

# ENVIRONMENTAL IMPACT ASSESSMENT REPORT

The Burrow CFERM scheme

Appendix 2C

Volume 3



# THE BURROW CFERM SCHEME

## Update of Coastal Erosion and Flood Risk and Scheme Costs Technical Report



IBE1820  
The Burrow CFERM Scheme

Update of Risks and  
Scheme Costs

Rev D02

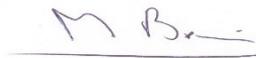
14th January 2025

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## Approval for issue

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14th January 2025

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# 1 INTRODUCTION

## 1.1 Background

In February 2018 RPS were commissioned by Fingal County Council (FCC) to assess the feasibility of a localised, small-scale coastal defence scheme to reduce the flood risk that exists in the Rogerstown Outer Estuary area. The scope of this initial commission was to develop a socially and environmentally sustainable scheme to reduce the risk of coastal flooding throughout the study area.

Storm Emma and several other arduous storm events in the winter period of 2017/2018 caused the position of the shoreline at the Burrow to retreat by more than 20m in some areas, consequently, RPS' commission was extended to include the development of interim emergency erosion management measures to provide short term mitigation to the issue of coastal erosion along the Burrow. The measures subsequently developed by RPS involved the construction of a wave attenuation array, comprised of precast concrete Seabee units placed in front of the worst affected section of the Burrow frontage.

In recognition of the erosion risk across the study area the scope of the original RPS study was revised to include additional elements of work. These additional elements of work included:

- A coastal erosion assessment along the Rush South and North beaches.
- The development of coastal protection options for the Burrow and Rush South and North beaches.

The resultant study which was undertaken as per guidance detailed in the Office of Public Works (OPW) Schedule A.1 “*Scope & Terms of Reference of Coastal Erosion and Flood Risk Management (CFERM) study*” identified a very significant risk of coastal flooding and erosion at the Burrow whilst at Rush South, the risk related primarily to coastal flooding.

In respect of the Burrow, a preferred coastal management scheme (henceforth referred to as the “*Proposed Development*”) was identified and progressed through preliminary design. An environmental impact assessment report (EIAR) was subsequently undertaken in accordance with the EIA Directive (Directive 2011/92/EU as amended by 2014/52/EU)” with a view to FCC submitting a planning application in accordance with Schedule 5 of the Planning and Development Regulations 2001 – 2018.

## 1.2 The Proposed Development

The Proposed shoreline management measures at the Burrow, as illustrated in Figure 1.1, are split into three areas, the northern extent of the spit at the end of Burrow Road, at Marsh Lane, and along Portrane beach. The Proposed Development consists of the following main elements:

- Construction of a c.190 m long earth embankment at the end of Burrow Road.
- Construction of a c.130 m long sheet piled flood wall and a c. 200 m embankment along Marsh Lane.
- Installation of back drainage behind the proposed defences with associated outfalls.
- Installation of non-return valves to existing outfalls to prevent backflow of water from the estuary.
- The construction of seven fishtail (or ‘Y’ shaped) groynes structures in combination with a beach renourishment scheme at Portrane beach. These groyne structures will help control the longshore and cross-shore transport elements of the prevailing littoral drift along c.1.3 km of the coastline of the Burrow.
  - Each groyne will extend seaward by approximately 70 m at a spacing of c.175 m to create seven sediment sub-cells along the Burrow. The total footprint of the proposed groynes will equate to c.0.4 hectares.
  - The beach renourishment will involve transporting dredged material from a licenced marine aggregate extraction site (presently assumed to be Liverpool Bay) to the Burrow and pumping the material ashore to fill each of the seven sediment sub-cells created by the fishtail groyne structures.

The primary objectives of the Proposed Development are to:

- Provide effective coastal flood protection during a 0.5% Annual Exceedance Probability (AEP) event based on the Medium Range Future Scenario (MRFS) whereby sea levels are expected to rise by +0.50 m by 2100.
- Mitigate the ongoing coastal retreat along the beach frontage.
- Restore and enhance the recreational value of the natural beach amenity which has significantly deteriorated over recent years due to an overall loss of sand material from the beach.
- Enhance and protect the fixed and shifting dune systems of the Rogerstown SAC which have been deteriorated by chronic and acute erosion over recent years.

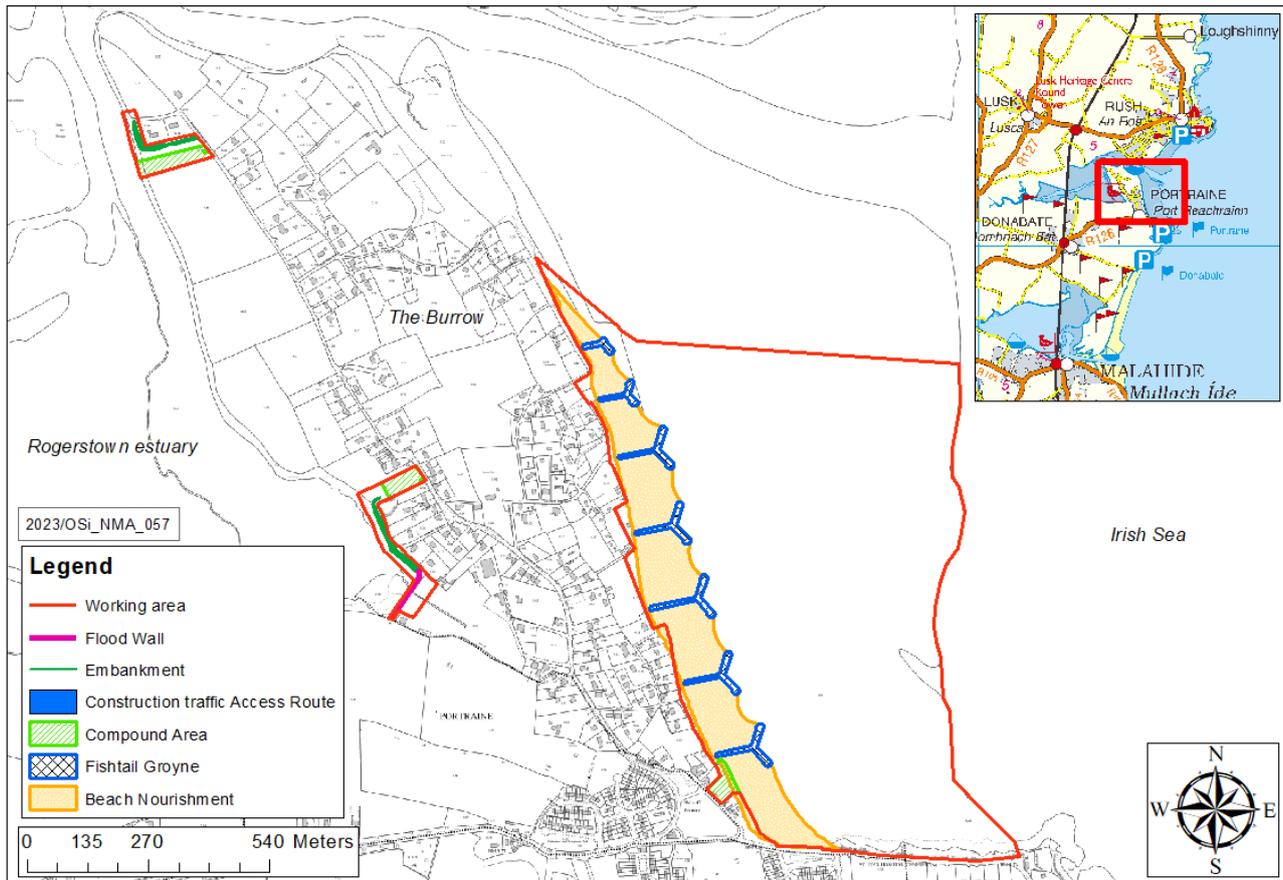


Figure 1.1: Overview of the Proposed Development at the Burrow, including Site Boundary and Working Areas

Various alternative options considered for the management of the coastal flood and erosion risk yielded a range of Benefit Cost Ratios (BCR). However, the Brundtland Commission (Brundtland, 1987) states that “*sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*”. The commission subsequently recommends that any development should be assessed in context of the three pillars of sustainability, i.e. Social, Environmental and Economic receptors.

Based on this holistic approach, it was concluded that the Proposed Development was the only all-round sustainable solution for the Burrow. Whilst alternative options were more economically viable, the Proposed Development reduced the social impact of coastal flooding and erosion whilst minimising the environmental impact on nearby environmental designated habitats.

A high-level economic assessment undertaken as part of the study concluded that the Proposed Development would produce a BCR of between 0.25 and 2.00, depending on the rate of future climate change and thus the coastal risk mitigated by the scheme in the Burrow area.

## 1.3 Purpose of this Report

Since the original report was completed, there have been several changes which have the potential to affect the coastal flood and erosion risk and cost benefit analysis for the Proposed Development, including:

- The estimated extreme coastal boundary water levels, associated with astronomical tide, storm surge and seiche/local wind set-up allowance, for the coast of Ireland, as defined in the Irish Coastal Protection Strategy Study (ICPSS, 2010) have been updated. This information has now been superseded by extreme water level outputs from the more recent Irish Coastal Wave and Water Level Modelling Study 2018 (ICWWS) as published in 2020.
- A PRIME 2 dataset has been supplied by FCC to facilitate the inclusion of a detailed bed friction map within the coastal flood simulations.
- The coastline along the Burrow has continued to retreat with the upper foreshore also having reduced in level.
- New guidance has been issued by the OPW for undertaking an economic appraisal of flood relief schemes (2023).
- Recent global events including the emergence of COVID-19 together with Wars in the Ukraine and Gaza have resulted in an unprecedented increase in construction materials price inflation.

Cognisant of the points above, the purpose of this technical report is to:

1. Provide an updated assessment of the coastal flooding and erosion risk posed to the Burrow based on new coastal flooding simulations which take account of:
  - New extreme water level information for the study area as defined by the ICWWS 2018 study.
  - The PRIME 2 dataset which has been used to produce a bespoke bed friction map for the study area.
  - Recent topography information which accounts for any morphological changes to the study area since the original report.
2. Update construction and maintenance costs for the Proposed Development. Where possible, these costs have been based on current contractor estimates with information from SPONS 2023 being used as an alternative.

This information was subsequently shared with John Chatterton Associates Ltd who prepared an updated economic appraisal of the scheme in-line with the Economic Appraisal of Flood Relief Schemes Interim Technical Guidance Note which was published by the OPW in 2023. This work is presented in a standalone report, the findings of which are summarised in Section 5 of this document.

It should be noted that this Technical Report is not intended to replace the original CFERM study but is instead to provide an update on the coastal flooding and erosion risk elements and the economic appraisal. As such, this document should be read in conjunction with the original CFERM report.

## 2 UPDATE OF COASTAL EROSION RISK AT THE BURROW

As per the original CFERM report, the risk of coastal erosion at the Burrow was assessed based on a historical trend analysis (HTA) using the Digital Shoreline Analysis System (DSAS) which is a geographic information systems (GIS) tool produced by the US Geological Society (USGS, 2018). For the purposes of brevity, readers are referred to the original CFERM report for a detailed description of this methodology.

However, suffice to say that the dataset used to inform the original HTA was updated to include topographic survey data which was recorded as part of four individual survey campaigns undertaken in 2019, 2020, 2022 and 2024. In all, this increased the number of available datasets from 10 to 14. The digitised shoreline datasets that were used to update this assessment are illustrated in Figure 2.1.

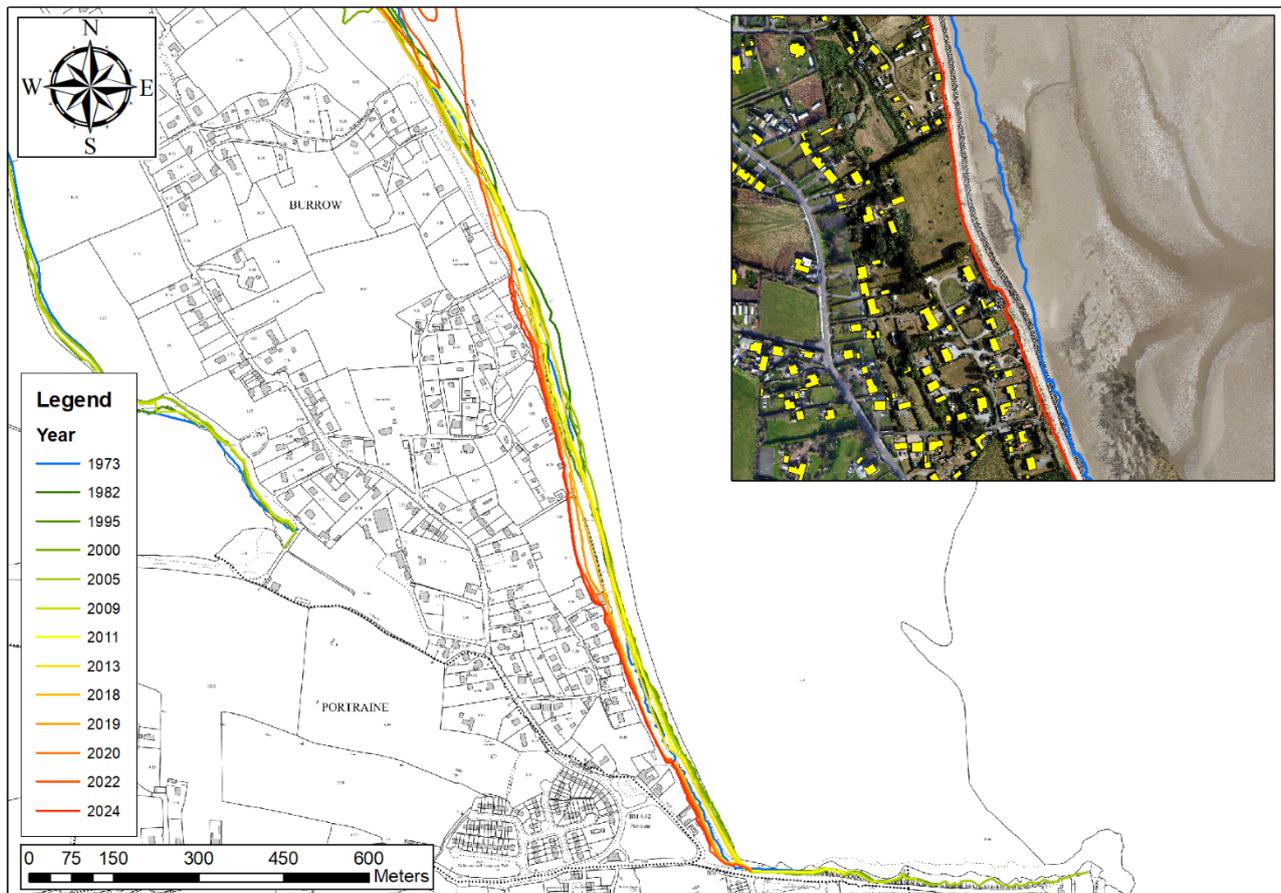


Figure 2.1: Overview of the digitised shoreline datasets between 1973 and 2024 used to update the historical trend analyses of coastal change along the Burrow.

Recognising that coastal erosion along the Burrow is not uniform, the shoreline was split into five individual sections to reflect the following approximate areas:

1. Brooks Pub.
2. Existing sheet piling north of Brooks Pub.
3. The extent of the original Seabee units.
4. The pitch and putt to beach lane.
5. North of beach lane.

These areas are illustrated in Figure 2.2 overleaf.

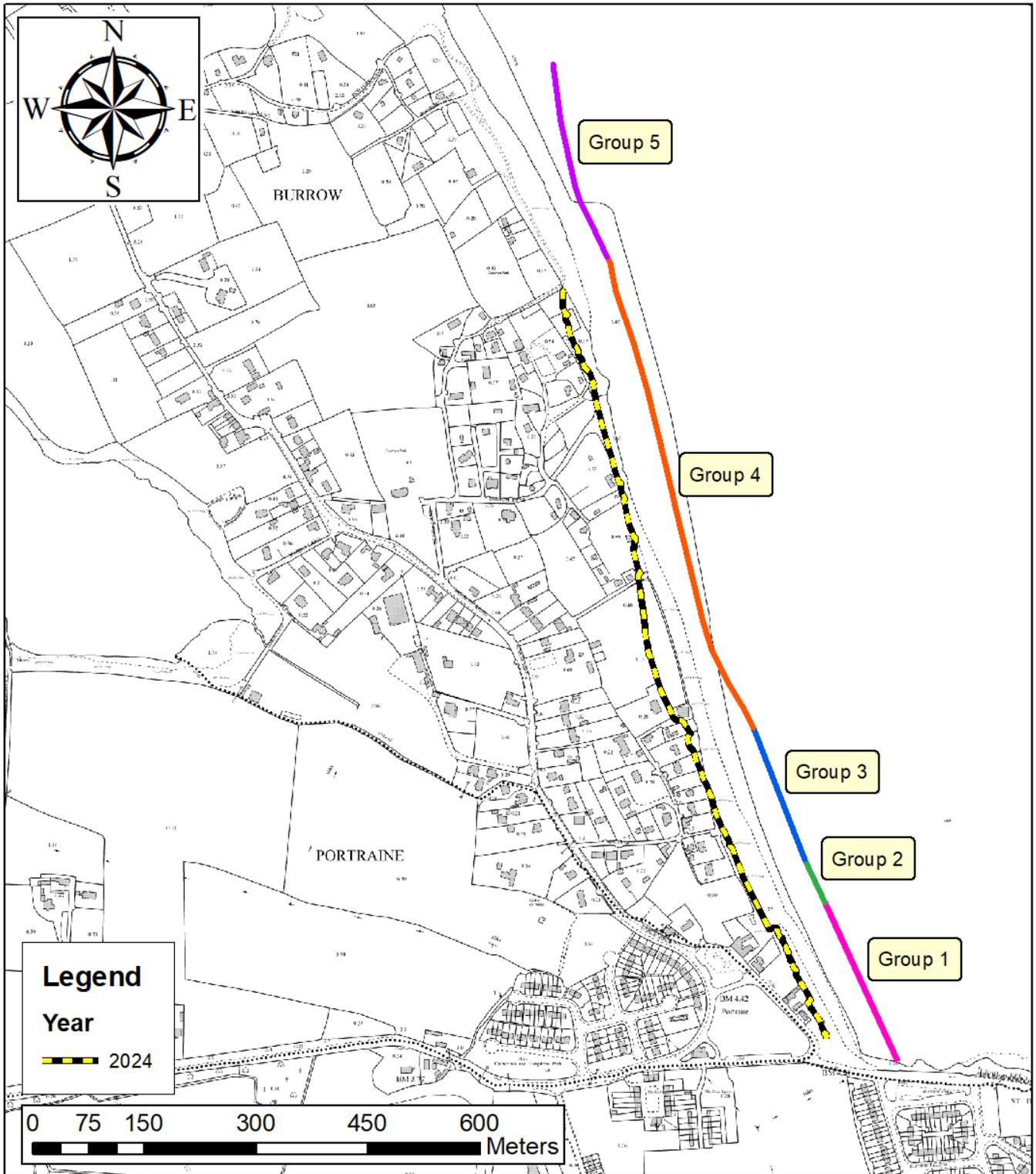


Figure 2.2: The groups used to update the historical trend analyses of coastal change along the Burrow.

Based on the new assessment and considering net shoreline movement, it was found that:

- Between 1975 – 2018, the average net shoreline movement ranged between -3.95m and -23.02m as illustrated in Figure 2.3. The max movement over this same period ranged between -7.58m and -42.64m as shown in Figure 2.4.
- More recently, between just 2011 – 2024, the average net shoreline movement ranged between -10.81m and -32.53m as illustrated in Figure 2.3. The max movement between this same period ranged between -25.19m and -54.92m as shown in Figure 2.4.

Regarding the rate of coastal change, the same analyses demonstrated that:

- Between 1975 – 2018, the average rate of shoreline movement ranged between -0.09m and -0.42m per year as illustrated in Figure 2.5. The max rate of change between this same period ranged between -0.17m and -0.52m per year as shown in Figure 2.6.
- More recently, between just 2011 – 2024, the average rate of shoreline movement ranged between – 1.32m and -2.90m per year as illustrated in Figure 2.5. The max rate of change between this same period ranged between -2.09m and -4.88m per year as shown in Figure 2.6.

Using this information, RPS produced an updated future coastal change map for the study area which illustrates potential future coastal retreat over the next 50 years based on a 2 m/yr and 4 m/yr erosion scenario as shown in Figure 2.7. These scenarios were identified as being generally representative of the average and max rates of erosion observed along the Burrow between 2011 and 2024.

The number of properties affected by coastal erosion over a 50 year period for various scenarios, based on this updated analysis is summarised in Table 2.1 below.

Table 2.1: Successive properties lost to coastal erosion up to year 50 based on various scenarios

	<b>MRFS 2 m/yr erosion</b>	<b>MRFS 4 m/yr erosion</b>	<b>MRFS Defended scenario</b>
10	17	31	0
20	31	83	0
30	55	142	0
40	82	199	0
50	114	234	0

This information was used in conjunction with the findings of the updated flood risk assessment to inform the updated economic assessment presented in Section 5.

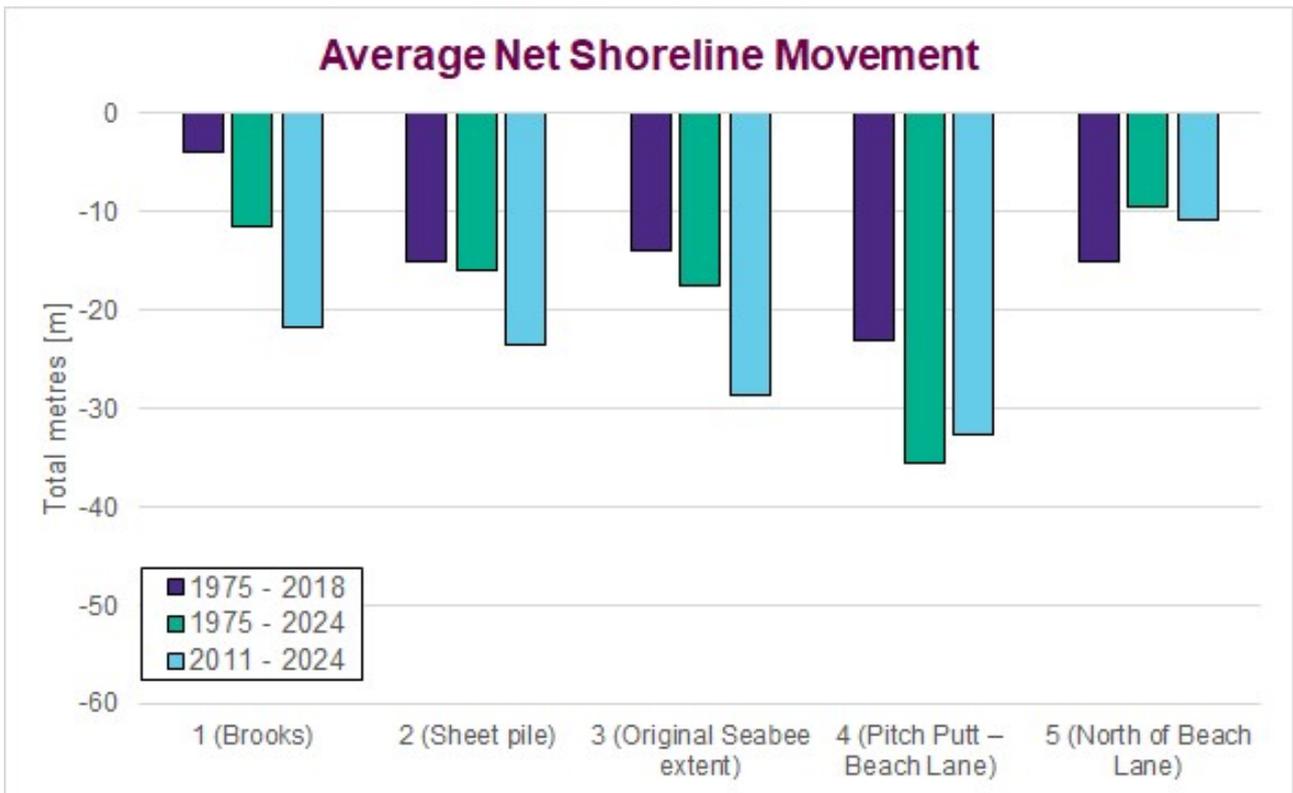


Figure 2.3: Average net shoreline movement along the Burrow based on various epochs

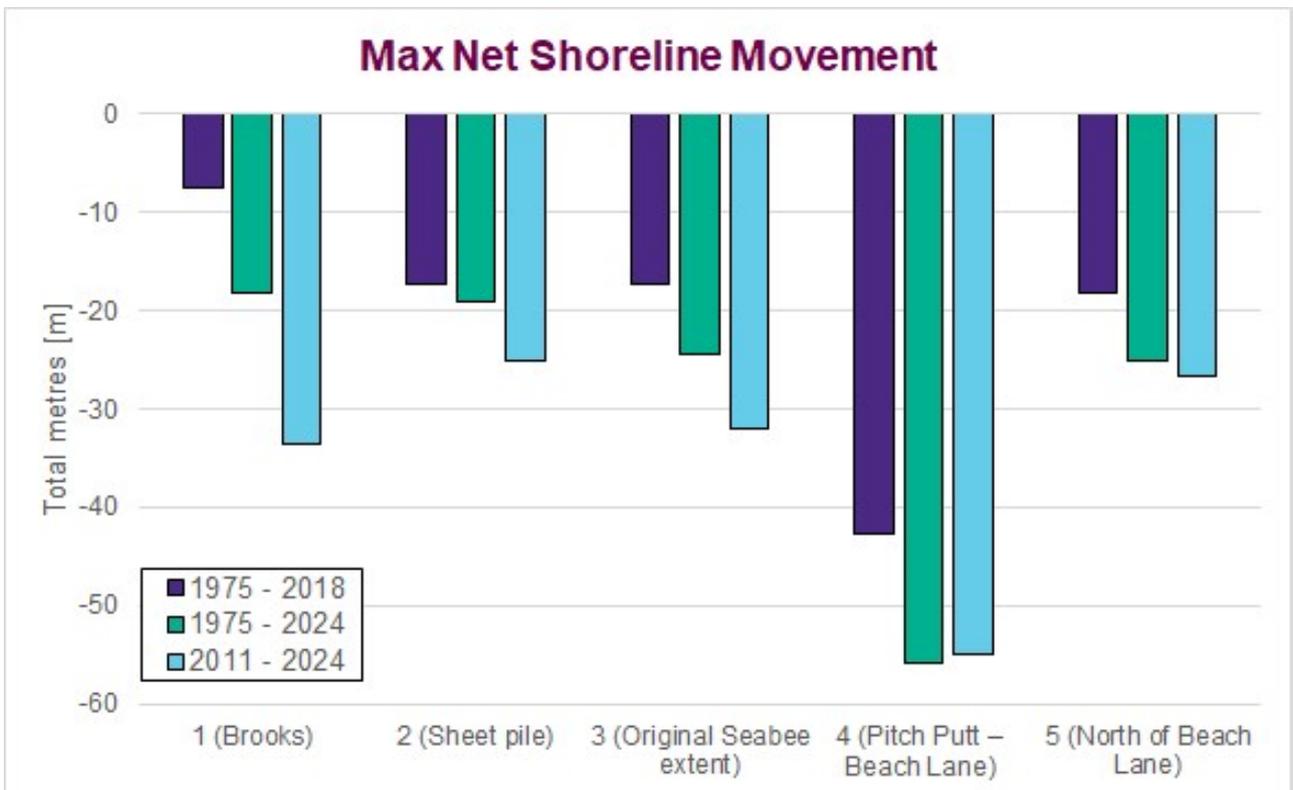


Figure 2.4: Max net shoreline movement along the Burrow based on various epochs

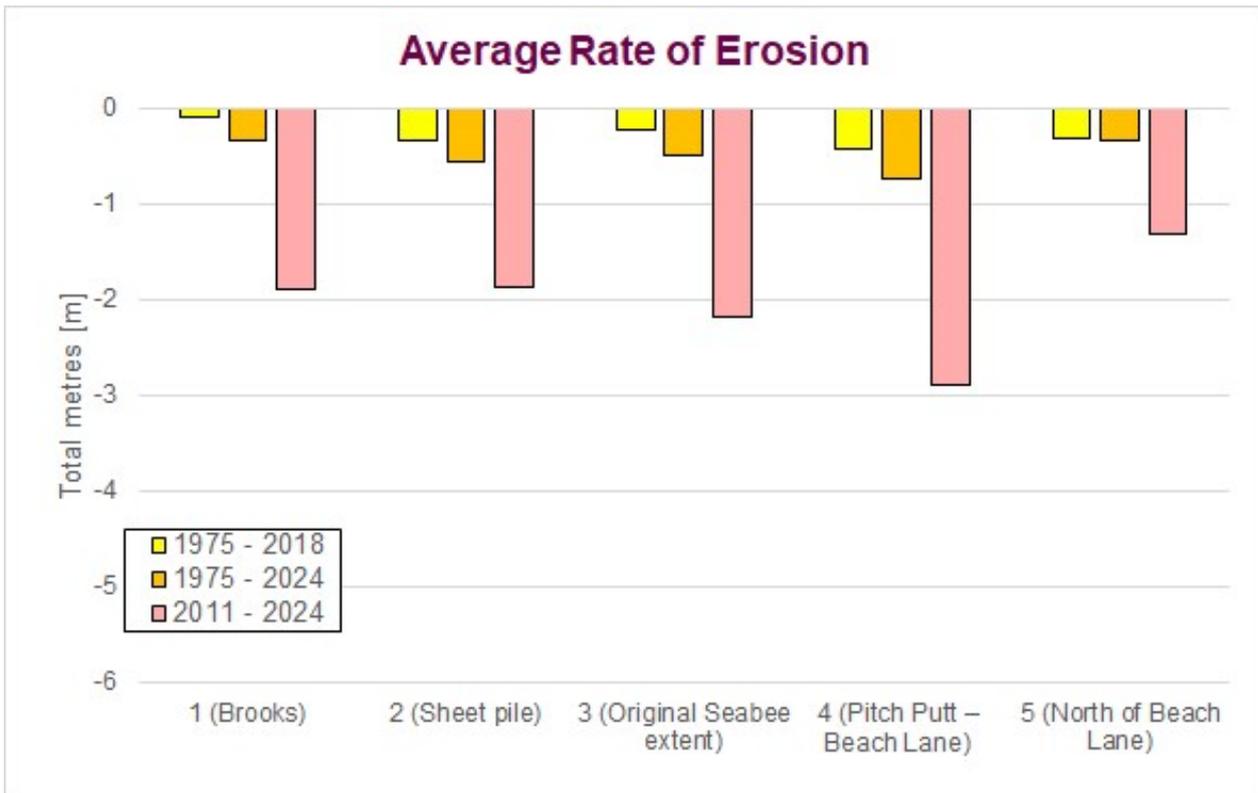


Figure 2.5: Average rate of shoreline change along the Burrow based on various epochs

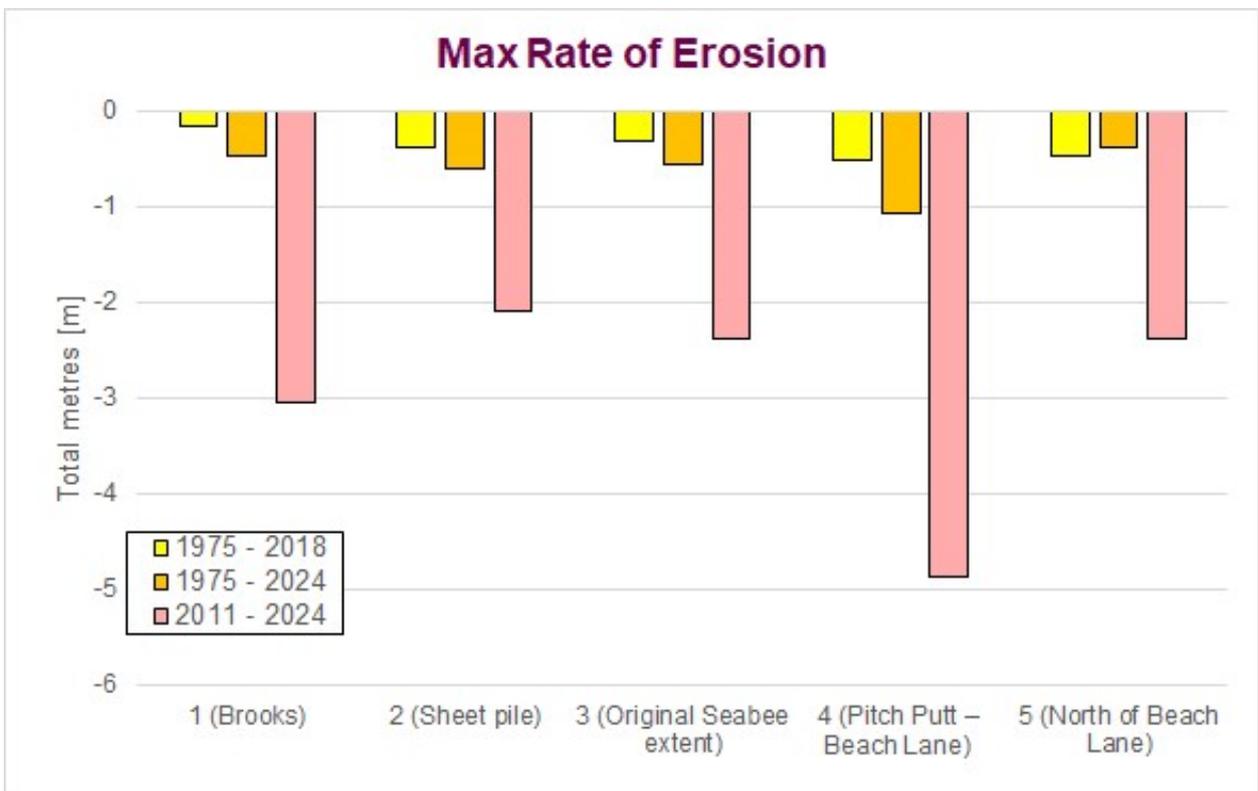
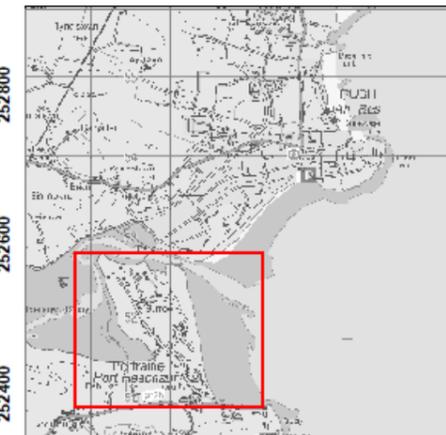
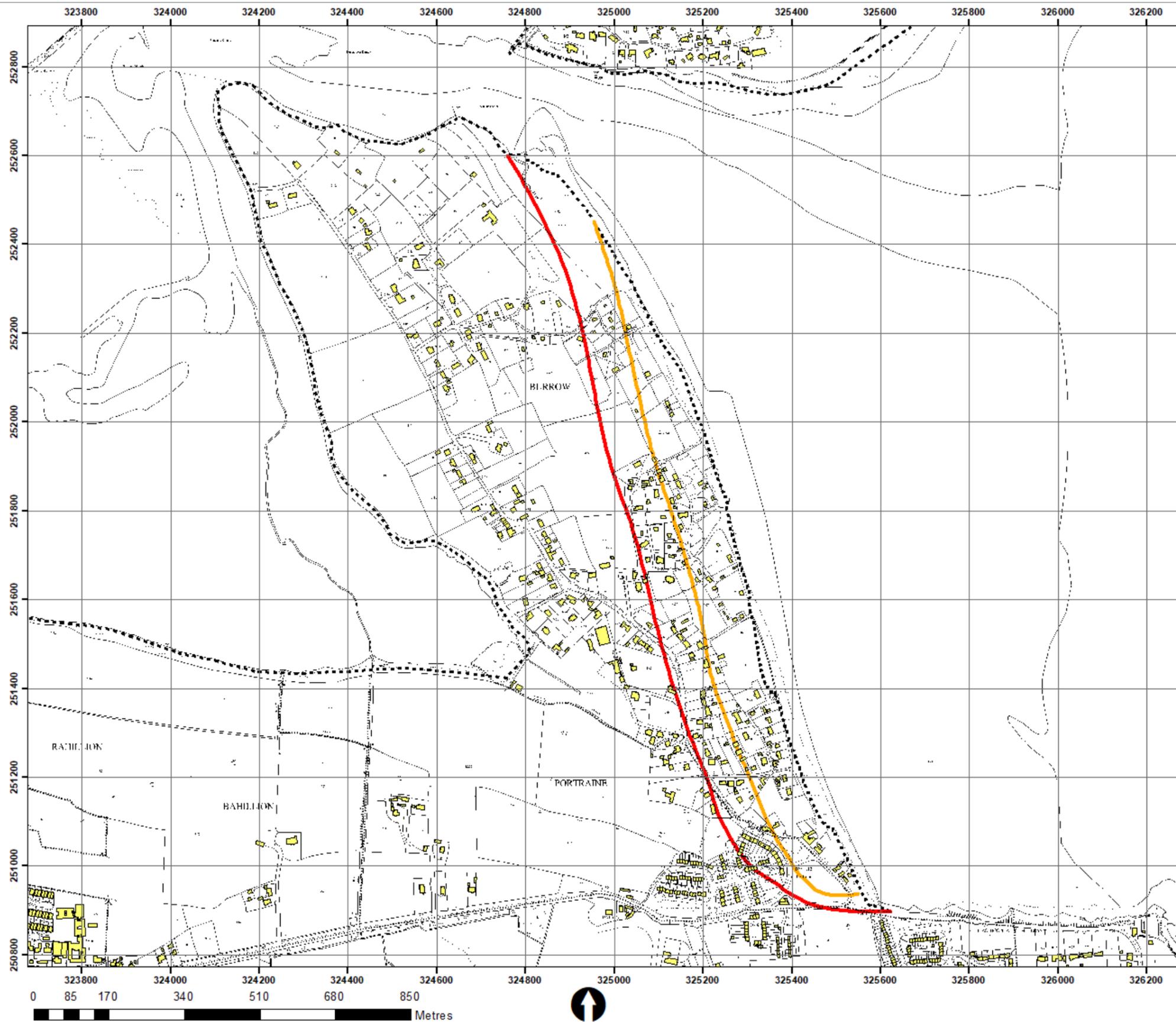


Figure 2.6: Max rate of shoreline change along the Burrow based on various epochs



- Legend**
- Buildings
  - Shoreline +50yrs at 2 m/yr
  - Shoreline +50yrs at 4 m/yr

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CLIENT <b>Comhairle Contae Fhine Gall</b> Antrim and Newtownabbey Council		
PROJECT <b>Rogerstown Coastal Flood &amp; Erosion Risk Management Study</b>		
TITLE <b>+ 50 years Coastal Change Map: 1</b>		
Drawing Status	Sheet Size	Drawing Scale
Final	A3	1:8000
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IBE1820_+50yrs_Erosion_1		-
Project Leader	Drawn By	Date
K.C.	N.M.	26/04/2024
Initial Review		
K.C.		

Figure 2.7: Projected coastal change across the Burrow over the next +50 years based on 2 and 4 m per year erosion scenarios

### 3 UPDATE OF COASTAL FLOODING RISK AT THE BURROW

The coastal flood simulations as described in the original CFERM report were also updated to:

- Account for the revised extreme water levels as defined by the Irish Coastal Wave and Water Level Modelling Study (ICWWS) 2018. The original and updated extreme water levels are summarised in Table 3.1
- Include a bespoke bed friction map which was developed using the PRIME 2 dataset as supplied by FCC.
- Account for morphological changes to the shoreline and elevation of the foreshore area as defined by recent topographic surveys of the study area.

In-line with the original assessment, coastal flood simulations were undertaken for eight individual return period events. These simulations were then re-run with water levels increased by +0.25m to reflect potential sea level rise over the next +50 years based on the Medium Range Future Scenario and with the coastline adjusted to account for erosion based on the 2m and 4m per year retreat scenarios. As summarised below, a total of 24 scenarios were run to define the flood risk at the Burrow based on a range of different scenarios:

- Current climate x 8 return period scenarios (see Figure 3.1)
- x8 return periods repeated based on a MRFS with +0.25m of sea level rise by +50 years, with the coastline setback by c.100m to account for the 2 m per year erosion scenario (see Figure 3.2).
- x8 return periods repeated based on a MRFS with +0.25m of sea level rise by +50 years, with the coastline setback by c.200m to account for the 4 m per year erosion scenario (see Figure 3.2).

Flood simulations were also re-run to calculate the flood extent with the Preferred Scheme in place for a MRFS 1 in 200 year return period scenario (see Figure 3.3).

Table 3.1: Extreme water level information (ODm, OSGM15) near the Burrow as defined by the ICPSS (2010) and more recent ICWWS (2020)

AEP event [%]	ICPPS (2010) Water Level [m]	IWWS (2020) Water Level [m]
50	2.67	2.80
20	2.79	2.89
10	2.89	2.96
5	2.99	3.02
2	3.12	3.11
1	3.22	3.18
0.5	3.31	3.25
0.1	3.54	3.41

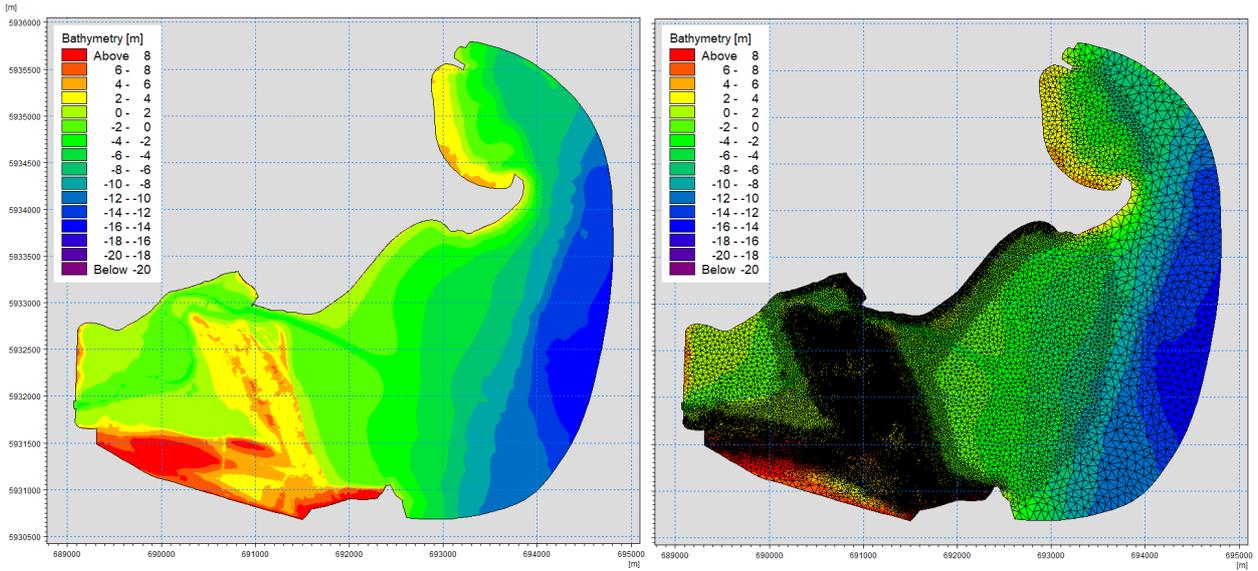


Figure 3.1: Extent and bathymetry (left) and mesh structure (right) of present day flood model

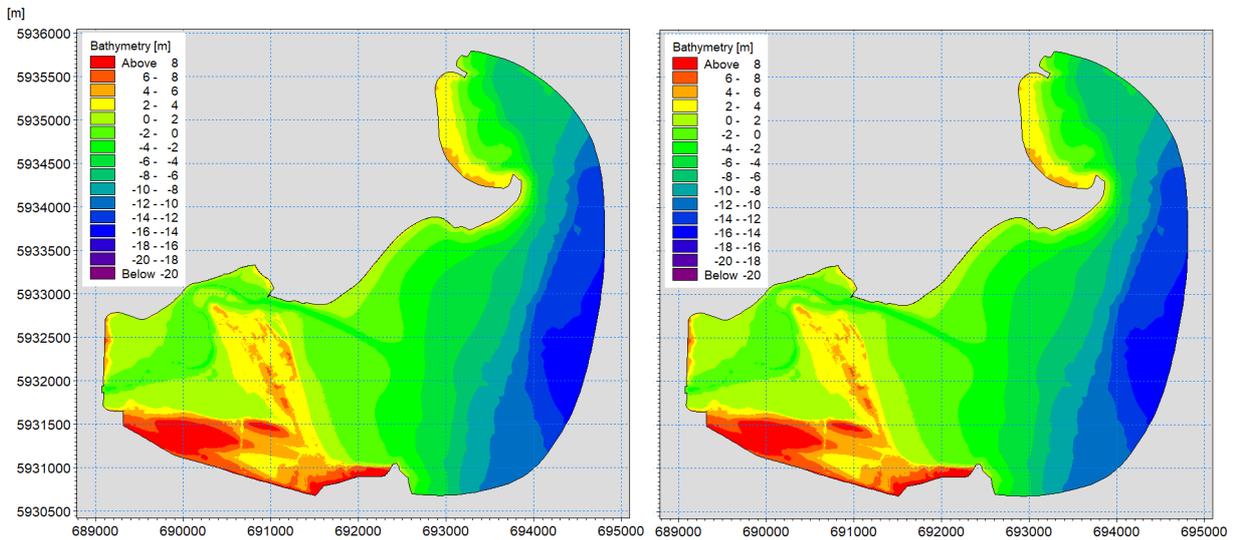


Figure 3.2: Bathymetry of the +50 year scenario model with 2 m/yr (left) and 4 m/yr (right) erosion applied

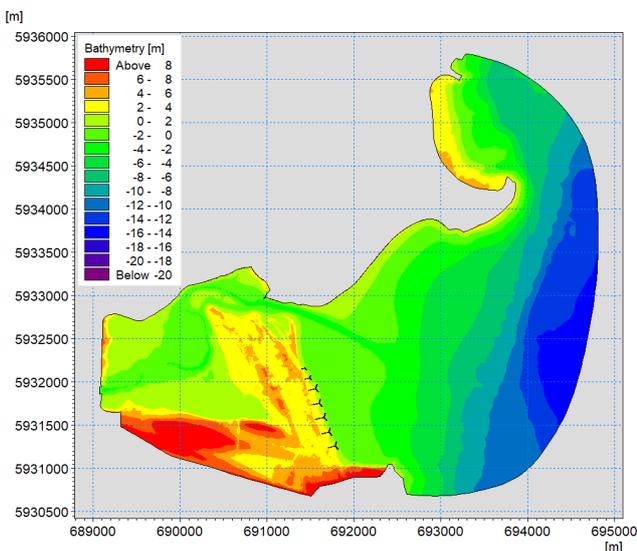


Figure 3.3: Extent and bathymetry of the Preferred Scheme model

A key to where the updated coastal flood extents based on the various scenarios are presented is given in Table 3.2, whilst the number of individual properties affected by flooding under each scenario is summarised in Table 3.3. It should be noted that the buildings affected by flooding are based on a geo-directory dataset which defines whether a property is residential, commercial, vacant or occupied etc; only occupied buildings have been considered for the purpose of this assessment.

It will be noted upon review of Table 3.3 that the number of properties affected by flooding under the 4m/yr erosion scenario is significantly lower than those affected under the 2m/yr erosion scenario despite the same extreme water levels being applied to each simulation. This difference can be accounted by the fact that more properties have been lost to coastal erosion under the 4m/yr erosion scenario and therefore are not present to be affected by coastal flooding.

Whilst not presented in this document, all coastal flood simulations also output flood depths that were used to inform the updated economic assessment which is presented in Section 5.

Table 3.2: Summary of coastal flood extent figures

Figure	Scenario
Figure 3.4	Current climate, no sea level rise and the coastline
Figure 3.5	MRFS, +0.25m SLR with +50yrs erosion @ -2m /yr
Figure 3.6	MRFS, +0.25m SLR with +50yrs erosion @ -4m /yr
Figure 3.7	MRFS, +0.25m SLR – Defenced Scenario

Table 3.3: Summary of the number of properties affected by coastal flooding across the Burrow during various return period, climate change and erosion scenarios

AEP event [%]	Number of Properties affected			
	Current Climate	MRFS 2 m/yr erosion	MRFS 4 m/yr erosion	MRFS Defended scenario
50	6	50	13	0
20	6	54	15	0
10	7	65	17	0
5	9	66	21	0
2	9	69	26	0
1.	9	77	27	0
0.50	9	82	29	0
0.10	10	108	45	10

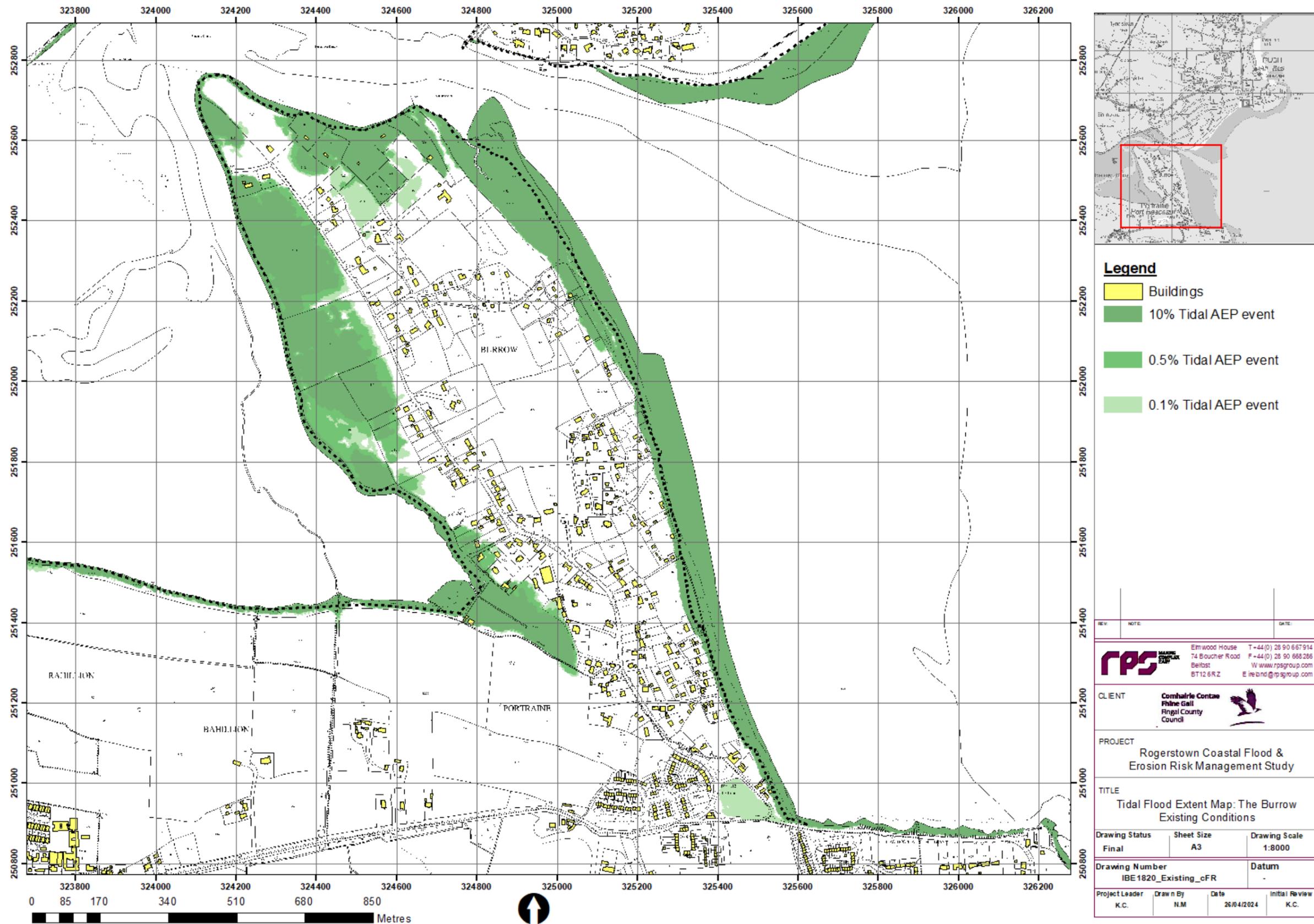


Figure 3.4: Updated Tidal Flood Extent Map: The Burrow – Present Day Conditions (i.e. no sea level rise or coastal change)

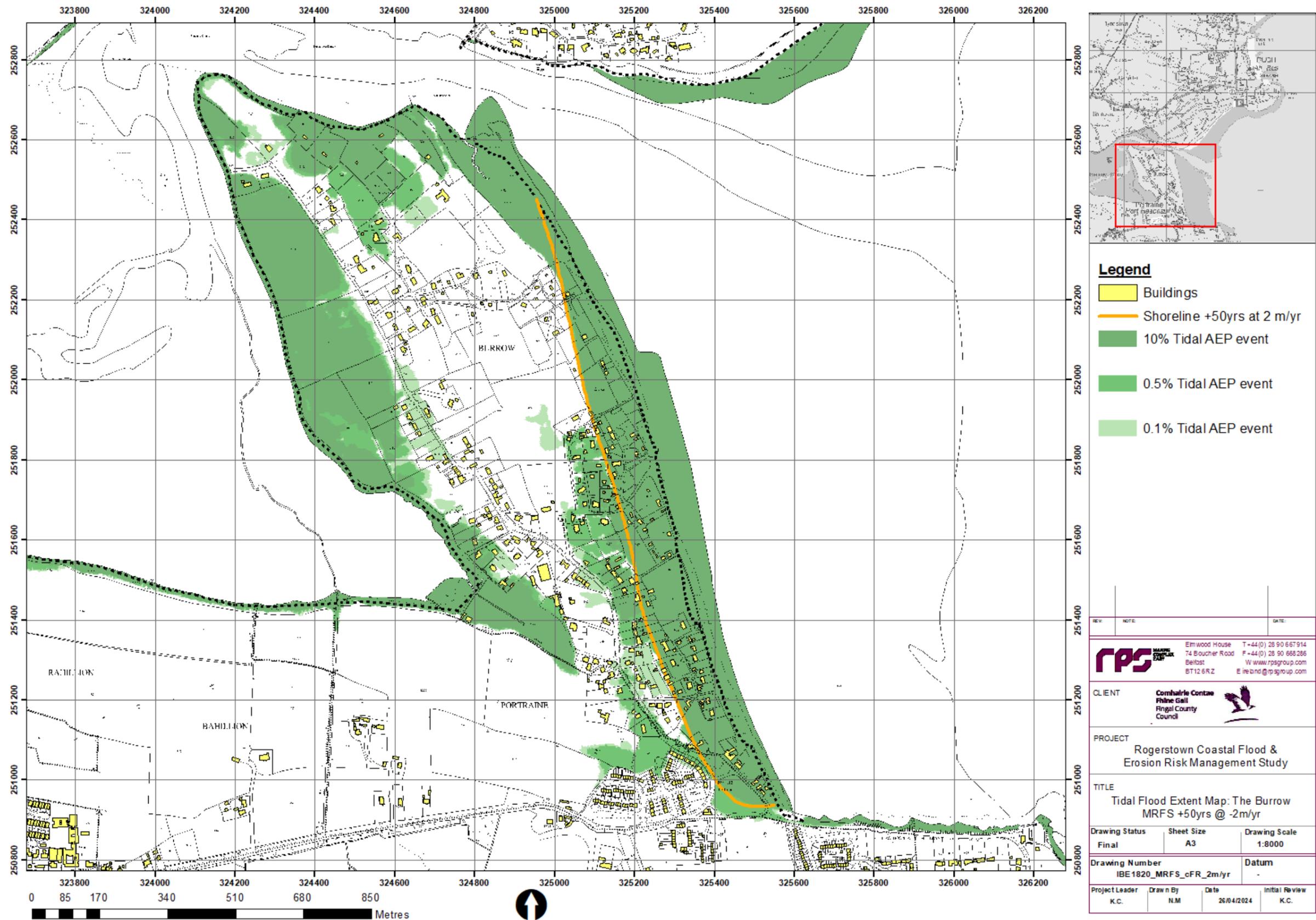


Figure 3.5: Updated Tidal Flood Extent Map: The Burrow – MRFS (+0.25m SLR) with erosion at 2m/yr for 50yrs



Figure 3.6: Updated Tidal Flood Extent Map: The Burrow – MRFS (+0.25m SLR) with erosion at 4m/yr for 50yrs

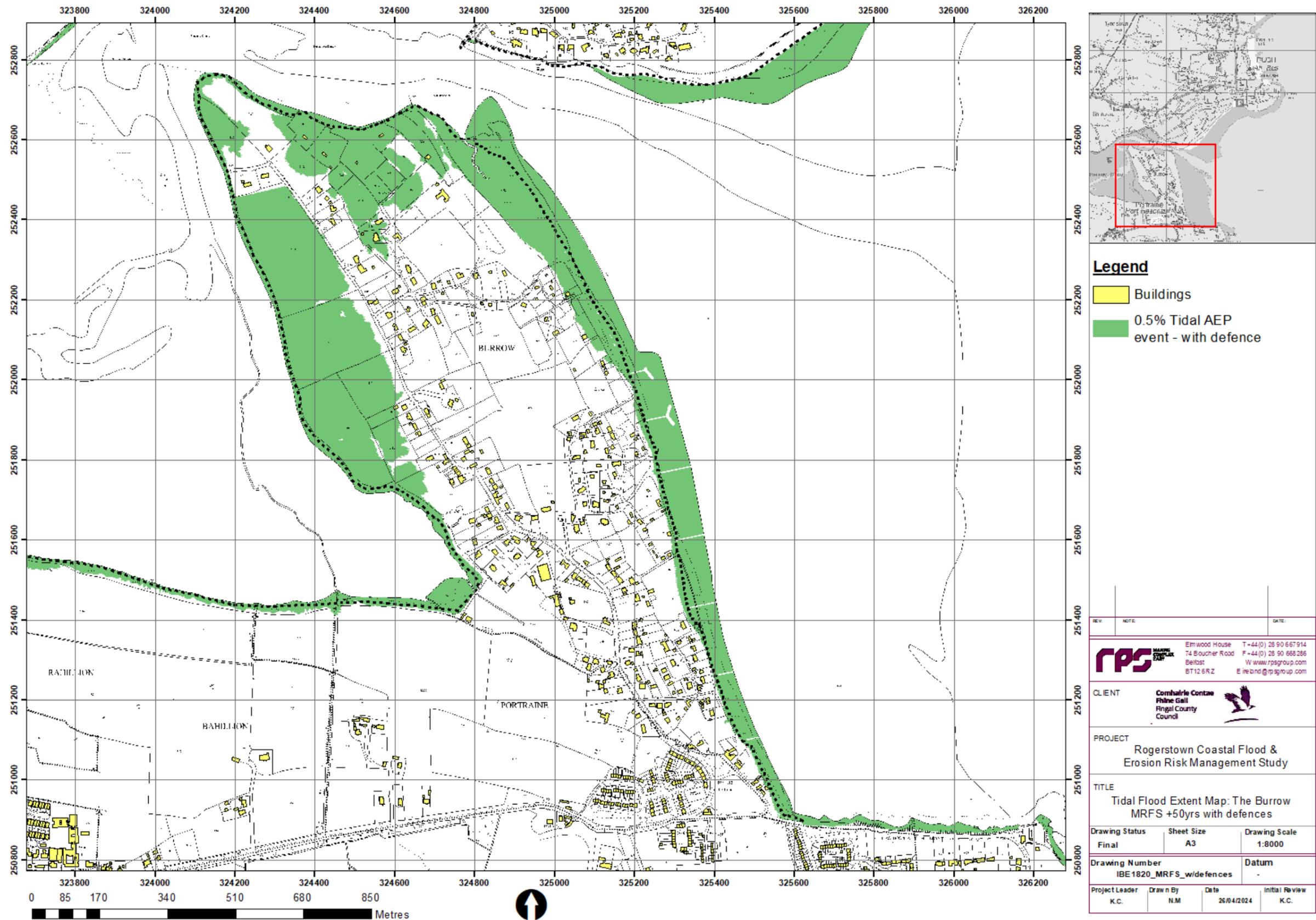


Figure 3.7: Updated Tidal Flood Extent Map: The Burrow – MRFS (+0.25m SLR) Defended Scenario with preferred Scheme in place

## 4 UPDATE OF COSTS FOR PREFERRED SCHEME

RPS liaised with specialist contractors, Ashleigh Construction and Boskalis, to develop updated cost estimates for the Preferred Scheme. Estimates for the civil engineering elements were primarily provided by Ashleigh with Boskalis providing estimates in relation to the transport and provision of beach nourishment material.

This primary information, where necessary, was supplemented, using material quantities that were calculated using Civils 3D AutoCAD software in combination with rates from previous RPS jobs, SPONS 2023, Environment Agency unit rates and further estimates. Conversions from GBP to EUR were applied using an exchange rate of 1.17.

A detailed breakdown of costs associated with the Preferred Scheme is provided in the supporting excel document “*IBE1820 - The Burrow Preferred Scheme Cost Estimate D03.xlsx*”, and a summary of the estimated initial capital costs, including optimism bias and other capital costs is presented in Table 4.1 below.

Table 4.1: Summary of initial capital cost estimates for the Preferred Scheme at the Burrow.

Costing Summary	Cost Estimate (€ ex.VAT)	Cost Estimate (€ ex.VAT)
<b>PV Enabling Costs</b>		€3,077,494.35
<b>PV Preliminary Costs</b>		€3,575,820.46
<b>PV Construction Costs</b>		€16,367,930.99
Element 1 Construction Costs - Burrow Road Embankment	€359,495	
Element 2 Construction Costs - Marsh Lane Flood Wall and Embankment	€1,166,816	
Element 3 Construction Costs - Portrane Beach Groynes and Renourishment	€15,414,498	
<b>Contractor's Profit Margin (assume 10%)</b>		€1,694,080.86
<b>Optimism Bias (43.5%)<sup>1</sup></b>		€7,120,049.98
<b>Total Cost (€, ex VAT)</b>		<b>€31,835,376.63</b>

Future maintenance costs for the operation and maintenance of the flood embankment and wall structures were derived from Scottish Environment Protection Agency (SEPA) Unit Cost Database (UCD) for flood protection measures<sup>2</sup>. This equated to an average annual cost of €39,021 ex. VAT which includes for an additional 43.5% to account for optimism bias and 10% for professional fees.

For the groyne structures it was assumed, based on previous experience, that approximately 10% of the initial construction costs would be incurred once every ten years, with maintenance generally relating to the supply and replacement of rock armour material which may have been displaced by storm events. Additionally based on sediment transport modelling, it was estimated that c. 50% of the beach nourishment material would need to be replaced once every 10 years. In all, this equated to an annual cost of €17,455,199 ex. VAT including optimism bias, professional fees, preliminary and enabling works.

A detailed breakdown of costs and supporting assumption regarding preliminary & enabling costs, optimism bias and operation and maintenance is provided in the supporting excel document “*IBE1820 - The Burrow Preferred Scheme Cost Estimate D03.xlsx*”. All of this cost information was used to inform the updated Economic Appraisal summarised in the following Section.

<sup>1</sup> See “*IBE1820 - The Burrow Preferred Scheme Cost Estimate D03.xlsx*” for justification of Optimism Bias

<sup>2</sup> <https://www.gov.scot/publications/guidance-support-sepa-responsible-authorities/pages/10/>

## 5 UPDATED ECONOMIC APPRAISAL OF THE PREFERRED SCHEME

This Section of the report summarises the findings of the updated economic appraisal undertaken in accordance with the Economic Appraisal of Flood Relief Schemes Interim Technical Guidance Note produced by the OPW which was completed by John Chatterton Associates (JCA, 2024) under sub-contract to RPS.

In recognition of the uncertainty regarding the future rate of coastal erosion along the Burrow, the economic appraisal was undertaken for the following four base scenarios:

- **Scenario A:** Constant rate of erosion of 2m/yr and no property thresholds for coastal flooding.
- **Scenario B:** Constant rate of erosion of 2m/yr and a 200mm property threshold applied for coastal flooding.
- **Scenario C:** Constant rate of erosion of 4m/yr and no property thresholds for coastal flooding.
- **Scenario D:** Constant rate of erosion of 4m/yr and a 200mm property threshold applied for coastal flooding.

In addition, sensitivity testing in respect of Transaction Discount Rates (TDR) was undertaken using:

- 3.5% from years 0 to 30 and 4% thereafter to year 50.
- A flat 3% rate for 50 years.
- A flat 5% rate for 50 years.

In the interest of further examining the sensitivity of the assessment, all scenarios were considered using two property values:

- The median value of properties within Eircode K36 (Malahide)
- 50% of this median value.

Including the sensitivity testing described above meant that in effect, a total of 24 individual economic appraisals were undertaken for the Preferred Scheme. A full description of the assumptions used in applying the OPW appraisal guidance to the Burrows appraisal and a discussion regarding the potential effects any changes might have on the final Net Present Value and Benefit Cost Ratio of each scenario can be found in the standalone Economic Appraisal report (JCA, 2024).

This appraisal was informed by the findings of the updated coastal flooding and erosion risk assessment and scheme costs as described in earlier Sections of this report.

### 5.1 Summary of updated economic appraisal

Table 5.1 summarises the results of the economic analysis for the four scenarios with varying Transaction Discount Rates (TDR) and property valuation assumptions applied.

It was found that using the €520,000 median property value gave a Benefit Cost Ratio (BCR) of greater than unity for all 12 scenarios. Reducing the typical property value to 50% of the median value for Eircode K36 properties achieved a BCR greater than unity for all scenarios except D5 (4m/year erosion, 200mm property flooding threshold).

For this scenario, the PVb of property loss is significantly increased in the latter years of the 50-year project horizon (see 5% TDR values) with fewer properties therefore remaining to accumulate flood damages leading to reduced flooding benefits for the proposed scheme.

Scenario B with the lower erosion rate and flooding threshold included was found to produce a BCR of between 1.10 & 1.81, depending on the TDR and property value applied.

JCA concluded that based on the projected coastal flood and erosion risk posed to the Burrow over the next 50 years that the scheme as proposed by RPS will produce a BCR greater than unity for 96% of 24 scenarios assessed.

It should be noted that the overall economic viability of the scheme could potentially be significantly enhanced should suitable areas for marine aggregate extraction be identified and licensed in Ireland in the future. This would offset much of the mobilisation and transportation costs associated with the nourishment campaign as identified for the Preferred Scheme at the Burrow which currently equates to just less than €3million owing to the nearest licensed site being located in Liverpool Bay.

Table 5.1: Summary results for each Scenario with sensitivity analysis and upper and lower property price estimates.

			Property Value		
			€ 520,000		€ 260,000
Scenario		Test Discount Rate	Benefit Cost Ratio	NPV (€)	Benefit Cost Ratio
A	2m/year erosion, No property flooding Threshold	3.5/4%	1.822	53,699,011	1.445
A3	2m/year erosion, No property flooding Threshold	3%	1.950	68,402,560	1.554
A5	2m/year erosion, No property flooding Threshold	5%	1.551	31,878,963	1.218
B	2m/year erosion, 200mm property flooding Threshold	3.5/4%	1.687	44,909,770	1.311
B3	2m/year erosion, 200mm property flooding Threshold	3%	1.806	57,998,597	1.410
B5	2m/year erosion, 200mm property flooding Threshold	5%	1.437	25,292,593	1.104
C	4m/year erosion, no property flooding Threshold	3.5/4%	1.968	63,250,276	1.136
C3	4m/year erosion, no property flooding Threshold	3%	2.080	77,754,914	1.201
C5	4m/year erosion, no property flooding Threshold	5%	1.789	45,675,784	1.031
D	4m/year erosion, 200mm property flooding Threshold	3.5/4%	1.878	57,407,895	1.047
D3	4m/year erosion, 200mm property flooding Threshold	3%	1.985	70,901,236	1.106
D5	4m/year erosion, 200mm property flooding Threshold	5%	1.712	41,179,777	0.953

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