ground investigations. The existing defences are considered to have failed in Year 5. After this, it can be anticipated that the ground behind will quickly suffer the effects of washing out as it comprises mainly made ground under the

existing promenade and road. Access along the promenade road for traffic, and hence access to a number of residential and commercial properties will be prevented. It is assumed that this also occurs in Year 5 as once the defences have failed the promenade and promenade road cannot be considered safe for use. The railway embankment to the rear of the promenade road comprises earthworks and is therefore vulnerable to the effects of inundation and erosion following the collapse of the promenade and promenade road. This is therefore considered to be unsafe for use once the coastline has reached within 5.0m of its base. It is considered that this will be in Year 10. From Year 20 onwards, the new erosion rate presented for Colwyn Bay in the SMP2 of 0.3m per year until Year 50 and then 0.7m per year from 50-100 has been applied. This results in the loss of the A55 in Year 55”.

The above forms the basis for the overall justification for all three phases of the Waterfront Project.

With the construction of phase 1 of the Waterfront project there would be some modification of the above, considering Phase 3 on a stand-alone basis. However, notwithstanding this, given that there has been no change in conditions applying across the eastern half of the phase 3 frontage, the risks associated with the defences remain as previously identified and outlined above i.e.

- Regular overtopping of defences causing damage to the sea wall structures and promenade surfacing, exposing fill material, requiring temporary closure of the promenade to traffic in the first instance and, if repairs cannot sustainably be carried out, total closure of promenade access to pedestrians, cycles and vehicles (including emergency services);
- Failure of defences arising from storm damage, with damage spreading rapidly longshore;
- Loss of utilities' services buried beneath the promenade;
- Loss of boundary wall and erosion of the embankment¹ and bridges supporting the railway leading to closure of the railway; and
- Loss of access/egress to the A55 from the promenade; and
- Loss of the A55. The area where there is the greatest risk to this will be at the eastern end where the bridge supports are immediately to landward of the railway bridge (ref Figure 10 (R) below).

Figure 10: Existing Highway Gates



(L) Promenade/Rotary Way Junction

© Google Maps



(R) Promenade/Cliff Gardens Junction

Current CCBC Management Arrangements

The current actions undertaken in relation to managing the coastal defences and the risk to hinterland assets and the general public are as follows:

- Regular monitoring of beach topography;

¹ It should be noted here that whilst Network Rail routinely carry out asset inspections in relation to the condition of the embankment down to the boundary wall with the highway, it must be recognised that failure/breaching of the sea wall would lead to an instantaneous loss of support to this embankment and potential rotational failure of the embankment which would compromise the operation of the railway.

- Use of NRW flood warning system to close the public highway between Rotary Way and Beach Rd/Cliff Gardens, using the existing gates (ref Figure 10);
- Proactive maintenance of railings, sea wall and promenade identified during quarterly coastal defence asset inspections by Authority staff;
- Reactive maintenance to damaged railings, sea wall and promenade surfacing following storms, including provision of additional toe works as necessary e.g. as carried out in 2005.

CCBC have a current operational procedure in relation to managing the risk to promenade users from high tides and or damage (Conwy CBC, May 2017), the key elements of which are summarised below:

- The trigger conditions for potential closure of the promenade is a tide level of 3.9m ODN or greater, which typically is predicted to occur for periods of up to 7 days at a time, 1-2 times per month, concurrently with strong onshore winds, from directions NW to NE.
- Following review of the data the decision for closure is taken by Council staff from the Flood Risk and Infrastructure (FR&I), Open Spaces (OS) and Harbourmaster (HM) departments. County Councillors for the immediate location are informed directly and CCBC's marketing department inform the general public via social media.
- The road barrier at Cliff Gardens is closed first, followed by a walk through the Promenade length to inform remaining cars, followed by closure of the road barrier at Rotary Way junction.
- When the high tide has passed, an inspection of the coastal defence is carried out by FR&I to record condition and to ensure that the promenade is safe to re-open. Any debris thrown up onto the Promenade during the storm is cleared before re-opening.
- County Councillors for the immediate location are informed directly and CCBC's marketing department inform the general public via social media that the promenade has been re-opened.

During autumn and winter seasons when there are consecutive days of high tides and onshore winds, or when repairs are required following storm damage, the promenade can remain closed for a few days or longer at a time.

In the near future, it is highly likely that a decision will have to be made as to whether to continue to carry out repairs and should the decision be that repairs will not sustain the defences further then a decision to permanently shut the promenade, with the associated consequences for general users and, particularly the emergency services, would have to be made.

2.4.4 Wider Impacts of Lack of Investment

As well as the specific local impacts on infrastructure identified above there are wider local, regional and national impacts that the failure of the defences would have.

Both the Chester to Holyhead railway and the A55 are of regional and national importance in the conveyancing of both freight and passengers to/within North Wales, both commercially and from a commuter/tourism/amenity perspective.

Both of these pieces of infrastructure provide a significant link between the UK and the Republic of Ireland, with Holyhead the 3rd ranked port in Wales for tonnage of freight handled (3 million tonnes per annum in 2012). At that time there were over 8,000 average daily HGV/LGV traffic movements on the A55 near Colwyn Bay and over 6,000 on the same road to the west near Bangor, contributing approximately 20% of all traffic movements on the A55 (ref Figure 11).

The Chester to Holyhead railway provides an important route for passengers with hourly direct or connecting services to/from London Euston via Chester as well as commuter routes connecting the North Wales coast to the urban conurbations of Liverpool and Manchester particularly. The railway is also an

important freight asset with up to four trains a day transporting ballast, from the quarry at Penmaenmawr, through Colwyn Bay for use on the UK rail network.

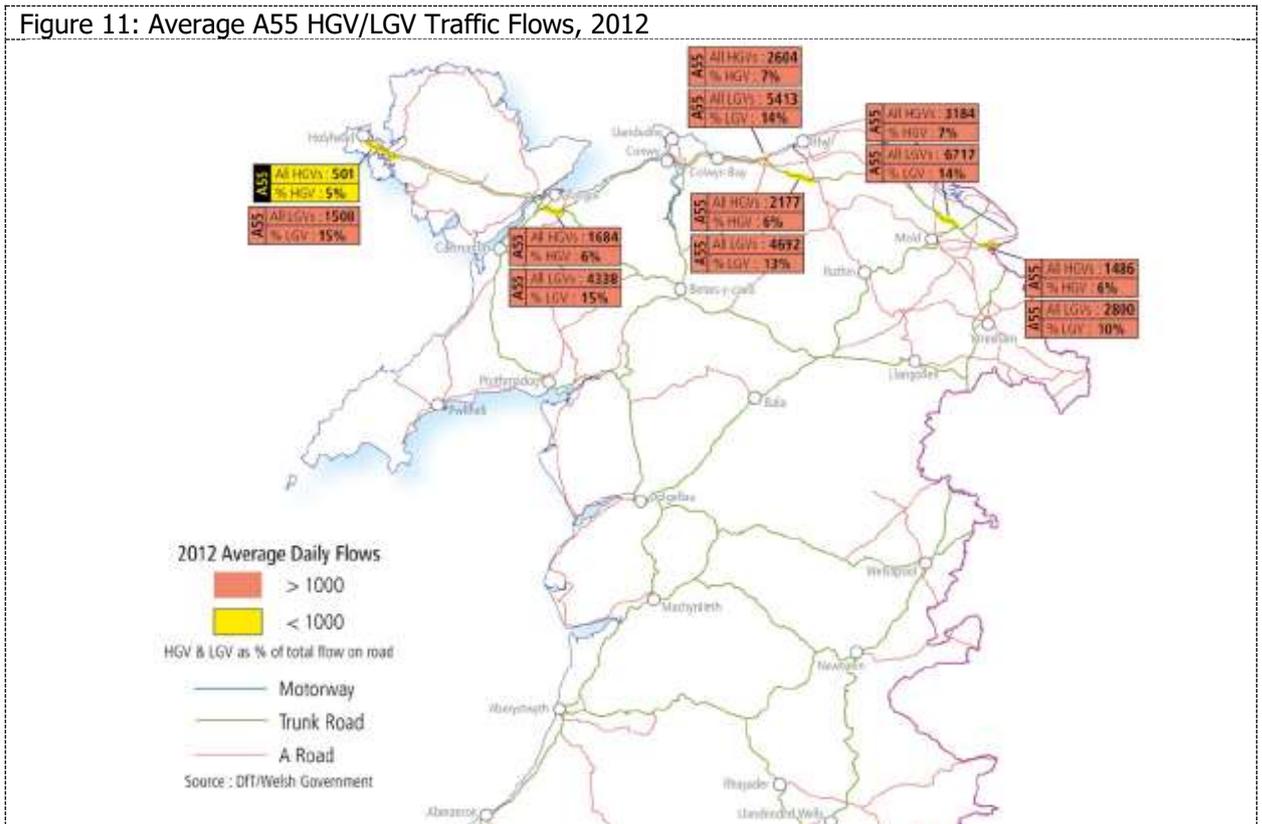
Tourism is a major factor in the economy of North Wales and tourists coming into the area predominantly use the railway or the A55. In 2017, the Conwy Borough attracted 6.71 million tourism day visitors (STEAM data 2017) with associated annual expenditure of over £200 million. More than 60% of this expenditure is associated with the wider Llandudno, Colwyn Bay and Conwy area, all of which require access to be gained through Colwyn Bay.

In 2014 an estimated 90,000 people commuted from Wales into England on a daily basis, whilst this covers the whole of Wales, thousands of people in North Wales are estimated to use the railway and A55 for this purpose, as well as people making the reverse journey.

In April 2012 the MV Carrier grounded on the coastal defences which protect the A55 at Llanddulas to the east of Colwyn Bay necessitating the A55 to be closed in both directions for over 24 hours. The disruption this caused in terms of clogging up local roads and increased journey times had a significant effect on both the local population and the movement of freight vehicles.

It is clear from the above that any disruption to the A55 and/or the North Wales coast railway will have a significant economic impact on both the local community as well as the wider regional economy of the area and accordingly it is considered imperative that solutions are found to fund such works that safeguard the present coastline and the infrastructure located behind it.

Figure 11: Average A55 HGV/LGV Traffic Flows, 2012



3. PHASE 3 ARRANGEMENTS

3.1 OBJECTIVES

The primary objectives associated with the Phase 3 element of the Colwyn Bay waterfront project are:

- To limit overtopping of the existing defences to appropriate levels commensurate with the primary hinterland receptors;
- To mitigate the risk of failure of the coastal defences and the erosion of the shoreline that would take place without on-going shoreline management;
- To safeguard the utilities, rail and transport infrastructure at risk from damage resulting from overtopping and/or erosion;
- To regenerate the promenade area and provide improved amenity commensurate with the overarching waterfront regeneration plan.

3.2 HYDRAULIC PERFORMANCE

The Colwyn Bay Waterfront modelling work undertaken included flume modelling of new linear defences (Royal Haskoning, July 2010) that would reduce overtopping to acceptable limits in relation to the primary hinterland receptors, pedestrians, cyclists and vehicles, in accordance with then best practice guidance (EurOtop, August 2007) and at the same time provide opportunities for promenade regeneration in accordance with the project objectives.

Suggested allowable overtopping parameters identified in the current version of EurOtop (EurOtop, 2018) in relation to the primary hinterland receptors are provided in Table 3.1 below, with criteria applicable to the Phase 3 frontage are highlighted.

Hazard type and reason discharge	Mean discharge (q) (l/s/m)	Max Volume Vmax (l/m)	
Overtopping limits for Pedestrians			
People at structures with possible violent overtopping, mostly vertical structures	No access should be permitted	No access should be permitted	
People at seawall / dike crest. Clear view of the sea.	H _{m0} = 3 m	0.3	600
	H _{m0} = 2 m	1	600
	H _{m0} = 1 m	10-20	600
	H _{m0} < 0.5 m	No limit	No limit
Overtopping limits for Vehicles			
Cars at seawall / dike crest, or railway close behind crest	H _{m0} = 3 m	<5	2000
	H _{m0} = 2 m	10-20	2000
	H _{m0} = 1 m	<75	2000
Highways and roads, fast traffic	Close road before debris in spray becomes dangerous	Close road before debris in spray becomes dangerous	
Overtopping limits for Property behind defence			
Building Structure Elements	H _{m0} = 1-3 m	≤1	<1000
Damage to equipment set back 5-10m		≤1	<1000
Note			
Calculated overtopping is in reality zero when value is less than this figure	H _{m0} = 1 m	0.03	
	H _{m0} = 3 m	0.16	
	H _{m0} = 5 m	0.4	
	H _{m0} = 7 m	0.6	

The modelling examined a series of eight different defence profiles under a range of 19 different tidal and wave combinations (with annual probabilities of occurrence between 1% and 10% - equivalent to return periods of 1 in 10 to 1 in 100years) from which an optimum preferred profile was identified, in terms of wave overtopping performance, structural stability and other wider frontage objectives – amenity, regeneration etc. This profile is shown in Figure 12. As well as the coastal defences as detailed, this option would require raising of the highway and associated ancillary works level across the frontage

For the purposes of comparison of the proposed works with the conditions currently applying, EurOtop equations were used to provide an estimate of the overtopping that currently takes place across the Phase 3 frontage, with the results as detailed in Table 3.2 below.

Scenario	Nearshore Wave Conditions ²			Mean Wave Overtopping Discharge q (l/s/m)		
	Water Level (m ODN)	Inshore Wave Height Hmi (m)	Peak wave Period Tp (Secs)	Phase 3 Design Profile	Existing ³ (Wall only section)	Existing ² (Wall with rock toe)
TC9	4.80	2.4	12.1	0.02	319.74	204.66
TC10	4.80	2.8	11.6	0.09	372.21	238.24
TC11	4.80	3.3	11.5	0.30	433.94	277.75
TC12	4.80	3.4	12.0	0.44	471.57	301.84
TC17	4.80	2.4	8.6	0.02	212.27	135.87
TC18	4.80	3.2	12.8	0.26	482.19	308.64
TC13	5.80	1.6	6.6	0.00	484.81	211.10
TC14	5.80	1.8	6.6	0.00	561.94	246.09
TC15	5.80	2.3	6.8	0.05	413.72	347.98
TC16	5.80	2.6	6.6	0.15	460.82	387.59
TC19	5.80	2.4	8.5	0.05	552.98	465.11
TC20	5.80	2.6	11.0	1.26	800.49	673.29
TC21	5.80	3.2	11.8	5.34	1042.69	877.01
TC22	4.30	2.5	8.9	0.02	133.81	56.94
TC23	4.30	3.0	12.3	0.07	254.67	108.37
TC24	4.30	3.4	12.1	0.17	281.49	119.78
TC25	5.30	1.5	7.0	0.00	169.29	91.11
TC26	5.30	2.7	11.3	0.20	556.99	423.52
TC27	5.30	3.1	12.1	0.59	696.16	529.34

The above shows that the new works proposed provide a significant improvement that accords with current guidance and would significantly reduce the overtopping taking place.

Reference to the existing conditions shows that for all the conditions modelled there would be significant overtopping taking place that would swamp the promenade and highway, as witnessed by the observations that have been made during storm events.

However to examine what level of overtopping could be expected during normal tide conditions and coincident waves under existing conditions, EurOtop calculations were run for a Mean High Water Spring Tide (MHWST) - 3.85m ODN - and a Highest Astronomical Tide (HAT) - 4.60m ODN - which occur on a fortnightly basis and typically twice yearly frequency respectively, in combination with a number of the

² The wave conditions for the existing conditions were transformed from the model location used in the physical modelling studies to a point at the toe of the existing defences using the one-line wave transformation model - Swan One - (Delft, TU, n.d.)

³ The crest level used in these calculations is the average level applying of 5.66m ODN (range 5.1-5.9m ODN).

lower wave conditions used in the physical modelling, which represent conditions that would be expected to occur a number of times in any year. These results are provided in Table 3.3 below.

Scenario	Nearshore Wave Conditions ⁴			Mean Wave Overtopping Discharge q (l/s/m)		
	Water Level (m ODN)	Inshore Wave Height H _{mi} (m)	Peak wave Period T _p (Secs)	Phase 3 Design Profile	Existing (Wall only section)	Existing ⁵ (Wall with rock toe)
MHWST1	3.85	1.6	6.6	NC	18.09	NC
MHWST2	3.85	1.8	6.6	NC	28.96	NC
MHWST3	3.85	2.3	6.8	NC	89.71	NC
MHWST4	3.85	2.6	11.0	NC	177.14	NC
MHWST5	3.85	3.2	12.8	NC	248.07	NC
HAT1	4.60	1.6	6.6	NC	49.11	28.09
HAT2	4.60	1.8	6.6	NC	69.59	39.80
HAT3	4.60	2.3	6.8	NC	175.39	100.31
HAT4	4.60	2.6	11.0	NC	312.39	178.66
HAT5	4.60	3.2	12.8	NC	418.20	239.18

These results confirm that even under typical tide and wave conditions, the overtopping experienced across the frontage under present defence conditions is in excess of the appropriate values for the primary hinterland receptors (ref Table 3.1).

⁴ The wave conditions for the existing conditions were transformed from the model location used in the physical modelling studies to a point at the toe of the existing defences using the one-line wave transformation model - Swan One - (Delft, TU, n.d.).

⁵ Values not calculated by EurOtop when the water level is below the crest level of the armour toe.

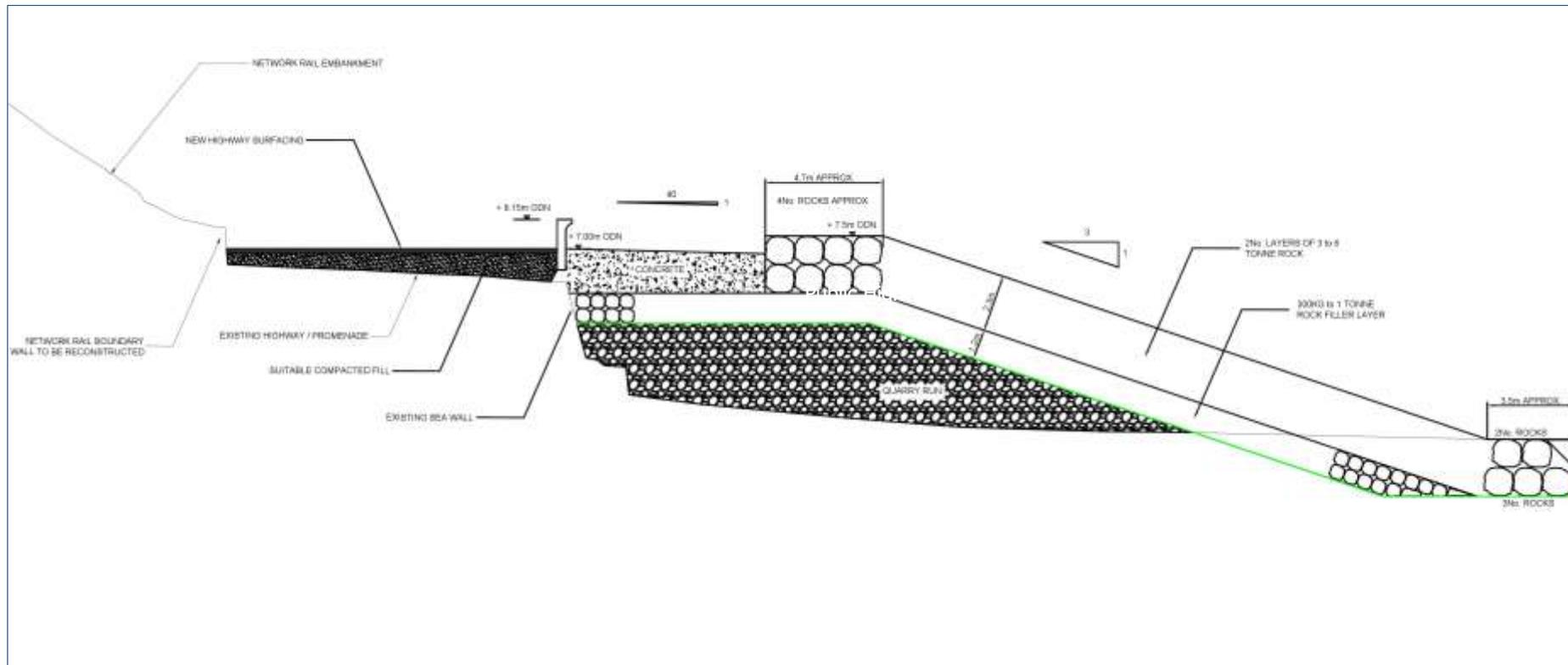


Figure 12: Typical suggested Phase 3 concept design defined from physical model tests

3.3 DEFENCE OPTIONS

3.3.1 Strategic Context

The current Shoreline Management Plan (SMP2), which includes the CCBC shoreline east of the Great Orme at Llandudno, was completed in 2010 and subsequently adopted by CCBC (Halcrow, July 2010).

In the SMP2 Colwyn Bay is located within policy unit 11a PU2.2 – Rhos-on-Sea to Llanddulas. The agreed future policies and approaches for management across this frontage is provided in Table 3.4 below:

Location (Policy Unit)		Policy and Approach (from 2011)		
		0-20 years	20-50 years	50-100 years
2.2	Rhos on Sea to Llanddulas	Hold the Line – By maintaining and improving / raising the existing defences. A strategy study needs to be undertaken to confirm the long term economic viability	Hold the Line – By maintaining and improving / raising the existing defences, subject to confirmation through the strategy study.	Hold the Line – By maintaining and improving / raising the existing defences, subject to confirmation through the strategy study.

The justification in the SMP for these policies was as follows:

- Socially the policy manages risk to the railway and other infrastructure as well as other assets in the erosion risk zone, including the cycleway and coastal path; and
- Economically, the viability of the policy depends on the estimated costs for relocating railway and road infrastructure which would be at long term risk.

The Colwyn Bay Coastal Defence Strategy (Conwy CBC, October 2007) developed the SMP policy, examined in detail options through development of the Project Appraisal Report [PAR] (Mott MacDonald, October 2010) and identified the economic risks associated with adopting a Do-Nothing (Walkaway) scenario.

3.3.2 Defence Phase 3 Options

The primary function of works across the Phase 3 frontage is to safeguard the integrity of the shoreline, provide protection to local and national infrastructure and safeguard life.

Essentially there are three options available to the Authority with regard to the Phase 3 frontage:

- Option 1: Continuation of the current management regime in relation to damage to the sea wall, promenade and highway and existing emergency response in relation to closure of the public highway during storm events. This is currently the default position for the Authority, as detailed in section 0;
- Option 2: Continuation of Option 1 + extension of the existing rock armour protection along the whole of the frontage;
- Option 3: Implementation of the Phase 3 works in the form identified from the physical modelling or in some other modified arrangement;

Continuation of Option 1 may prolong the useful life of the current arrangements beyond the residual life estimated under the walkaway scenario (ref section 2.3) but it does not represent a long term sustainable approach to coastal defence management that can be continued for any significant length of time.

Option 2 has a twofold benefit compared to Option 1 in that it:

- a) would provide additional passive resistance in front of the wall that would reduce the risk of failure/collapse;

- b) may reduce the frequency of road closures required in respect of the typical events that occur year on year. However, under more extreme events, whilst mean overtopping rates would be expected to be lower (ref Table 3.2) the overall impacts expected would be similar.

Overall, Option 2 would delay the onset of damage but with predicted climate change in the future, the risk of damage would increase until such time that maintaining the defences in that form would become unsustainable.

Option 3 meets all the overall objectives for the frontage in that it provides:

- a) improved coastal defence to existing hinterland infrastructure assets;
- b) reduced coastal defence and highway maintenance expenditure;
- c) opportunities for improved amenity;
- d) improved highway usage; and
- e) opportunities for re-generation of the public realm.

The extent of works for Options 2 and 3 are shown in Figure 13 and Figure 14 respectively.

3.3.3 Cost Estimates

At the present time the average costs for Option 1 are £30-40,000 per annum.

The capital cost estimate for providing a further length of rock toe across the remaining 400 metres of frontage, to the same profile as the existing (ref Figure 5) – Option 2 – is estimated to be approximately £2.0million.

The capital cost estimate, including a 30% contingency/estimate bias allowance, for providing the coastal defences for Option 3 as detailed in Figure 12, is as follows:

Coastal Defence Works:	£24.2 million
Associated Highway Works:	£ 6.2 million
On-costs, profit etc:	£ 3.6 million
 Total estimated cost:	 £34.0 million

This figure may be subject to change resulting from further ground and structural investigations to be carried out and detailed design work.

3.3.4 Economic Justification

The economic basis / business case for investing in the Colwyn Bay Waterfront project was originally provided in the 2010 PAR.

This quantified the direct economic damages associated with the following:

1. The cost associated with local diversion of traffic that uses the promenade, in terms of additional distance and journey time for users;
2. The direct (like for like) replacement cost of services underneath promenade/highway;
3. The cost of delay to rail users associated with loss of the rail line at Old Colwyn and the cost of providing a rail replacement bus service between Abergele & Pensarn and Llandudno Junction stations;
4. The cost associated with diversion of traffic in the event of loss of the A55 highway, in terms of additional distance and journey time for users; and
5. The value of commercial and residential properties that would be lost in the event of erosion, across the Phase 1 & 2 lengths.

In addition, the economic benefit of the improved tourism that the provision of a sand beach across the Phase 1 & 2 frontage would provide, compared to the dis-benefit of providing a rock armour revetment was evaluated. No allowance for potential "Risk to Life" was included in the economic assessment.

These figures were updated in the Phase 2 PAR review (Conwy CBC, May 2018). This identified that overall, based on a 100 year appraisal period, the total discounted economic damages prevented by incorporation of all three phases of the Waterfront Scheme was estimated to be between £330million and £450million. The range representing the uncertainty associated with the timing of failure of the current defences.

Looking at the phase 3 frontage in isolation it can be seen that the majority of the direct damages are associated with this length of frontage, with estimated discounted damages of between £295million and £415million, associated with items 1-4 above.

For this exercise, the direct damages calculated associated with the diversion costs for rail and road users, assume that the diversions/replacement services remain in place from the time they commence until the end of the appraisal period (year 99).

This only provides estimates of direct damages and but does consider the wider impact on the economy that damage to or loss of the A55 and/or the railway would have on the wider North Wales and National economy particularly in respect of impacts on tourism, on which the local economy relies, and on the movement of people and freight across the area, as discussed in section 2.4.4 above.

It should also be noted that if Option 2 works were carried out, the direct damages would reduce to an estimated £150million, assuming the rock toe works bought an extra 20-30 years before the defences failed.

3.3.5 Stakeholder Engagement

It is clear from the above and from the information collated earlier in the report that there are a number of key stakeholders that will benefit from improved protection to their infrastructure and the introduction of improved coastal defence measures across the Phase 3 frontage, namely:

- Conwy County Borough Council as Lead Coastal and Flood Risk Management, Highway Authority and Harbour Master;
- Sustrans, whose National Cycle Route 5, runs along the promenade directly behind the defences;
- Dŵr Cymru Welsh Water⁶ and SP Systems, whose utilities' assets are directly protected by the coastal defences;
- Network Rail, whose Chester to Holyhead railway is located immediately to landward of the coastal defence line; and
- The Welsh Government Network Management Division, who have responsibility for the A55 trunk road.

Critically however in respect of potential funding, the frontage does not provide direct protection to residential and business properties, which is the key indicator used in prioritising Welsh Government's Flood & Coastal Erosion Risk Management (FCERM) spending.

The Welsh Assembly Minister for Environment, Energy and Rural Affairs made a statement on Flood and Coastal Erosion Risk Management to the National Assembly on 12th March 2019 (Senedd.tv, 2019). With regard to funding future works she confirmed that the proposals for the Phase 3 frontage were not included for in the current programme (to financial year 2021-22) as they don't meet the priority for funding identified above.

Coincidentally, on the same day the Deputy Director of the Water and Flood Division of Welsh Government wrote to Conwy CBC confirming that any scheme at Old Colwyn would be ineligible for CRMP funding (Appendix II).

⁶ DCWW have previously contributed to the costs of making good the existing defences, when a void appeared in the promenade close to their services, following storms in Spring 2018.

Furthermore, the Minister highlighted the need for Welsh Government, National Resources Wales and Local Authorities to work in partnership with e.g. utilities and transport bodies that benefit from the provision of coastal defences with regard to sharing responsibility for expenditure where there are clear benefits to these operators, highlighting in response to a question, that this approach was being adopted with regard to proposals for the Colwyn Bay Waterfront Phase 3 frontage.

Also, whilst acknowledging that WG officials had had contact with Conwy CBC and Network Rail officials in relation to proposals for this frontage, the Minister however highlighted that it was Conwy CBC's responsibility to bring other stakeholders together, in relation to proposals for this frontage. In response to this the Assembly Member for Clwyd West suggested that a summit should be convened to find a way forward for this scheme, involving all stakeholders, otherwise he felt that there was a low chance of the scheme going ahead (Darren Millar AM, 2019).

In addition, the local MP – the RT Hon David Jones – contacted the UK Government's Secretary of State for Transport requesting assistance from Westminster but was advised that whilst the strategic importance of the infrastructure at risk was acknowledged, this was a matter for the relevant parties identified above.

3.4 POTENTIAL PHASING OPPORTUNITIES

In terms of potential options for sub-phasing the proposed Phase 3 works, there are limited options available due to the nature of the works. Given the precarious nature and poor condition of the existing defences, Option 1 can only be considered as a temporary measure in the immediate term, until such time that improved arrangements can be put in place.

In broad terms, potential phasing arrangements are considered to be limited to:

1. Implement Option 2 works in the short term and the full phase 3 proposals further down the line;
2. Implement Option 3 proposals in stages, doing a section of frontage at a time;
3. Consider options for purchasing and stockpiling materials ahead of construction for Phase 3;

Considering each of these in turn.

3.4.1 Option 2 then Option 3

Implementing Option 2 in the short term would provide immediate benefits in terms of reducing the risk of failure of the existing defences, by providing improved passive resistance in front of the wall. Overtopping of the wall would still take place, albeit at an estimated 50-85% of the mean rate that would occur under current conditions. Over time the rate would increase with predicted climate change, such that in <50 years predicted overtopping rates with the armour toe would be \geq present day conditions without the toe.

In respect of the anticipated damages, this would not significantly alter the risk of damage to CCBC operated infrastructure – railings, promenade, highway etc. and the operational restrictions in terms of road and promenade closures would be largely remain as at present.

The risk of loss of Utilities' infrastructure resulting from sea wall failure would reduce but with continuing damage to the promenade and highway surfacing the risk of service exposure and/or damage would remain.

The reduction in expected overtopping would reduce but not eliminate the risk of damage to the Network Rail boundary wall under current conditions although that risk would increase with time, associated with predicted climate change.

Finally, this approach increases the timescale until A55 highway infrastructure becomes threatened.

When the Option 3 works are commissioned, the rock imported for the toe works would be suitable for re-use in the full works, thereby reducing the cost of importing additional rock at the time.

Overall, whilst accepting that this approach does reduce the risk to infrastructure in the short term it does not, until Option 3 is completed, meet the wider objectives of supporting regeneration of the promenade area and the provision of improved amenity commensurate with the overarching waterfront regeneration plan.

Adopting this approach would add an estimated 2-3% to the cost of constructing Phase 3 outright.

3.4.2 **Option 3 in sections**

The potential for construction of Option 3 in sections is essentially limited to construction in multiple longshore lengths.

Such an approach would see an increase in overall costs associated primarily with some or all of the following:

- Multiple site mobilisation/demobilisation and temporary work e.g. road diversion costs;
- Multiple materials mobilisation/demobilisation costs e.g. setting up of facilities within quarries to produce the estimated 300,000 tonnes of rock fill required
- As the works provide for an increase in overall crest level of the promenade and associated raising of the highway, dependant on the lengths of sections, a tie-in would be required to be constructed at the boundary of new and old construction each time and then removed when the works re-commence.

With the risk being higher at the eastern end it would make sense for the works to commence at the this end of the frontage and proceed in a westerly direction, although this would mean that the working face would be facing into the prevailing wind/wave direction, which would mean it would be at potentially greater risk of disruption during storms.

It is estimated that each set up could potentially add up an estimated 3-5% of the overall cost.

Constructing the work in two sections would most appropriately be done between Rotary Way and Beach Rd/Cliff Gardens firstly and then from Rotary Way to the western end of the Phase 3 frontage. This would avoid temporary highway tie-in construction as the first phase would tie-in to levels on the easterly side of the ramp.

The anticipated split of costs for this approach would be:

Section 1: £25.3 million;
Section 2: £11.0 million.

Total Cost: £36.3 million

Alternatively, if Section 1 was further split into two, based on constructing the full profile over the length that doesn't presently have any rock toe (approx. 400 metres) then the split would be:

Section 1: £17.2 million;
Section 2: £ 9.2 million;
Section 3: £11.0 million.

Total Cost: £37.4 million

The above costs are subject to the caveats identified above in respect of contingencies/estimate bias allowance and present design uncertainties.

Such approaches require a commitment from funding agencies that monies will be available to complete all phases of the works.

The approximate locations of the sub sections are shown on Figure 14.

3.4.3 Stockpiling materials

Purchasing of bulk materials by the Client would require them to come to an agreement for rock to be produced and then set aside as the Client's property ahead of construction being confirmed. The rock would have to be stockpiled either at source or at a location that the Client has available.

This option has a higher risk to the Client if agreement is not in place that the Works will take place, in that it will have paid for rock which, in the event that the scheme does not go ahead or is temporarily shelved, it may not have an immediate alternative use for.

Purchasing of rock will have storage costs associated with it if it is stored at source and additional double handling costs and/or transport costs if it is stored away from the source. Conversely this would be offset to a degree by the extra cost that the rock would cost if purchased in the future.

This option has a higher risk associated with it than the other options and if the costs or monies available are equivalent to say that to construct Option 2 then it would be more appropriate to consider carrying out that work in-situ rather than purchasing and temporarily stockpiling the rock elsewhere, notwithstanding that the additional cost of building and taking down (approx. £500,000) may be more expensive than stockpiling it.

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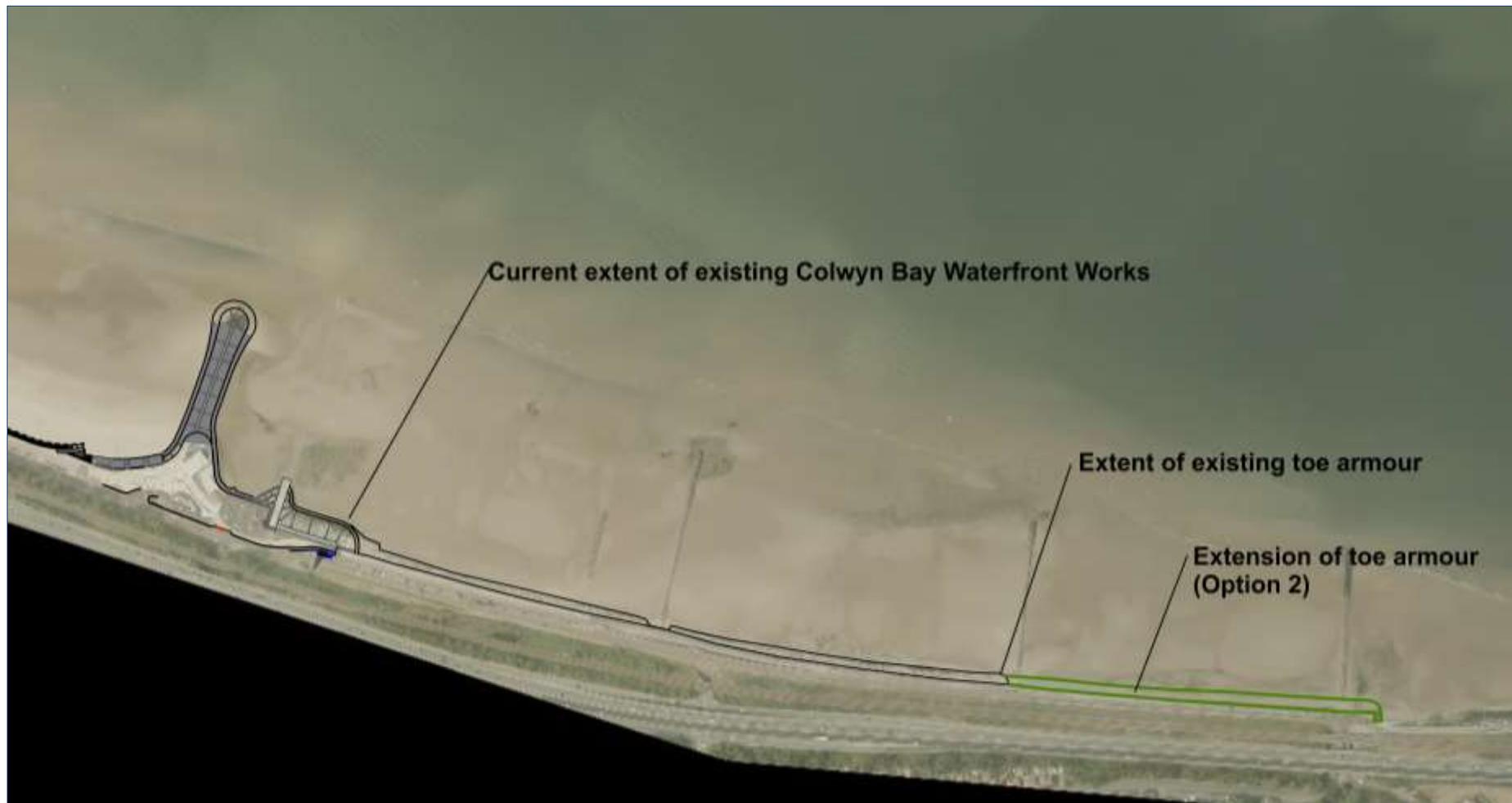


Figure 13: Proposed Works Extents – Option 2

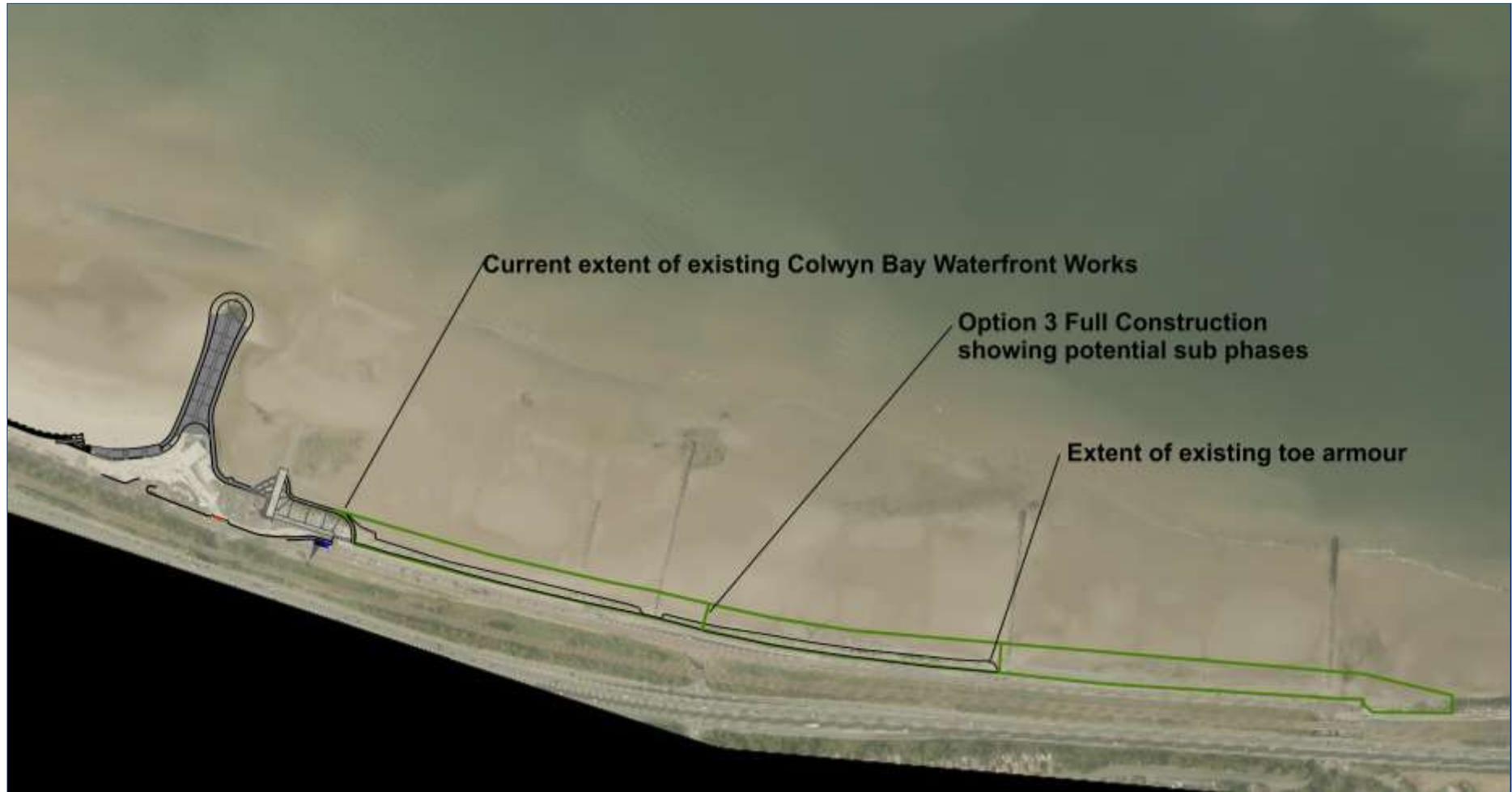


Figure 14: Proposed Works Extents – Option 3

4. PUBLIC SERVICE IMPACT REVIEW

4.1 INTRODUCTION

As identified in section 3.3.4 above an assessment of the direct economic damages, if no further coastal defence management works were to be undertaken by Conwy CBC, was undertaken as part of the development of the business case for Welsh Government Grant Aid for the Colwyn Bay Waterfront project.

The damages calculated assume that as well as there being no future investment works in coastal defence measures by the Coastal Erosion Risk Management Authority (Conwy CBC) the damages would be limited to the like for like replacement cost of the services in respect of Utilities and the cost of providing an alternative service with regard to the road and rail infrastructure that would be affected. Specifically, this did not include construction of new infrastructure in an alternative position or the cost of carrying out works to protect the asset.

In reality, this may not be the case so as part of the review and in order to gauge to what degree of economic benefit is gained by the various infrastructure providers affected, a review of what actions would be taken has been carried out as part of this study.

In order to inform this review and assessment, contact was made with those bodies whose assets are affected or who have responsibility for emergency service provision, in order to identify what they would do in order to ensure on-going operation of the asset/public safety, both temporarily and in the longer term.

The following stakeholders were contacted:

- CCBC Highways;
- CCBC Harbourmaster;
- CCBC Street Lighting;
- Dŵr Cymru Welsh Water;
- Emergency Services - Police, Fire, Ambulance;
- Network Rail;
- North and Mid Wales Trunk Road Agency (NMWTRA);
- North Wales Councils Regional Emergency Planning Service;
- Scottish Power;
- Welsh Government Network Management Division (Transport)

requesting details of the actions that would be taken by the organisation and an estimate of the associated costs of implementing those actions in the event that the existing coastal defences between Porth Eirias and Beach Rd/Cliff Gardens failed and were not replaced, specifically:

- if the asset had to be relocated where would that be;
- if the asset were to remain in place what measures would be taken to protect it; or if not
- what diversion arrangements, if any, would be put in place;
- what arrangements would be required to ensure public safety; and
- what other impacts would there be e.g. impacts on the local community etc.

Contact details for stakeholders are provided in Appendix III .

4.2 RESPONSES

Of the organisations contacted responses were received from:

- CCBC Highways
- CCBC Harbourmaster;
- CCBC Street Lighting;
- Dŵr Cymru Welsh Water;
- Network Rail;
- North Wales Councils Regional Emergency Planning Service

- Scottish Power;
- Welsh Government Network Management Division (Transport)

The following sections summarises the key points identified by the stakeholders.

4.2.1 CCBC Highways

- Loss of highway access would mean that traffic travelling along the A547 (Abergele Rd) towards the promenade is directed by current signage towards the seafront down Wynnstay Rd and onto the promenade at Cliff Gardens. In the event that the promenade highway was closed, which would also include closure of access from the A55 at Rotary Way, traffic would have to continue along the A547 into the centre of Colwyn Bay and thence onto the promenade at Marine Drive, between Porth Eirias and Rhos-on-Sea. This would lead to significant congestion, particularly during the summer months; and
- There would be a loss of parking on the promenade

4.2.2 CCBC Harbourmaster

- Loss of the promenade would mean loss of the promenade amenity and access to the beach at locations east of Porth Eirias;
- This would have a negative impact on public use of the beach at Old Colwyn and reduced numbers of visitors would impact negatively on the local economy
- In the event that the sea wall/promenade were structurally weakened public access would be prohibited;
- The cost of monitoring and managing the area – increased inspections, erecting and maintaining fencing is estimated to cost £30,000 per annum.

4.2.3 CCBC Street Lighting

- In 2015, the Street Lighting was located to the landward side of the highway between Rotary Way and Beach Road due to deterioration of the cable network. If the sea wall/promenade collapsed this would cause damage to the underground cable network with the risk of possible fatal or severe injury to the public;
- In general, if no Street Lighting was utilised in this area then there would be a possible increase in crime & anti-social behaviour which would have a negative effect on road & public safety & pedestrians; and
- With regeneration of the promenade (Option 3 only) street lighting would be upgraded to LED lighting with a 65% saving in energy and carbon footprint. This would also boost tourism.

4.2.4 Dŵr Cymru Welsh Water

- DCWW operate two lengths of sewer within the Phase 3 section of promenade
 - a combined trunk sewer; and
 - a parallel storage pipe

These are located below the promenade immediately behind the sea wall, so in the event of it being breached they could suffer structural damage, with a potential risk of loss of function and pollution.

- DCWW are committed to working with CCBC in relation to arrangements along the Phase 3 frontage;
- DCWW have contributed to emergency repairs carried out to the promenade in the past 12 months and are prepared to work collaboratively with key agencies, to consider the most sustainable long-term options for the protection of the coastal assets in Old Colwyn;
- DCWW have considered the risks associated with the failure of the existing coastal defences between Porth Eirias and Beach Road including dealing with local failures and an assessment of risk in the event of total loss of the affected 1.2km length of promenade, compromising the associated trunk and storage sewers in their entirety;

- In the event of localize repairs being required, it would require flows from Beach Road pumping station (and possibly Tan Lan sewage pumping station) to be tankered for the duration of the work. Repairs downstream of Rotary Way and the Civic Centre could require temporary slipway closure on and off the A55 to enable tankering of flows. Estimated repair costs (include tankering costs) could be in the region of £350,000 per annum average. *CEUK note it is assumed this would be per occurrence.*
- In the event that failure of the defences required the re-routing of services, DCWW have considered three options have been considered
 - A rising main below the seabed;
 - A rising main from Beach Road PS to Eirias Park and gravity sewer combination; and
 - A tunnel option, between Eirias Park Access Road and rear of Beach Road Pumping Station

DCWW have produced a high level estimate of the cost of these options of £4.3 million.

4.2.5 Network Rail

Network Rail responded that they had already been involved in discussions regarding this project and potential funding opportunities. They see CCBC, as the primary coastal protection authority, being responsible for providing coastal protection to third parties and that the risks should be addressed at a more strategic level by Welsh Government.

Network Rail confirmed that relocation or diversion of railway infrastructure would not be a viable option in the event of a failure of the current coastal defences. Under these circumstances the railway would be shut to protect public safety and not re-opened until the risk had been addressed. In the interim bus replacement services would be used.

Network Rail are the key stakeholder with regard to impact on infrastructure protected. It is, considered to be inconceivable, based on their response, that in the event that the sea wall was breached/failed, that they would countenance long term severance of their network. In this respect it is considered likely that they would put in place emergency measures in the short term to protect the toe of their embankment and would then carry out measures to provide long term protection. This was the approach taken by British Rail in 1990 following failure of the railway defences at Towyn in February 1990, which resulted in extensive disruption to the railway and widespread flooding of the hinterland (Coastal Flooding in Towyn 1990, n.d.).

Network Rail did not provide any values for their assets or the estimated cost of protecting them in the absence of investment in the current coastal defences. For the purposes of this study, the high level cost of implementing such works is estimated to be of the order of £5-10 million for temporary works and a further £15-20 million in the long term.

4.2.6 North Wales Councils Regional Emergency Planning Service

The NWCREPS responded that "they have no emergency planning/response impacts of an unplanned, long term closure of the Old Colwyn promenade".

4.2.7 Scottish Power

- There is a 400V low voltage cable running along the length of the promenade, approximately 450mm deep, which SP believe feeds a number of street lights and two small kiosks;
- In the event of a flood SP would isolate the cable at adjacent substations or link boxes. On the assumption that supplies would not be required on the promenade, this cable would be left isolated until a future plan was agreed. This emergency work / action would take approximately 2 hours;
- To permanently abandon the low voltage cable jointing work would be carried out at the boundary of the area affected. This would be estimated to cost in the region of £5000. Usually the abandoned cable would be left in the ground;
- The low voltage cable can also be used to maintain customer supplies when adjacent substations are switched out for planned maintenance. Diverting and retaining this low voltage cable would provide this security and flexibility, however it would not necessarily be an absolute requirement and SP could consider running the network without it;

- SP also operate 11,000V / 400V substations at Port Eirias and the Civic Centre, outside the Phase 3 frontage, which are not considered to be affected in the event of sea wall failure;
- Overall the scenario identified does not pose SP Energy networks significant network issues and they would be able to deal with the situation in an emergency, as it presents itself, with minimal impact on the local community.

4.2.8 **Welsh Government Network Management Division (Transport)**

- The Welsh Government Network Management Division are not aware of any assets that would require re-locating or diverting; and
- From a public safety perspective, they did not envisage any immediate arrangements that would be necessary to the A55 Dual Carriageway should the sea defences fail due to the fact that the rail track provided a buffer⁸.

The Welsh Government Network Management Division (Transport) did not provide any values for their assets. Current costs for construction of a two lane dual carriageway are estimated to be of the order of £10-12 million per kilometre (average 2005 costs updated to 2019 using Construction Tender Indices). However, given that any replacement road would have to be constructed in an elevated position, either supported on piles or through a bridge arrangement, on the same alignment it is likely that actual costs would be much higher, perhaps double.

4.2.9 **Emergency Services**

Of the Emergency Services only the North Wales Fire and Rescue Service responded and identified that they would need more time to carry out detailed analysis of impacts but commented that they “would consider that this would a major event requiring significant contingency arrangements to minimise the impact on business continuity”.

4.2.10 **Organisations that didn't respond**

No responses were received from North Wales Police, the Welsh Ambulance Service or NMWTRA. The emergency services do not have a responsibility for assets so their primary issues would be about managing public safety, access and traffic movements in the area, presumably in line with concerns raised by CCBC Highways and CCBC Harbour Master.

The North Wales Police, Fire and Ambulance services would presumably have a concern over any impact closure of the highway would have on response times. In addition, the RNLi would still be able to gain access to the sea at Porth Eirias (ref , left), if required, the access at Beach Rd/Cliff Gardens (ref , right) not being suitable anyway.

Figure 15: Beach Access Locations



Foreshore Access at Porth Eirias



Foreshore Access at Beach Rd/Cliff Gardens

⁸ Although this is strictly the case, damage to or loss of the embankment and bridge adjacent to the Promenade/Cliff Gardens junction would potentially threaten the integrity of the supports to the A55 at this location (ref Figure 10 – right)

4.3 **FUTURE ACTIONS**

Based on the responses, in practical terms, the likely impacts actions and associated costs that would ensue in the event that CCBC were unable to undertake future management of their defences are:

- Permanent closure of the promenade and highway to pedestrian and vehicular traffic at an estimated cost of about £30,000 per annum to the Local Authority;
- Modification to highway signage and implementation of a permanent vehicular diversion route through Colwyn Bay, cost unknown but estimated to be of the order of £20-30,000 per annum;
- Construction of terminal works at the interface with already completed sections of the Colwyn Bay Waterfront to safeguard the investment made here. Estimated to cost £3-5 million. Funded by CCBC with potential FCERM grant aid from WG;
- Diversion of part of the National Cycle Route 5 through the centre of Colwyn Bay with the associated risks and costs (new signage, routing etc.) this would entail;
- Permanent diversion of Dŵr Cymru Welsh Water services at a high level estimated cost of £4-5 million;
- Abandonment of low voltage electricity supply at a cost of £5000 to Scottish Power; and
- Provision of temporary and subsequently permanent protection to the railway embankment at an estimated cost to Network Rail of £20-30 million, assuming Network Rail would not allow their asset to be compromised in the long term. This approach would, it is expected, lead to some short term disruption to services e.g. the provision of rail replacement buses, whilst such measures were put in place.

At face value, the response from the Welsh Government Network Management Division suggests that they do not see there being any requirement on them to invest in protection works to their infrastructure, however that would only be the case if Network Rail carried out works to protect their asset, which they have said they would do. If they didn't then ultimately there would be a risk to the Trunk Road network, which could potentially cost conservatively up to £30 million to manage.

5. **FUTURE COLLABORATION**

Welsh Government have identified that as this phase of the project does not meet their criteria for funding, it is ineligible for funding under their current Coastal Risk Management Programme (CRMP) and that a collaborative approach needs to be developed to deliver the scheme and the benefits it provides to public and private organisations.

On the basis that no funds would be made available under Flood and Coastal Defence Grant Aid by the Welsh Government Environment Directorate, the key stakeholders that could reasonably be expected to participate, collaborate and potentially contribute to the cost of refurbishing the defences across the Phase 3 frontage are:

- Conwy County Borough Council as Lead Flood and Coastal Erosion Risk Management Authority under the Coast Protection Act 1949 and the Land Drainage Act, 1991 as amended by the Flood and Water Management Act, 2010;
- Network Rail whose assets currently protected represent the most economic value of the infrastructure protected at immediate risk;
- Dŵr Cymru Welsh Water whose local assets would need to be re-routed in the absence of works to improve the current defences;
- Welsh Government Network Management Division, whose National Trunk Road assets, managed by NMWTRA, would be at risk in the longer term if other stakeholders, i.e. Network Rail, did not carry out works.

In addition, the National Cycle Route runs along the promenade and Sustrans could also be approached with a view to potentially contributing to the scheme.

The starting basis for examining potential contributions arises from the costs to the various stakeholders, if improvement works are not carried out. At present day values the approximate costs that could be incurred by the key stakeholders, assuming the future actions, as defined in section 1.1, are carried out would be:

- | | |
|---------------------------------|-------------------------------|
| • Conwy County Borough Council: | £ 8-10 million ⁹ ; |
| • Network Rail: | £ 20-30 million; and |
| • Dŵr Cymru Welsh Water: | £ 4-5 million; |
| • Sustrans: | £ 1-2 million. |

If Network Rail were not to carry out works to protect their asset then NMWTRA would incur costs of an estimated similar magnitude as Network Rail to protect their assets.

As identified in section 2.4.4 any disruption to the railway would also have a loss in terms of impact on rail users, causing increases in journey times and requiring alternative transport to be laid on whilst protection measures were put in place. Based on accepted methodologies for quantifying the cost of delay and provision of a rail replacement bus service (Middlesex University Flood Hazard Research Centre , 2016), the economic cost to the nation has been estimated to be approximately £15 million per annum. In addition, there would be further indirect losses to the local and regional economies of Conwy and North Wales in terms of the impact on the numbers of tourists and the disruption to freight carried on the network between Abergele and Llandudno Junction.

It should also be recognised that without the proposed works there would be an indirect loss to the local economy of Colwyn Bay associated with the loss of a popular and well used section of promenade and the potential knock on impact this could have in terms of public perception on the remainder of the already completed waterfront.

Based on the above the estimated direct and indirect economic cost of allowing the existing defence line to fail and alternative measures be put in place by individual stakeholders clearly outweighs the costs of

⁹ Based on Annual expenditure of £50-60,000 per annum over 100 years and the cost of terminal works to protect the current waterfront investment.

developing a collaborative approach, where individual stakeholders contribute to the costs in line with the level of economic risk and disruption to their infrastructure/operations there would be.

In practice, it is appropriate that contributions made by individual stakeholders would not exceed the estimated costs that the stakeholder would incur if no works were promoted here. Such an approach is currently being explored with United Utilities (UU) in relation to proposed coastal defence works at Crosby on Merseyside, where the Local Authority (Sefton Council) are looking to promote an erosion protection scheme and UU's rising main and pumping station (part of the Mersey Estuary Pollution Alleviation Scheme) represent the primary infrastructure at risk in the short term. In this case, it is understood that UU are potentially looking to contribute up to the value of the cost to re-align their services outside the predicted limits of erosion. This is similar to the position that DCWW have at Colwyn Bay.

Without funding support from Welsh Government promotion of the scheme would require the remaining individual public and private bodies to contribute the full costs of the works, currently estimated to be approximately £35 million.

If the scheme were eligible under CRMP then Conwy County Borough Council would have to fund 25% of the cost. This would equate to £7-8 million, which roughly equates to the estimated direct costs they would incur in the event that the existing defences were allowed to deteriorate and fail. Based on the estimates provided a DCWW contribution would be of the order of £5 million, leaving a shortfall of £22-23 million to be found from other sources, primarily Network Rail and potentially Welsh Government Network Management Division.

It is understood that Network Rail have identified £1.2 million of investment, during their current CP6 funding period (2019-24)¹⁰, on their current defences to the east of the promenade/Cliff Gardens junction. However, the potential contribution to this scheme is significantly greater and would, it would be expected, require funds identified for other NR proposed schemes to be diverted to Colwyn Bay, based on urgency of need.

DCWW have already intimated that they would be willing to contribute to the costs of a scheme that preserves their current infrastructure, however further dialogue with Network Rail and the Welsh Government Network Management Division in particular is clearly essential if a collaborative way forward is to be achieved.

¹⁰ Letter from RT Hon Chris Grayling MP, Secretary of State for Transport to Rt Hon David Jones MP for Clwyd West – 25 Feb 2019.

6. **WAY FORWARD**

The report presented has defined the current conditions applying across the Colwyn Bay Waterfront Phase 3 frontage, provided an updated assessment of the risk to infrastructure if works are not carried out, identified the costs for a range of options for implementing the preferred scheme and provided a basis for developing funding arrangements for the scheme.

The current estimated cost for implementing the defence improvements that accord with the Council's overall Colwyn Bay Waterfront regeneration objectives is approximately £35 million, which includes a 30% contingency allowance to cover present uncertainties and unknowns.

However, Welsh Government Environment Directorate have identified that as the scheme does not provide protection to residential or commercial properties it is ineligible for funding under the Coastal Risk Management Programme. Accordingly, the scheme will have to be funded by key stakeholders whose assets/infrastructure receives protection from the proposals i.e.

- Conwy County Borough Council;
- Dŵr Cymru Welsh Water;
- Network Rail;
- The Welsh Government Network Management Division; and potentially
- SUSTRANS.

It is clear, from the budget costs identified, that the level of investment required cannot be met solely from the County Council's budgets alone and significant contributions are required from the other private and public stakeholders, primarily Network Rail, Dŵr Cymru Welsh Water and potentially the Welsh Government Network Management Division.

Welsh Government have to date been involved in promoting dialogue between interested parties and the AM for Clwyd West has proposed that a summit of interested parties be convened to move things forward. Dŵr Cymru Welsh Water have co-operated with Conwy CBC in carrying out maintenance due to storm damage and have indicated a willingness to co-operate in developing proposals further, however the value of their infrastructure alone combined with potential Council contributions would only provide a third of the expenditure required and a significant financial burden potentially falls on Network Rail and the Welsh Government Network Management Division.

At the present time there appears to be a lack of willingness by both these parties to engage on this matter and this needs to be the focus in the short term. In Network Rail's case the consequences of inaction or willingness to co-operate could lead to costs and/or damage on potentially a similar scale to that which occurred at Towyn 30 years ago.

The longer it takes to develop a way forward the greater the risk of catastrophic failure of the current defences. The frontage is at risk of overtopping and therefore promenade closure and potential damage on every spring tide period, particularly if onshore west to north west winds occur concurrently. Accordingly, there is only a finite time (probably less than 5 years based on condition assessments of the existing defences and likely storm frequency) that the Council are going to be able to continue their current policy of "make do and amend" and decide that this approach is no longer sustainable financially. In such a case the decision would have to be made to close the promenade permanently and nature would take its course requiring the other stakeholders to adopt their own action plans to protect their infrastructure.

The immediate risk of damage could be reduced by construction of a rock toe along that section of frontage where one doesn't exist, over approximately 40% of the length, at an estimated cost of approximately £2.0 million, which would contribute to safeguarding the integrity of the existing defences, where they are currently weakest and would also reduce the overtopping taking place across this part of the frontage. This would buy some time to develop arrangements for permanent improvements.

However, it is important to recognise that this only represents a short-term solution, that does not address the longer-term risk to infrastructure across the frontage, although the rock imported would be available to be re-used in the proposed works when they are implemented.

Notwithstanding the benefits that implementing Option 2 in the short term would have, it is important that adopting this approach is not allowed to lead to complacency amongst potential partners/collaborators, assuming that the proposed Option 3 works would not then need to be implemented. This would have a perceived negative affect on Colwyn Bay, by not delivering fully on the objectives for the Waterfront Project, that were set out at the outset, and therefore not fully delivering the wider benefits identified for the overall Colwyn Bay frontage.

Accordingly it is suggested that development of a collaborative approach between Conwy CBC, Welsh Government, Network Rail, the Welsh Government Network Management Division and Dŵr Cymru Welsh Water to a point where there is a binding agreement to contribute to the Option 3 works is made, albeit at a date in the future that is mutually acceptable to all parties, before there is a commitment by Conwy CBC to implement the stop gap works, should those funds be available.

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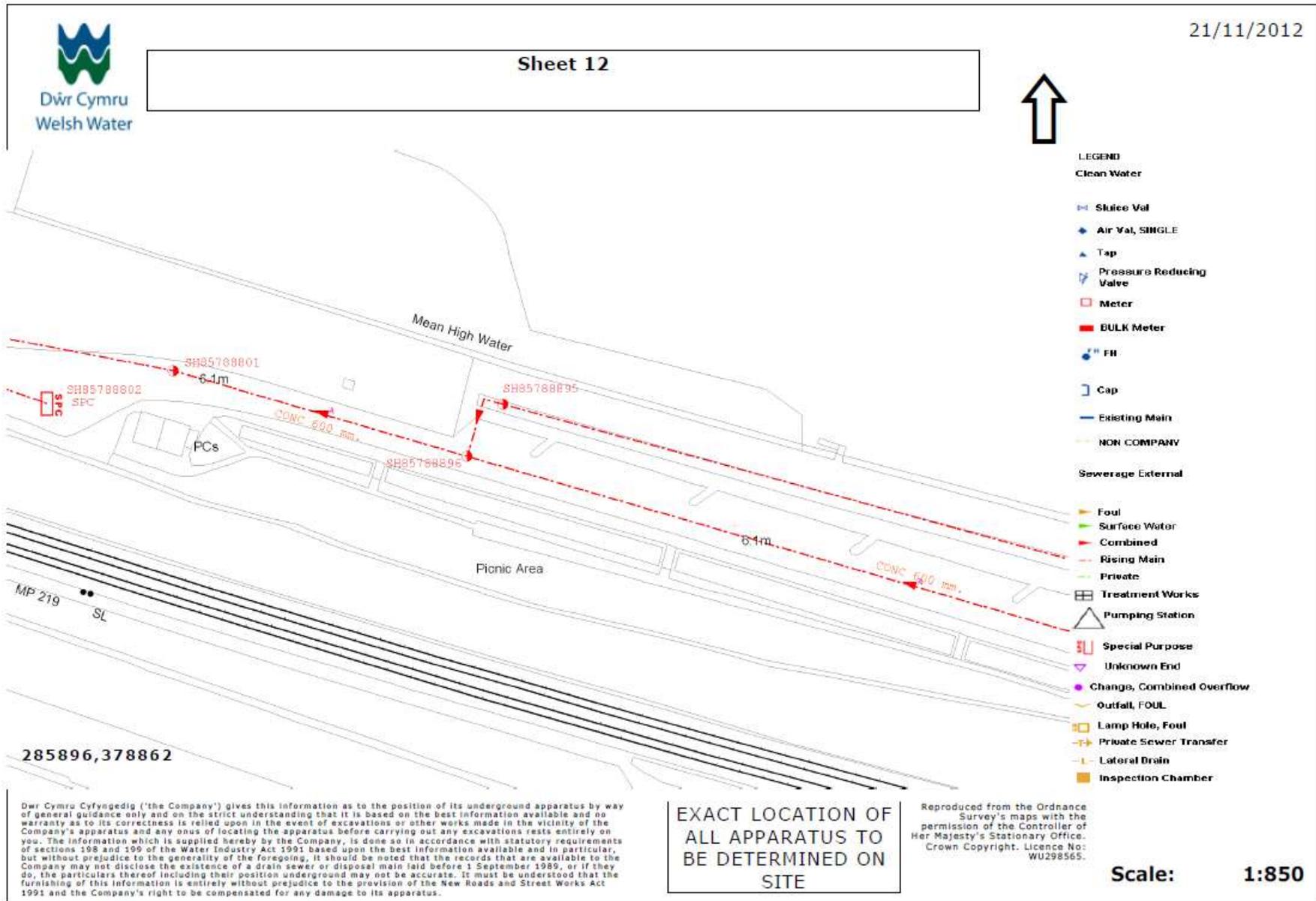
7. REFERENCES

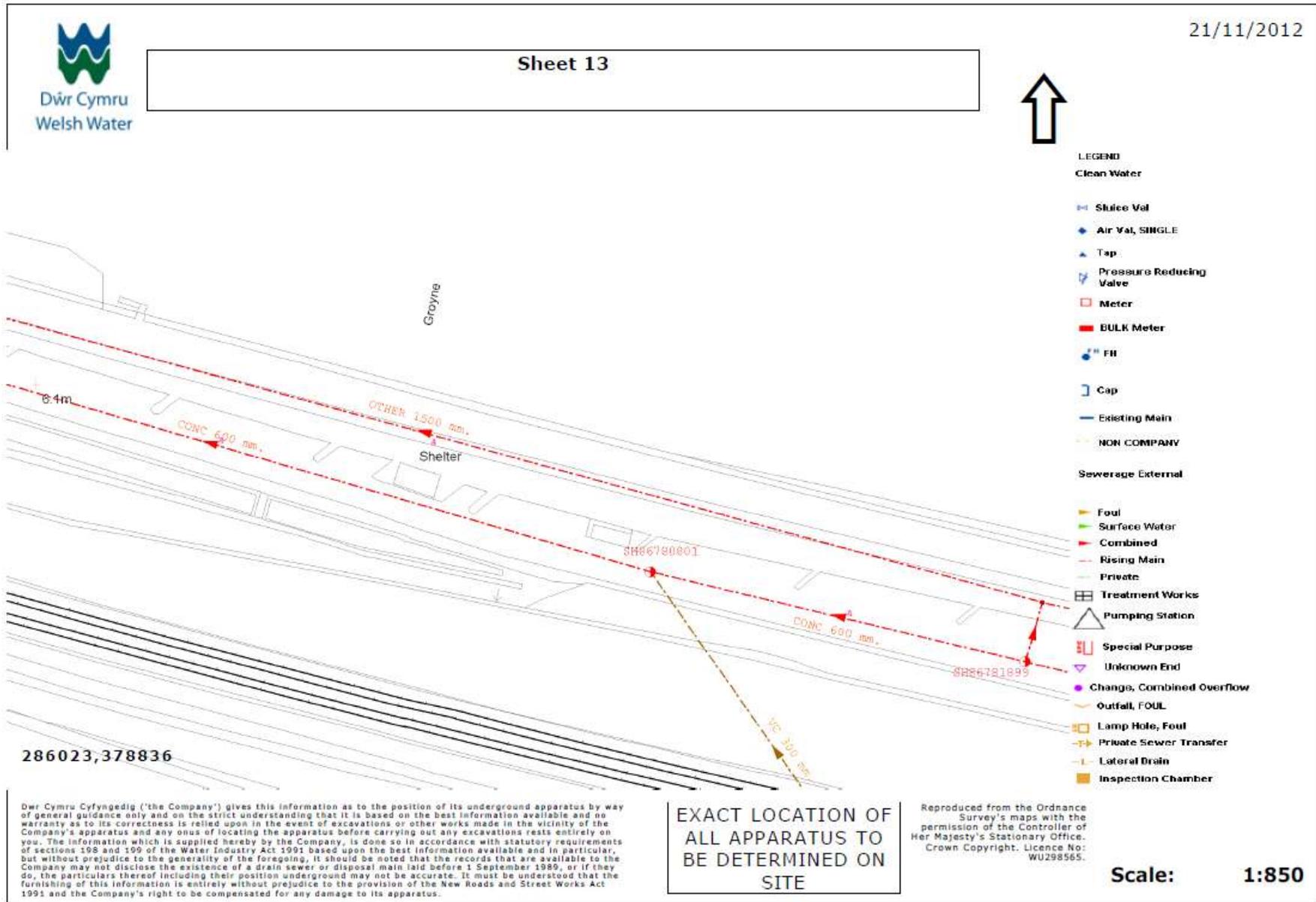
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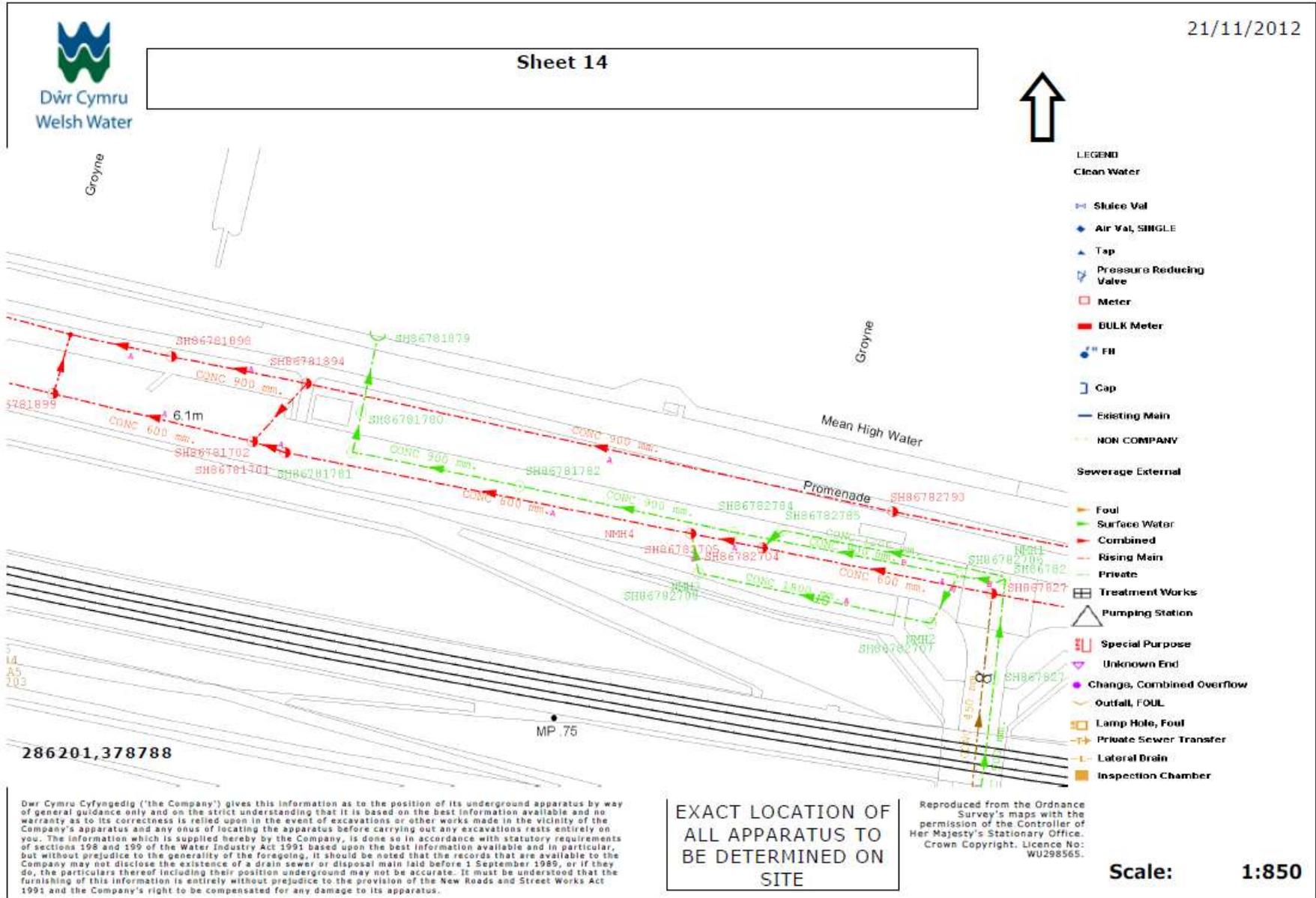
APPENDICES

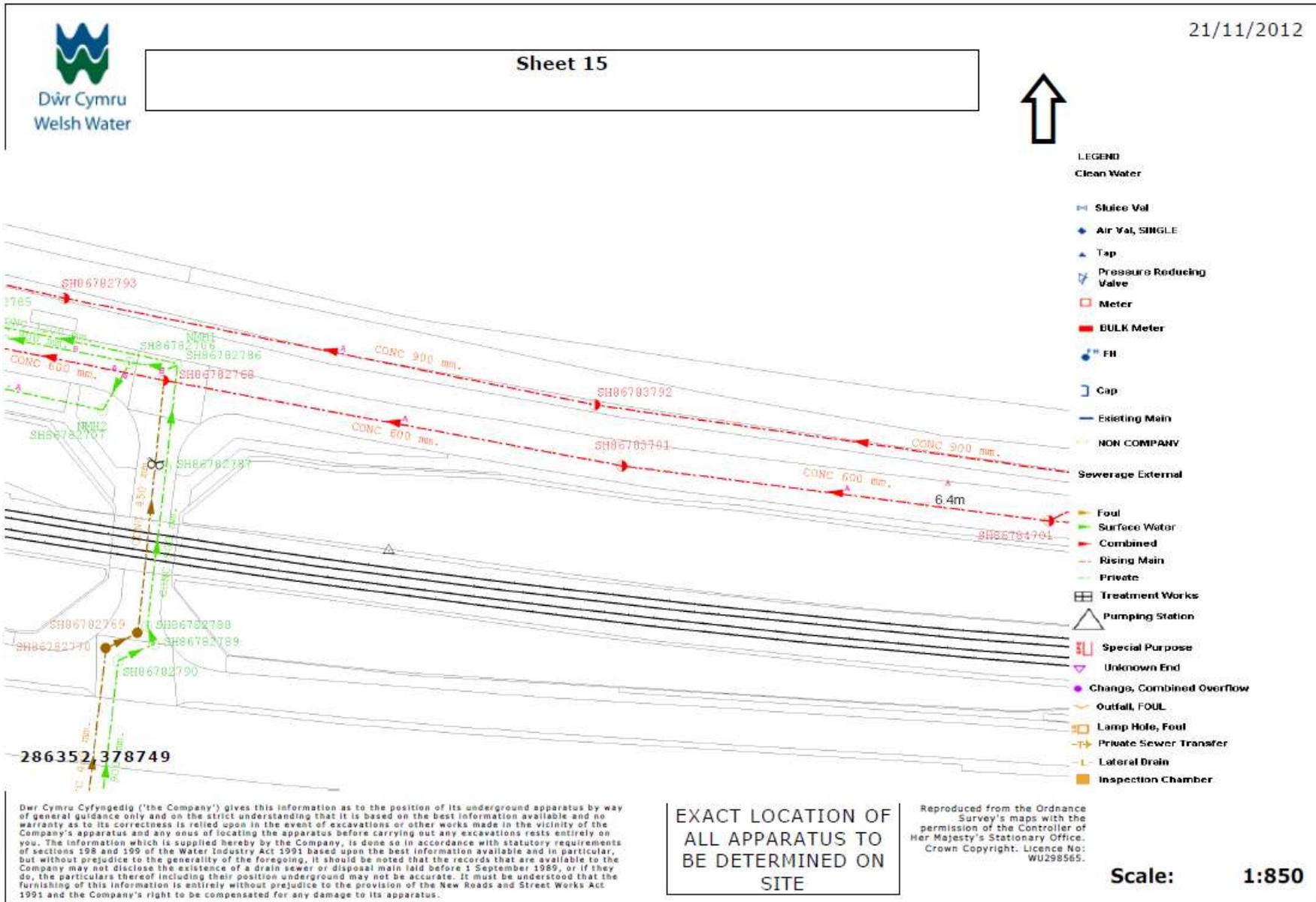
Appendix I: Utility Service Plans

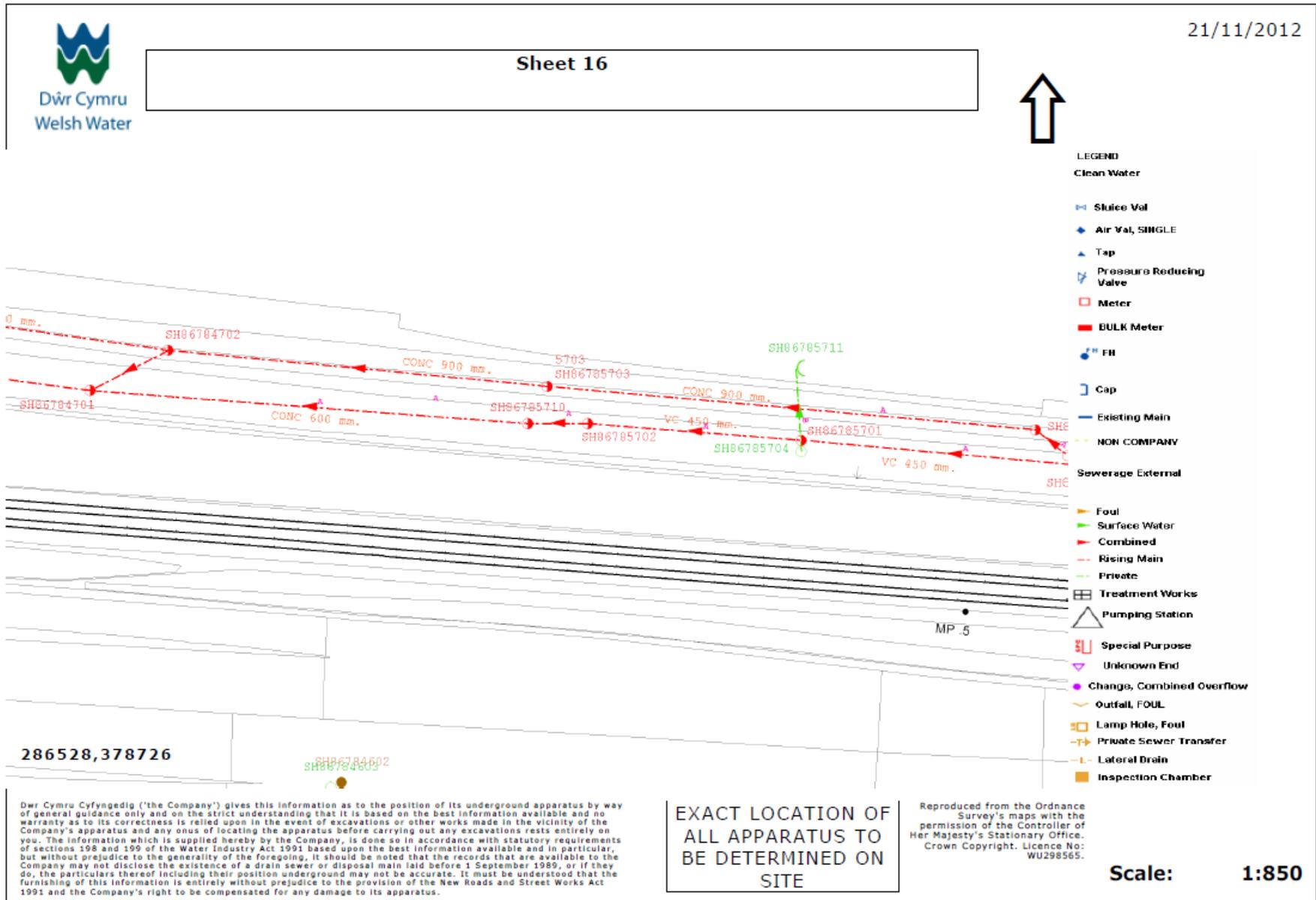
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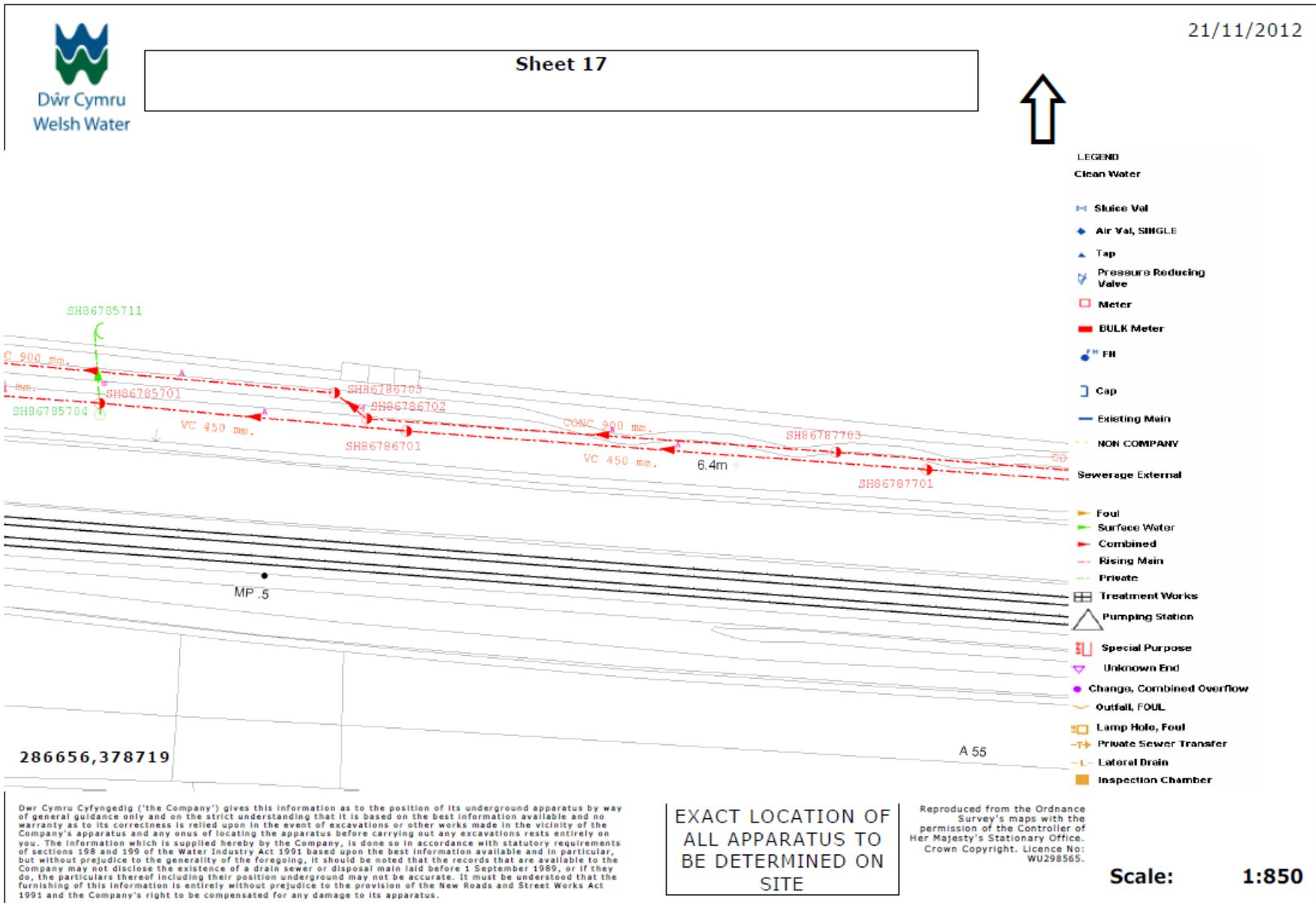


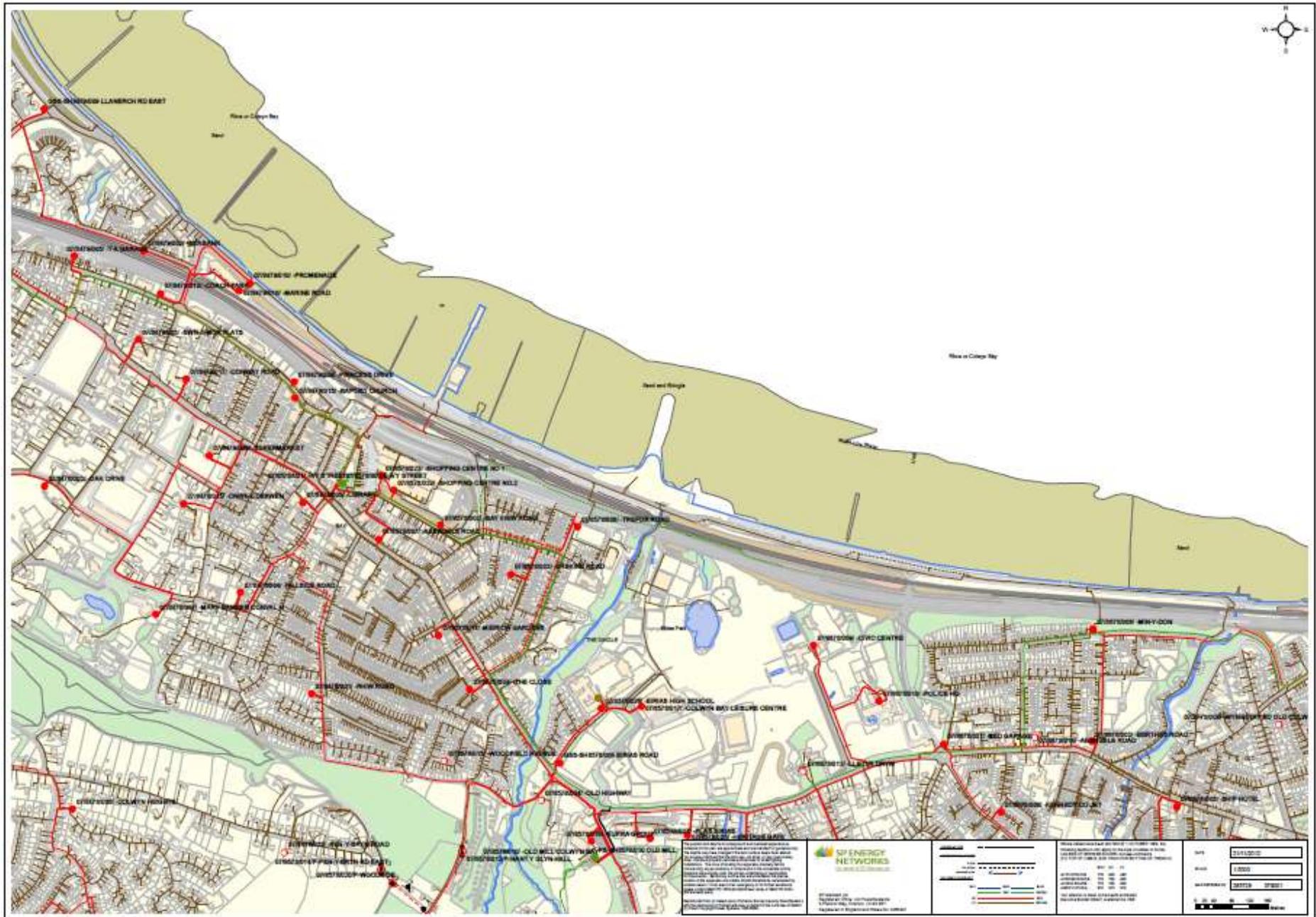












Appendix II: Letter from Welsh Government – March 2019

Water and Flood Division
Is-adran Dŵr a Llifogydd

Owen Conry
Conwy County Borough Council,
Mochdre Offices,
Conway Road,
Mochdre
LL28 5AB
owen.conry@conwy.gov.uk



Llywodraeth Cymru
Welsh Government

12 March 2019

Dear Owen,

I write following recent emails from Dyfed Rowlands, Conwy County Borough Council, regarding the Old Colwyn Coastal Defence works and the requests for Welsh Government funding through the Coastal Risk Management Programme (CRMP).

It is important that the best possible use is made of the resources available to support flood and coastal risk management across Wales, and in that regard the primary objective of the CRMP, and the Welsh Government's core programme, is to reduce risk to properties, primarily homes. It is on this basis that coastal defence schemes in the Colwyn Bay area have benefitted from significant Welsh Government funding to date.

Whilst the proposed scheme at Old Colwyn would reduce risk to infrastructure, this would be considered as a wider benefit within the CRMP. The proposed scheme at Old Colwyn does not meet the primary objective of the Programme – to reduce risk to homes and businesses. This is the measure by which all potential schemes have been assessed, and it is for this reason that I am writing to confirm that the proposed scheme is ineligible for CRMP funding.

Yours sincerely

Huw Owen
Deputy Director, Water and Flood Division, Welsh Government

Appendix III: Key Stakeholders Contact and Response Details

Stakeholder	Contact	Response Received
Dŵr Cymru Welsh Water	Sharon Ellwood sewerage.services@Dwrcymru.com	Yes 29/03/19
WG Highways	Carol Willgoose Carol.Willgoose@gov.wales	Yes 01/04/19
SP Energy Network	Terry Jones Terry.Jones@spenergynetworks.co.uk	Yes 02/04/19
CCBC Harbourmaster	Matt Forbes matthew.forbes@conwy.gov.uk	Yes 04/04/19
CCBC Highways	Stephen Daly Stephen.Daly@conwy.gov.uk	Yes 08/04/19
CCBC Street Lighting	Len Jackson Len.Jackson@conwy.gov.uk	Yes 09/04/19
North Wales Councils Regional Emergency Planning Service	Neil Culff neil.culff@nwc-reps.org.uk	Yes 28/05/19
North Wales Fire & Rescue Service	helen.macarthur@nwales-fireservice.org.uk	Yes 31/05/19
Network Rail	Andy Cross Andy.cross@networkrail.co.uk Dan Hughes Dan.Hughes@networkrail.com	Yes 19/7/19
North Wales Police	force.control@nthwales.pnn.police.uk	No Further chased on 03/04/19
North Wales Ambulance Service	amb_northshiftmanagers@wales.nhs.uk	No Further chased on 03/04/19