ROGERSTOWN COASTAL FLOOD EROSION RISK MANAGEMENT STUDY

Stage 1: Coastal Flood and Erosion Risk Assessment

Non-Technical Summary

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Rogerstown CFERM Study

Stage 1
Risk Assessment NTS

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Malcolm Brian		13 July 2020

Prepared by:

RPS Ireland Ltd

Kristopher Calder
Associate | BSc (Hons) MSc C.Sci MCIWEM C.WEM AMICE
Elmwood House
74 Boucher Road, Belfast
Co. Antrim BT12 6RZ

T +44 2890 667 914
E Kristopher.calder@rpsgroup.com

Prepared for:

Fingal County Council

Hans Visser
Biodiversity Officer

Fingal County Council
County Hall, Swords,
County Dublin

T (01) 890 5000
E hans.visser@fingal.ie

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1 INTRODUCTION

The purpose of this Non-Technical Summary (NTS) is to present the findings of a coastal flooding and erosion risk assessment of the Rogerstown estuary area. The work undertaken in support of this assessment forms Stage 1 of the Rogerstown estuary Coastal Flooding and Erosion Risk Management (CFERM) study.

This document presents the findings of:

- A historical review of coastal change.
- A description of key coastal processes.
- An assessment of the coastal flooding and erosion risk.

The locations considered by this study included the Burrow peninsula and the coastlines along Rush South and Rush North. These areas are shown in Figure 1.1.

It should be noted that the findings of the Stage 1 assessment which identified suitable coastal management options for each area is presented in an accompanying report.

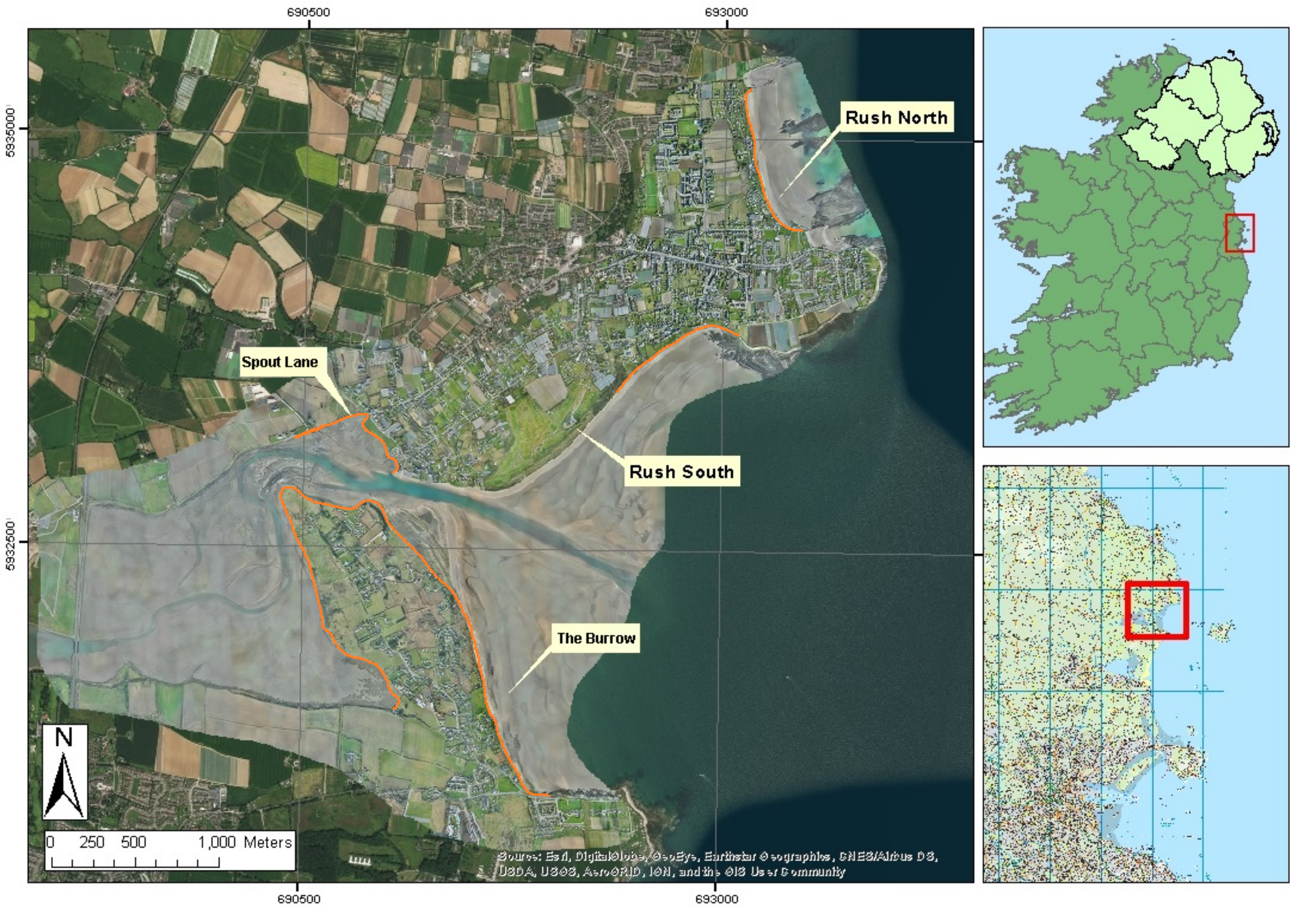

Figure 1.1: Location of the key study areas at the Burrow, Spout Lane and the Rush beaches

2 HISTORICAL REVIEW

To better understand the coastal change across the study areas RPS reviewed a range of historical maps and aerial photographs from between 1973 and 2019.

2.1 The Burrow

As shown in Figure 2.1 and Figure 2.2, coastal change along Burrow has been very complex. In summary, the historical review of coastal change at the Burrow found that:

- Between 1973 and 2000 the southern section of the Burrow advanced seaward by c.20m.
- The position of the shoreline remained relatively stable between 2000 and 2005 with very little net movement.
- Since 2005 the shoreline had remained relatively stable during summer months but retreated significant distances during some winter periods. This indicated that shoreline movement in this area is a result of ***acute erosion*** (i.e. storm specific, event driven) as opposed to ***chronic erosion*** (gradual, long-term).
- Following Storm Emma and several other extreme storms events, the shoreline along the southern section of the Burrow retreated by more than 20m in some locations. This resulted in a private residential property being demolished due to safety issues.

Previous studies of the Burrow concluded that the coastline along the Burrow was Dynamically Stable which means that the shoreline can move about an average position in response to different weather conditions.

However, with global change climate causing an increase in sea levels and more extreme storm events, this beach is now considered to be continually retreating.

Figure 2.1: Historical coastal change along the southern region of the Burrow between 1973 and 2019

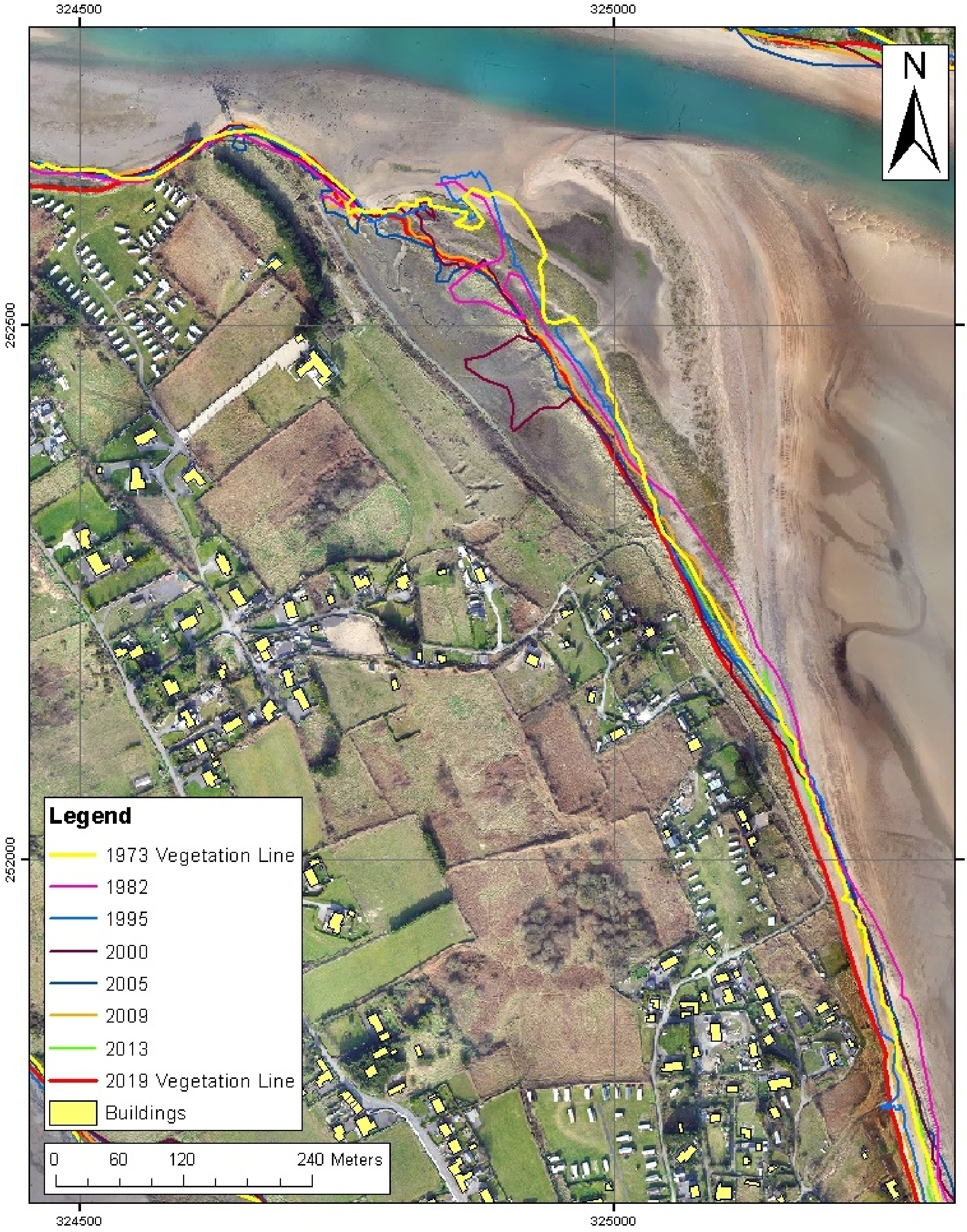

Figure 2.2: Historical coastal change along the northern region of the Burrow between 1973 and 2019

2.2 Rush South

As shown in Figure 2.3 and Figure 2.4, regions of Rush South have experienced episodes of erosion whilst other areas have been gradually accreting sand material. In summary, the historical review of coastal change at the Rush South found that:

- The coastline remained relatively stable in front of the golf course between 1995 and 2013.
- Between 2013 and 2019, the shoreline in the same area retreated by *c.*30m. Much of this erosion has been attributed to single extreme storm events like Storm Emma in 2018.
- At the northern extent of the beach in the region of the carpark, the shoreline advanced by approximately 20m between 1973 and 2019.

The fact that some rock armour along the northern section of this beach has been buried by sand indicates that this area is a net sediment sink and is gradually advancing seaward.

2.3 Rush North

Historical coastal change at Rush North is shown in Figure 2.5 and Figure 2.6. Based on this information it was found that:

- The beach at Rush North experienced a modest amount of accretion between 1973 and 2019. This resulted in a net advancement of the shoreline of up to 20m.
- The carpark at Rush North is well protected by rock armour as an offshore gas line comes ashore at this point.
- Some regions of Rush North did retreat by several metres between 2012 and 2019. Based available evidence this coastal retreat is expected to have occurred during Storm Emma in 2018.

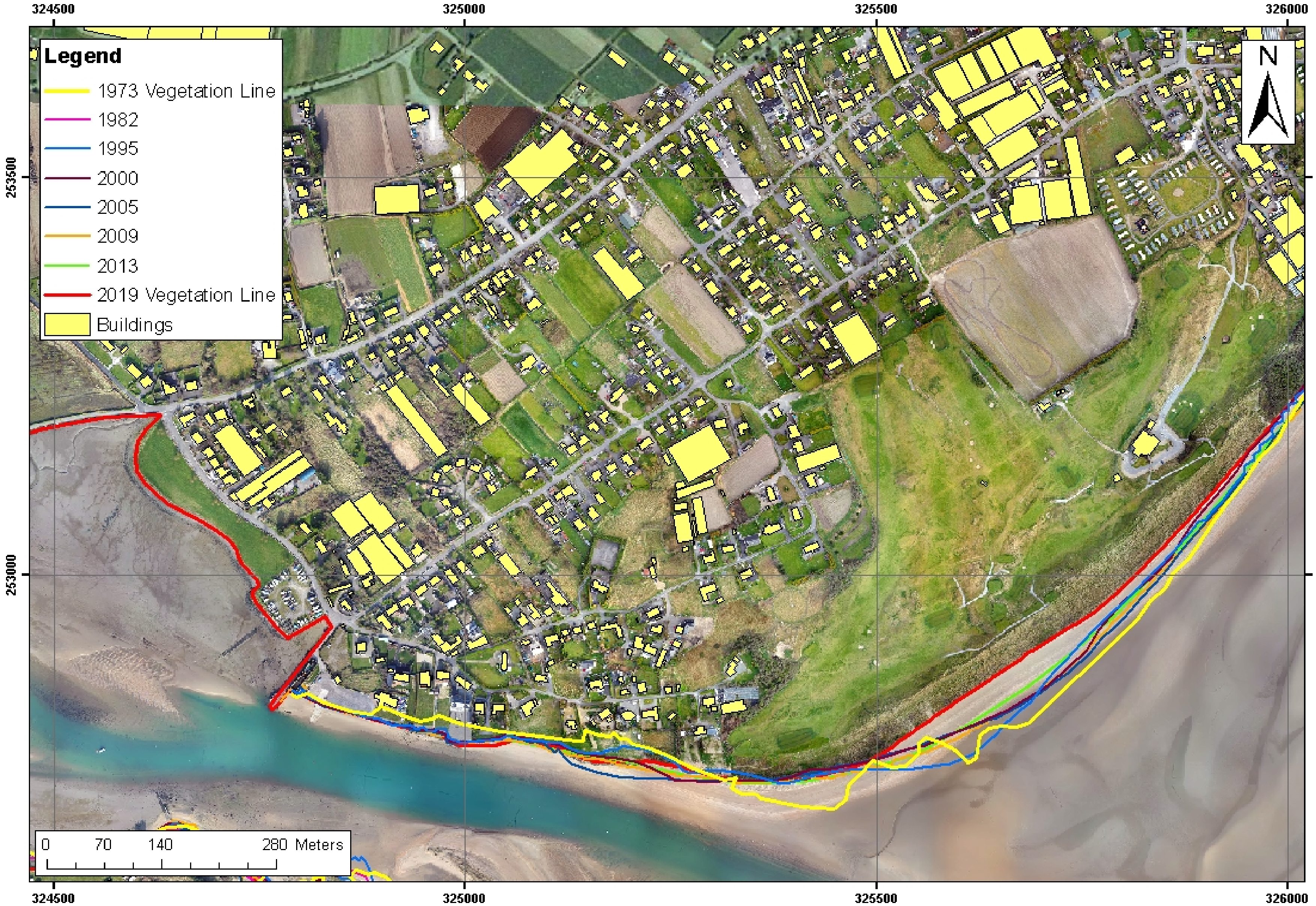

Figure 2.3: Historical coastal change along the inner region Rush South between 1973 and 2019

Figure 2.4: Historical coastal change along the outer region Rush South between 1973 and 2019

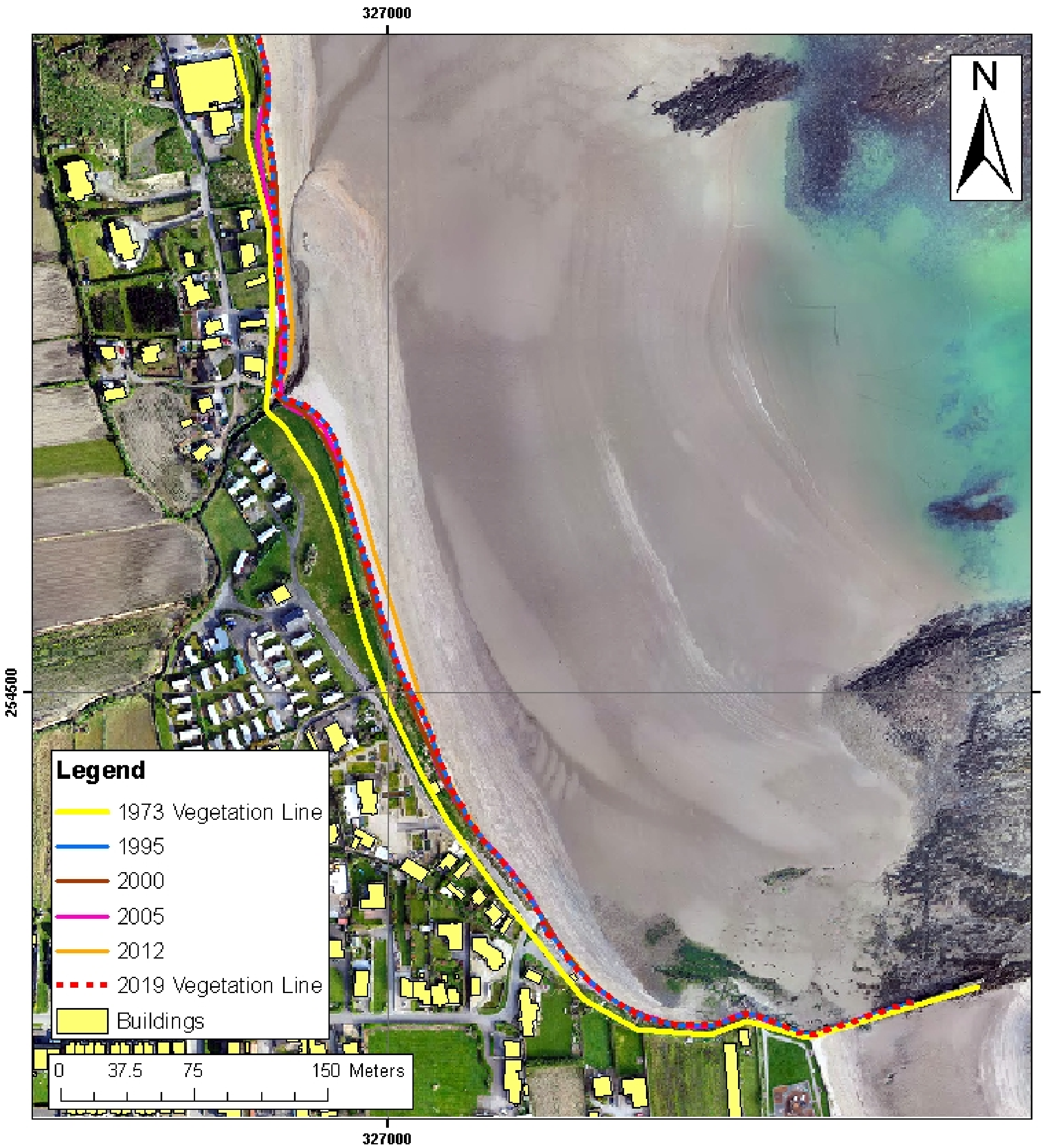

Figure 2.5: Historical coastal change along the lower region of Rush North between 1973 and 2019

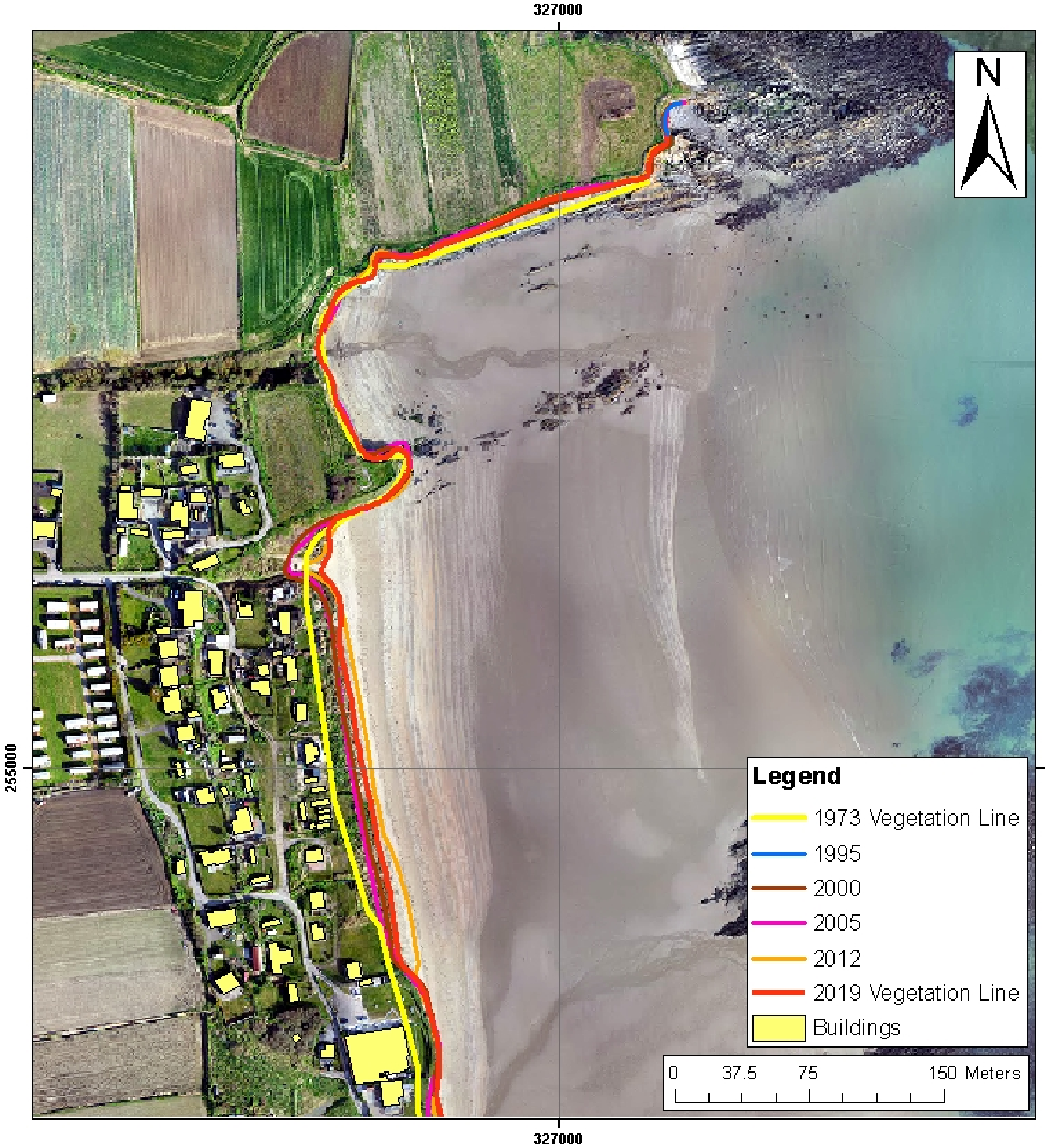

Figure 2.6: Historical coastal change along the upper region of Rush North between 1973 and 2019

3 COASTAL PROCESSES

Before assessing the coastal flooding and erosion risk across the study areas it was important to establish how the coastal processes function around the Rogerstown estuary.

To this end RPS used a series of advanced computer models of the study area, similar to the one shown in Figure 3.1, to evaluate:

- The tidal currents.
- The average and extreme wave climates.
- The sediment transport regime.
- The current and future scenario flood and erosion risk.

The findings of the sediment transport assessment are presented in Section 3.1 of this report. However, for the purposes of brevity the findings from the other assessments have been included in the CFERM Stage 1 Technical report only.

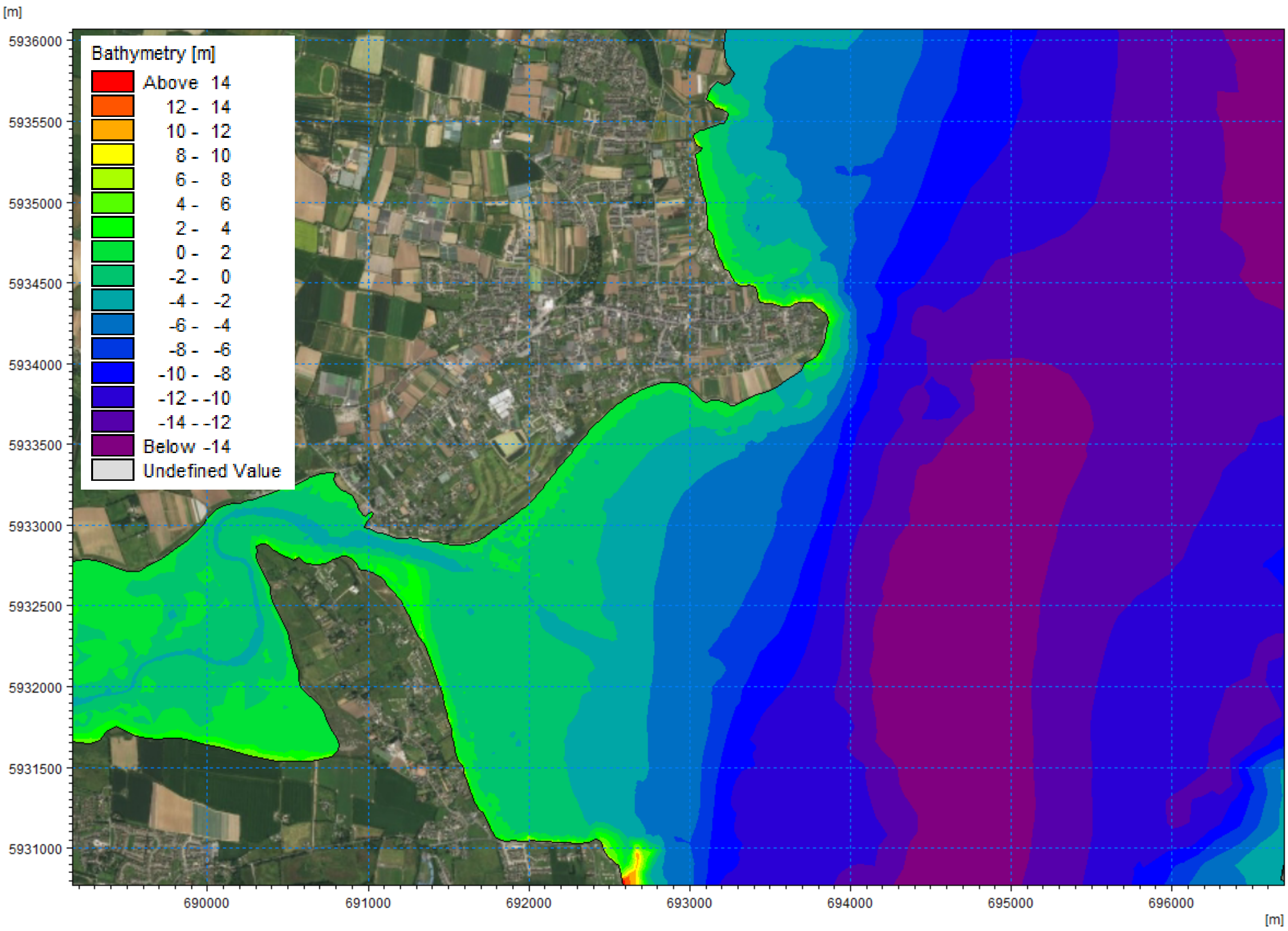

Figure 3.1: Detailed computer model of the Rogerstown estuary area

3.1 Sediment Transport Regime

RPS assessed the movement of sand across each of the three study areas during typical storm events from the north east and south using advanced computer models.

The movement of sand during each of these events is summarised in Figure 3.2 and Figure 3.3. A traffic light colour system whereby high, medium and low rates of sand movement are shown by red, yellow and green arrows respectively.

During north easterly storm events (see Figure 3.2) it was found that:

- Tides generally circulated (i.e. eddy) along Rush North. Sand could therefore move back-and-forth but did not tend to leave the beach.
- High rates of sand movement were detected along the toe of the dune at Rush South. This sand tended to move towards the estuary whereby the outgoing flow from the estuary would carry it away from the beach.
- At the Burrow, waves from the north east moved sand from the toe of the dune and carried it away from the beach towards the south east.

The movement of sand during south easterly events was more complex as shown in Figure 3.3. It was found that during these storm events:

- At the carpark in Rush South, sand tended to move south towards the estuary.
- At the Burrow, sand was transported northwards from the upper beach whereby strong flows from the estuary moved the sand into deeper water offshore.
- Much of this sand could be lost to the wider area which would result in a deficit of sand material along the Burrow and an increased risk of coastal erosion.

It is expected that the supply of sand to the Burrow is less than the volume of sand leaving the beach. The beach at the Burrow is therefore considered to be in a state of continuous coastal retreat.

Rush South is generally stable but regions of this coastline may retreat during storms. The beach at Rush North is not currently exposed to significant erosion pressures.

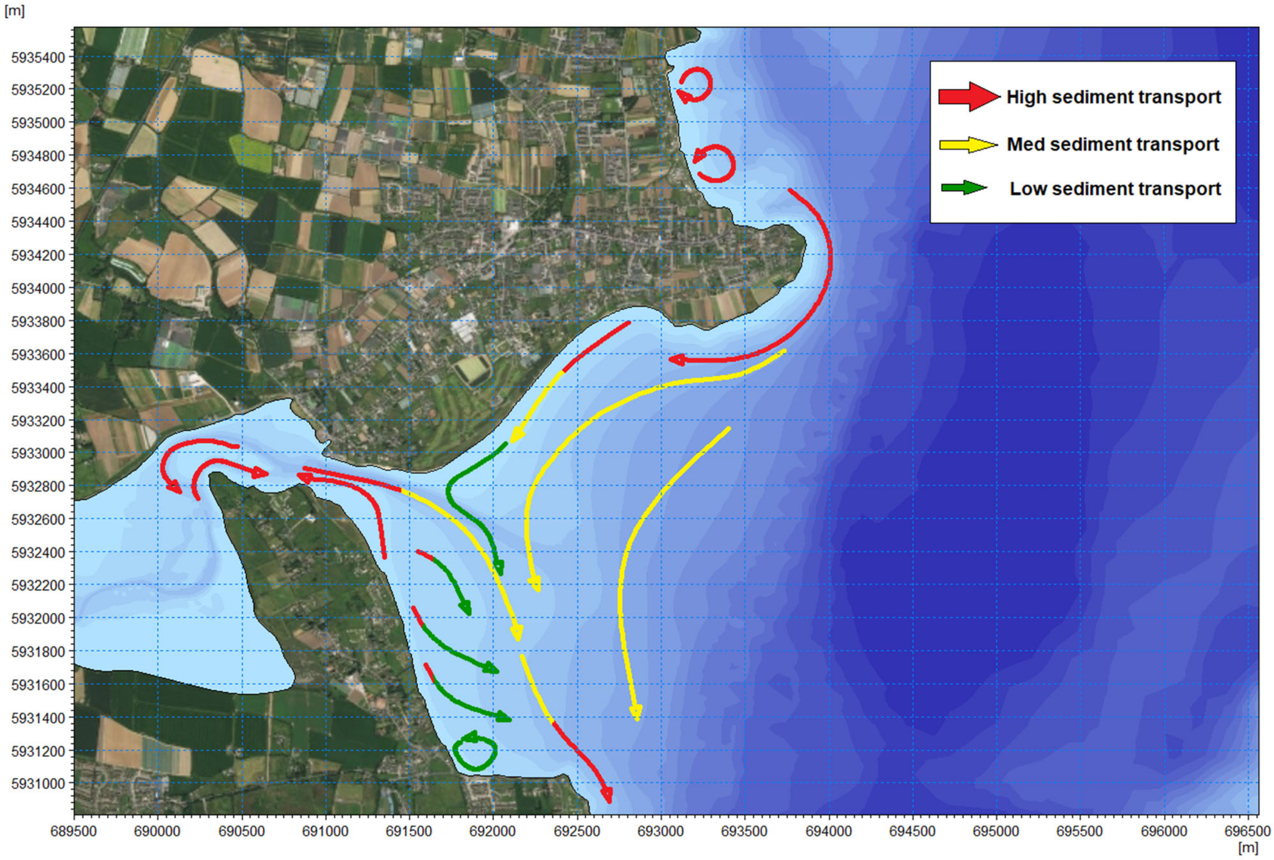

Figure 3.2: Typical sediment transport at Rogerstown during a north easterly storm event

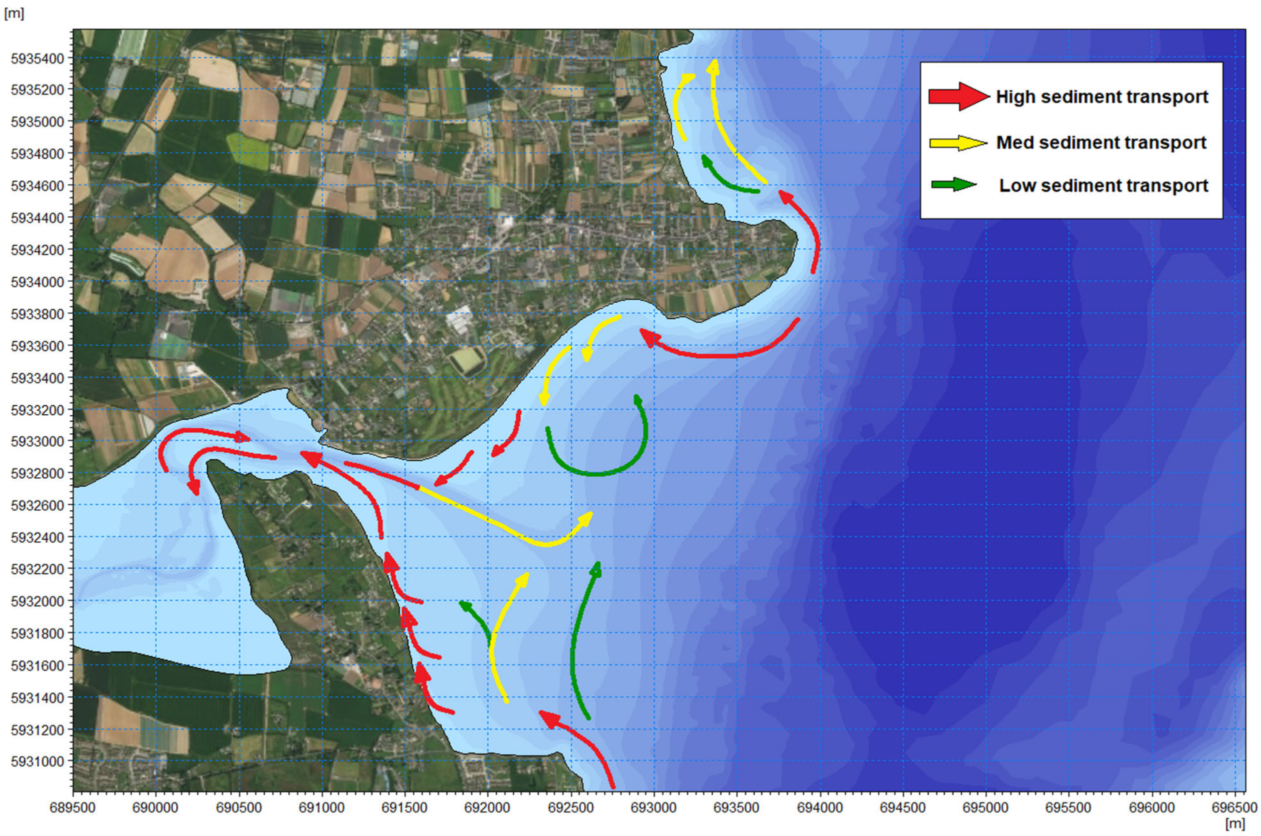

Figure 3.3: Typical sediment transport at Rogerstown during a south easterly storm event

4 COASTAL EROSION RISK ASSESSMENT

Coastal erosion is an important natural process that has been occurring for millions of years. It plays an important role in distributing sediment and contributes to the formation of special landscapes and habitats. Many of these habitats including those surrounding the Rogerstown estuary have since been protected by European legislation owing to their unique environmental characteristics.

But excessive erosion can also have a negative impact on areas where there is not enough space for coastal change. This is particularly problematic in urbanised areas where private properties or public amenities etc. can be threatened by erosion.

Quantifying erosion and considering the potential consequences is therefore crucial to developing a robust and sustainable management strategy. The following section of this report describes how RPS assessed coastal erosion.

4.1 How was coastal erosion calculated?

One of the most well accepted methods to calculate erosion is by comparing the position of coastline over time by using historical maps and photographs. Scientists can then calculate an average rate of coastal change and use this information to estimate future coastal change. This technique is referred to as **Historical Trend Analysis**.

Historical Trend Analysis in Practice

For example, to estimate where a coastline that retreated by an average of 1 metre per year would be in ten years, one could simply multiple the rate of change by a set time period, e.g. 10 years.

… i.e.:

Future coastal change = Rate of coastal change [m/yr] * set period of time [yr]

Future coastal change = -1.0 m/yr * 10yr

Future coastal change = -10 metres

The historical trend analysis at the Burrow and Rush was completed using the Digital Shoreline Analysis System (DSAS). This tool was produced by the US Geological Society and allows users to assess erosion across different sections of the same beach.

For this assessment RPS used data that spanned from 1973 to 2019. However, it will be seen from Table 4.1 which summarises the available shoreline information that only a piecemeal dataset was available for Rush North.

Table 4.1: Summary of available shoreline data

Year	The Burrow	Rush South	Rush North
1973	✓	✓	✓
1982	✓	X	X
1995	✓	✓	X
2000	✓	✓	✓
2005	✓	✓	✓
2009	✓	✓	X
2011	✓	✓	X
2013	✓	✓	✓
2018	✓	✓	X
2019	✓	✓	✓

4.2 What about Climate Change

It is well established that sea levels are rising due to coastal climate change. Although there is a degree of uncertainty regarding exactly how much sea levels will rise, it is generally accepted that sea levels could rise by up to one metre.

There are many negative impacts associated with an increase in sea levels. But from a coastal management perspective an increase in sea levels could:

- Allow bigger and more damaging waves to attack a shoreline. This in turn can increase erosion pressures on coastlines.
- Increase flood risk in low lying coastal areas.

Recognising these issues, the Office of Public Works (OPW) recommend that all coastal studies consider two different climate change scenarios. These scenarios are:

1. The **Medium Range Future Scenario (MRFS)** whereby sea levels are expected to rise by +0.50m by 2100.
2. The **High End Future Scenario (HEFS)** whereby sea levels are expected to rise by +1.00m by 2100.

An example how each climate scenario could affect sea levels is shown in Figure 4.1.

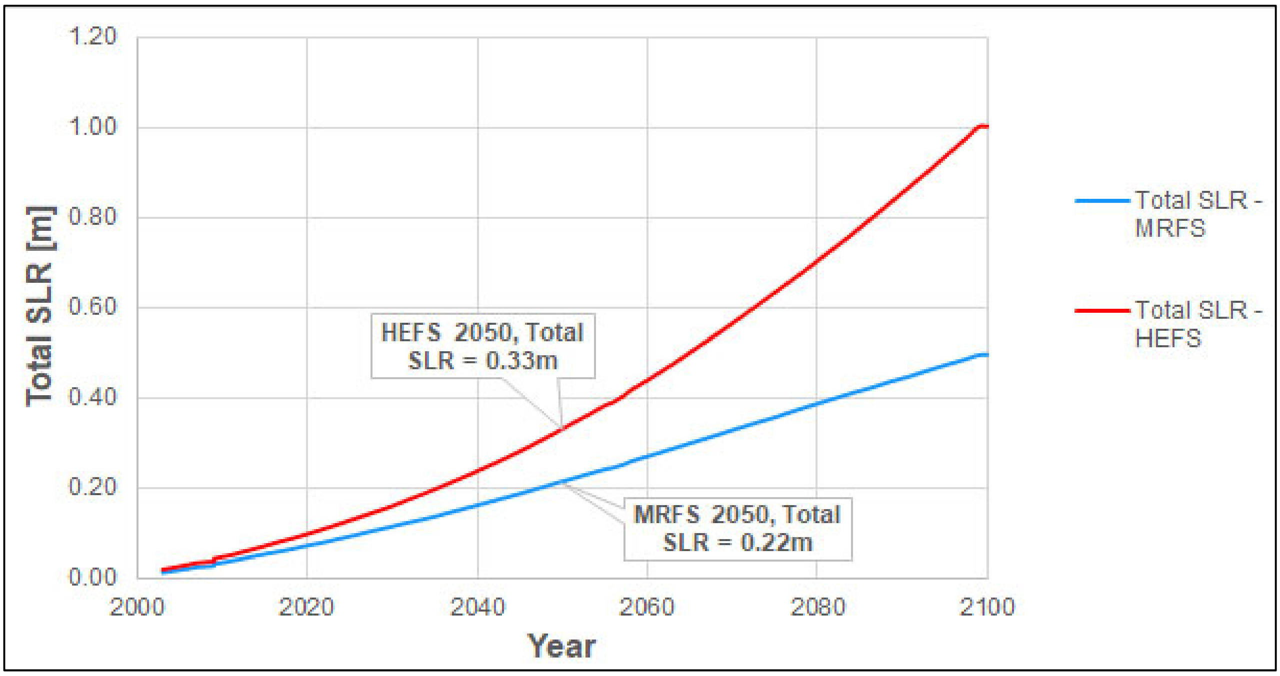

Figure 4.1: Projected total sea level rise by 2100 based on the OPW climate scenarios

Many scientific studies have found that the position and shape of a coastline naturally adjusts and realigns in response to a rise in sea levels. This theory which is known as "**The Brunn rule**" was used to determine how rising sea levels could impact coastal change.

4.3 Coastal Change Maps

RPS estimated future coastal change by 2050 and 2100 at each of the study areas using the methods outlined in the previous Sections. This assessment was undertaken based on existing climate conditions as well as the two future climate scenarios described previously.

4.3.1 Coastal Change by 2050

Based on available information it was found that depending on the future climate change scenario:

- The coastline at the Burrow could on average retreat by between *c.*19m and 39m (±14m) by 2050.
    - This could result in between 6 and 15 buildings being lost to erosion during the same period.
- At Rush South the coastline could on average retreat by between *c.*14m and 28m (±10m) by 2050 depending on future climate change.
    - No buildings are expected to be lost to erosion, but coastal retreat would result in the loss of some land.
- Localised regions of the coastline at Rush North could on average retreat by up to *c.*4m by 2050 (±6m)
    - Up to three buildings could be lost to erosion during this period.

For the purposes of brevity coastal change maps for 2050 are not included in this Non-Technical Summary but can be found the main CFERM Stage 1 Technical report.

4.3.2 Coastal Change by 2100

The estimated coastal change by 2100 for all three sites and climate scenarios is shown in a series of maps in Figure 4.2 to Figure 4.4. Based on this information it was found that depending on the future climate change scenario:

- The coastline at the Burrow could on average retreat by between *c.*48m and 88m (±30m) by 2100.
  - This could result in between 19 and 46 buildings being lost to erosion during the same period.
- At Rush South a coastline could on average retreat by between *c.*36m and 64m (±30m) by 2100.
  - No buildings are expected to be lost to erosion, but coastal retreat could adversely impact Rush Golf Club under future climate conditions.
- At Rush North the coastline could on average retreat by up to *c.*9m (±10m).
  - Up to 6 buildings could be lost to erosion during this period.

The extent and rate of future coastal change will depend on future storm events and climate change.

As there is no accurate way to accurately forecast storm events over an 80 year period it is important to recognise the actual future coastal change by 2050 and 2100 could be significantly different than reported in this study.

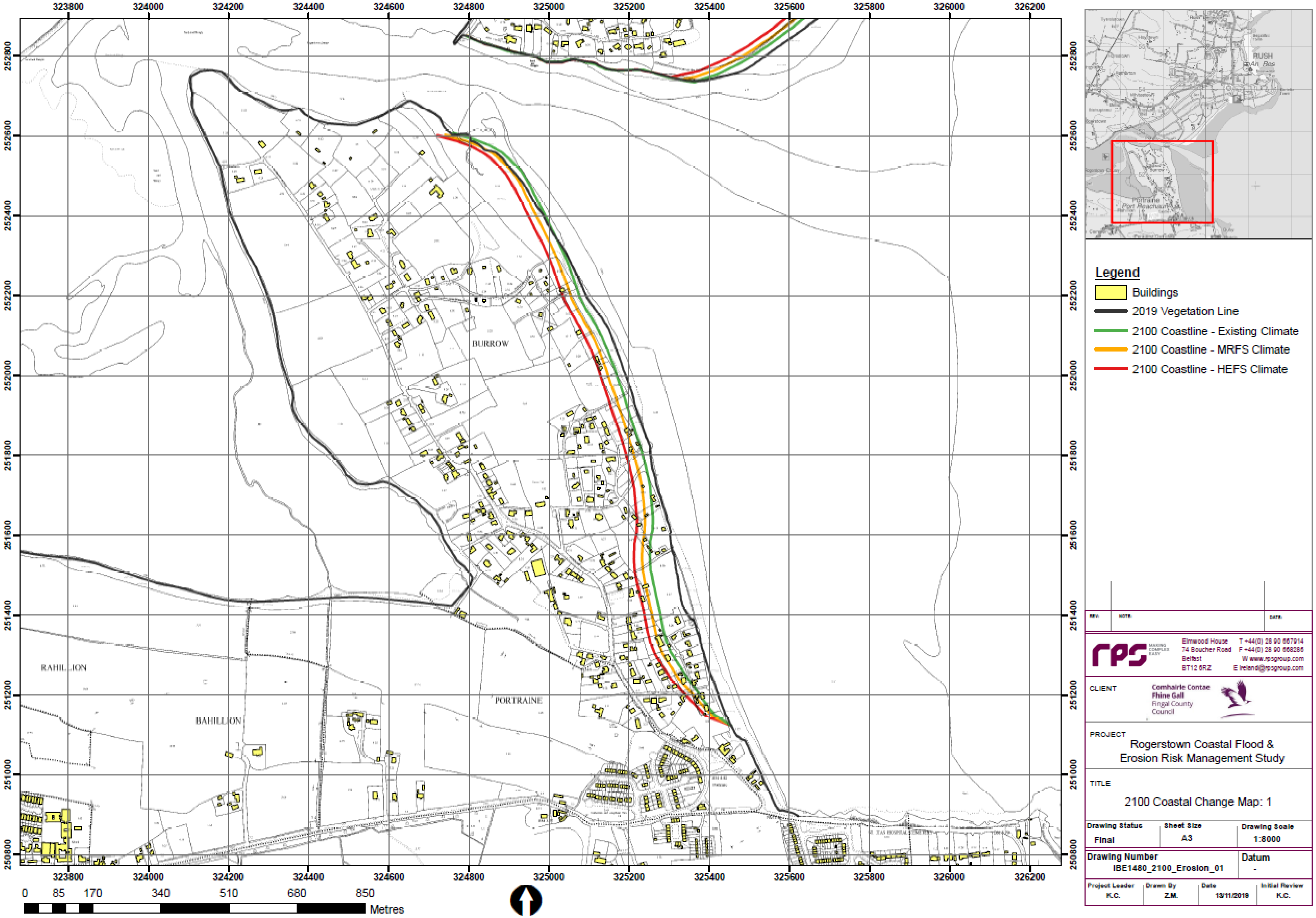

Figure 4.2: Projected coastal change at the Burrow by 2100 based on various climate scenarios

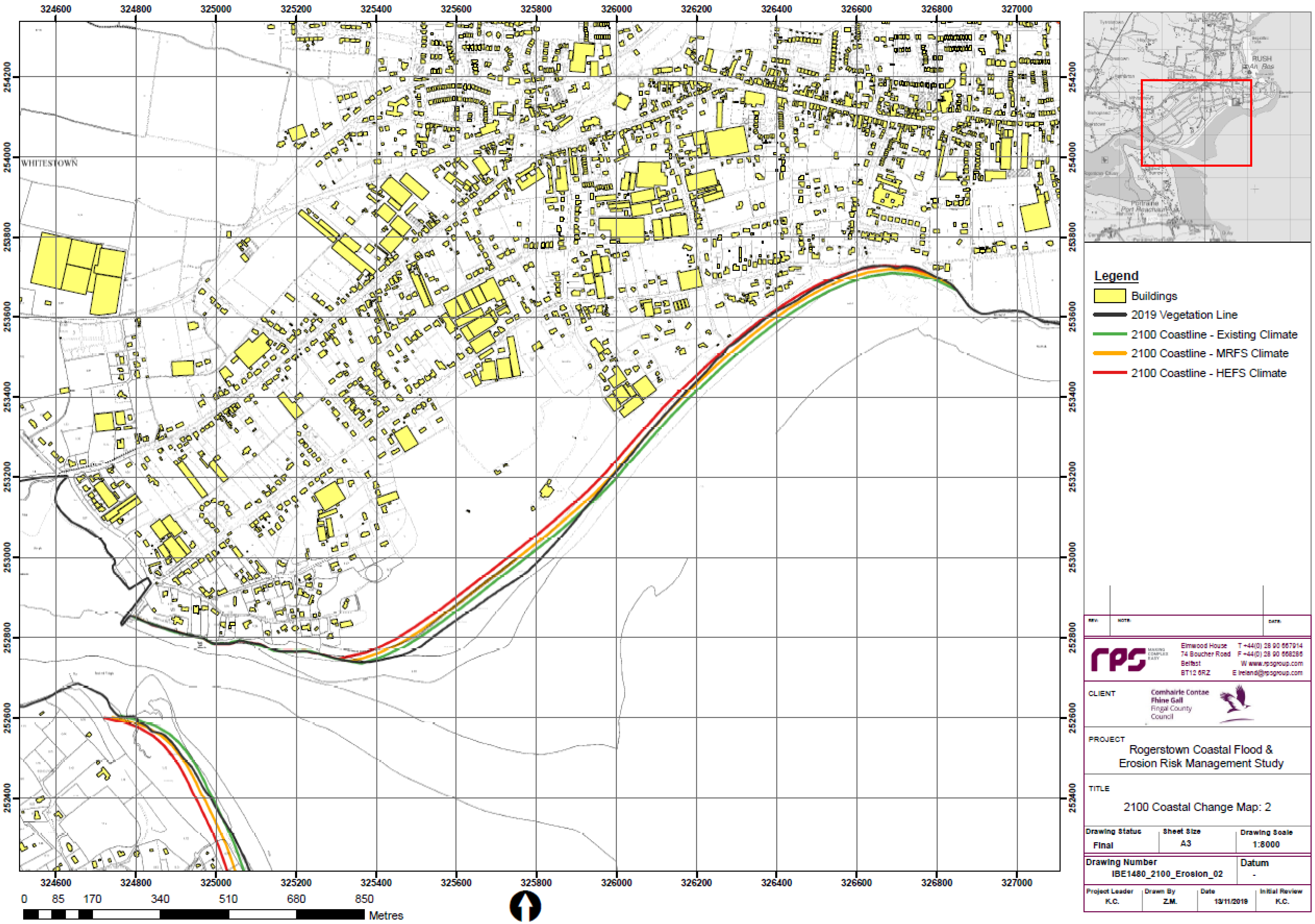

Figure 4.3: Projected coastal change at Rush South by 2100 based on various climate scenarios

Figure 4.4: Projected coastal change at Rush North by 2100 based on various climate scenarios

5 FLOOD RISK ASSESSMENT

Coastal flooding can cause damage to property such as homes and businesses, along with damage to and loss of service from infrastructure such as water supply or roads. It is therefore an important factor when developing any coastal protection strategy. This is particularly true for regions like the Burrow and Rush South whereby a soft dune system acts as a natural flood defence barrier.

When assessing coastal flood risk there are two important factors to consider. The first relates to flooding from high tide levels whilst the second relates to flooding caused by waves overtopping a coastal defence. Both have been considered as part of this study.

Assessing flood risk from rivers (fluvial flooding) was beyond the scope of this study, but RPS have included the risk of flooding from rivers based on results from the Fingal-East Meath Flood Risk Assessment and Management Study (FEMFRAMS, 2012).

5.1 How was the coastal flood risk calculated?

Using a series of advanced computer models, RPS assessed the potential flood risk across the various study areas for a range of different extreme events. In line with industry practice, each event had a specific return period (i.e. probability of occurring in any one year).

For example, a 1 in 2 year return period is expected to occur once every two years and has a probability 50% of occurring in any one year. A 1 in 50 year return period is more extreme and would be expected to occur once in 50 years with a probability of 2% of occurring in any one year.

This study examined the flood risk for a series of events ranging from 1 in 1 year event to a 1 in 1000 year event.

Using photographs taken during an extreme flooding event in January 2014, RPS confirmed that the computer models used for this assessment represented the coastal flooding to a high degree of accuracy.

5.2 Flood Risk – Present Day Conditions

Based on the existing flood risk across the study areas, RPS found that:

- Many regions of the Burrow are at risk of flooding, particularly along the western extent of the Burrow.
- At Rush South, there is a significant flood risk along Channel Road, Spout Road and south Shore Road.
- The flood risk at Rush North is minimal.

The number of buildings expected to be at risk from flooding at each area during the various return period events is summarised Figure 5.1 below. It can be seen that there is a significant number of buildings at risk across the Burrow and Rush South.

It should be noted that for the purposes of brevity, coastal flood maps have only been included in this document for the 2100 flood conditions. However coastal flood maps for all scenarios can be found the main CFERM Stage 1 Technical report.

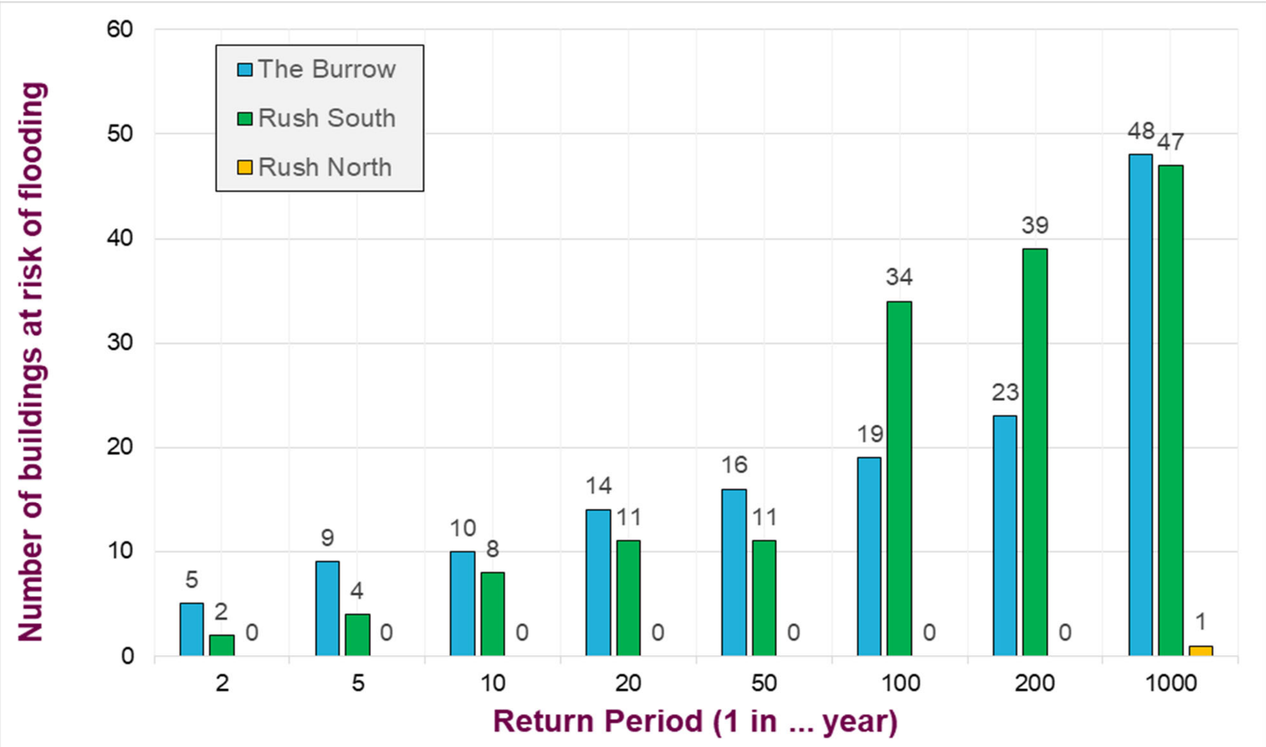

Figure 5.1: Number of buildings at risk of coastal flooding across the study areas

5.3 Potential Flood Risk by 2050

RPS also considered the impact of future sea level rise on flood risk by assessing two different climate change scenarios. These scenarios included:

1. The **Medium Range Future Scenario (MRFS)** whereby sea levels are expected to rise by +0.22m by 2050;
2. The **High End Future Scenario (HEFS)** whereby sea levels are expected to rise by +0.33m by 2050.

Based on the 2050 flood risk, RPS found that:

- Regions of the Burrow and Rush South remain at significant risk of coastal flooding.
- The number of buildings at risk of flooding at the Burrow could increase from *c.* 23 to *c.* 163 during a 1 in 200 year event depending on future climate change.
- The number of buildings at risk of flooding at Rush South could increase from *c.* 39 to *c.* 54 during a 1 in 200 year event depending on future climate change.
- The flood risk at Rush North remains minimal.

The number of buildings expected to be at risk from flooding by 2050 based on the MRFS and HEFS is summarised in Figure 5.2 and Figure 5.3 respectively.

Note that coastal flood maps for 2050 based on two future climate scenarios can be found the main CFERM Stage 1 Technical report.

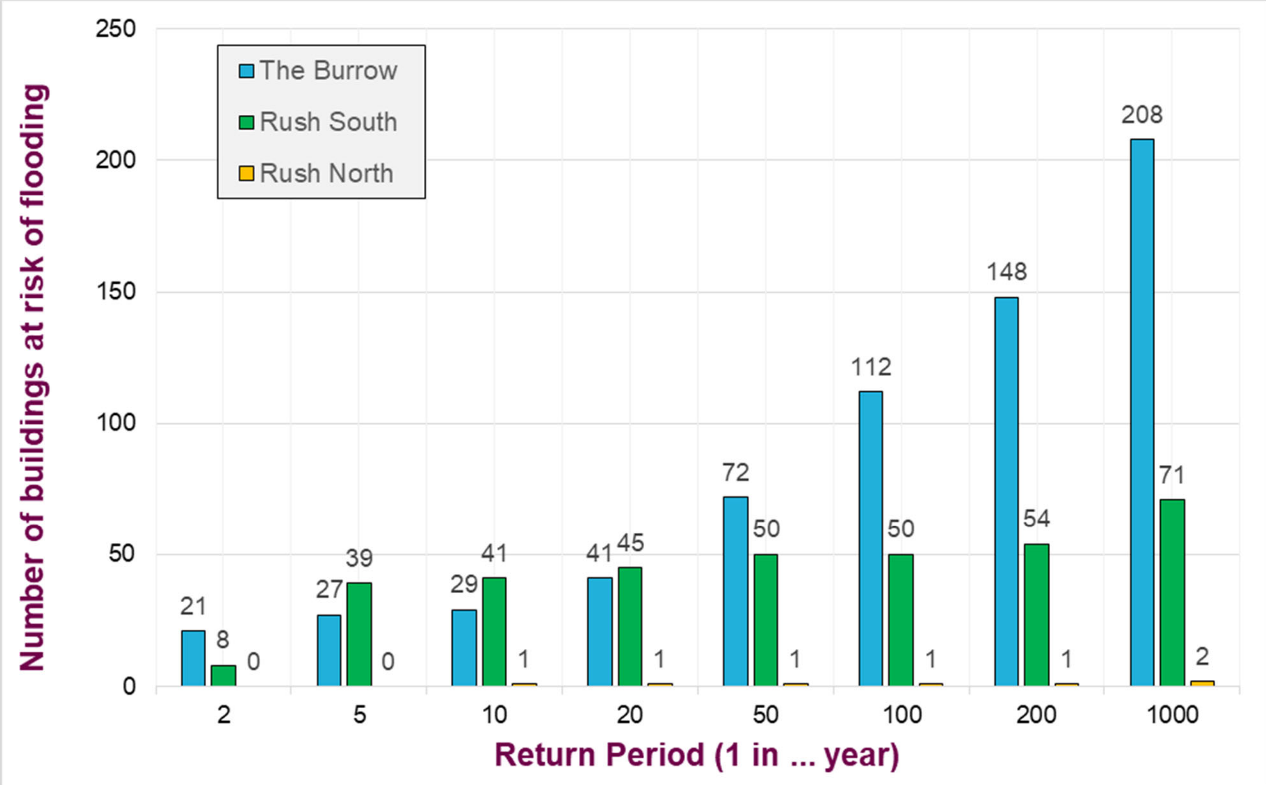

Figure 5.2: Total number of buildings at risk from coastal flooding by 2050 based on MRFS water levels and corresponding erosion extents.

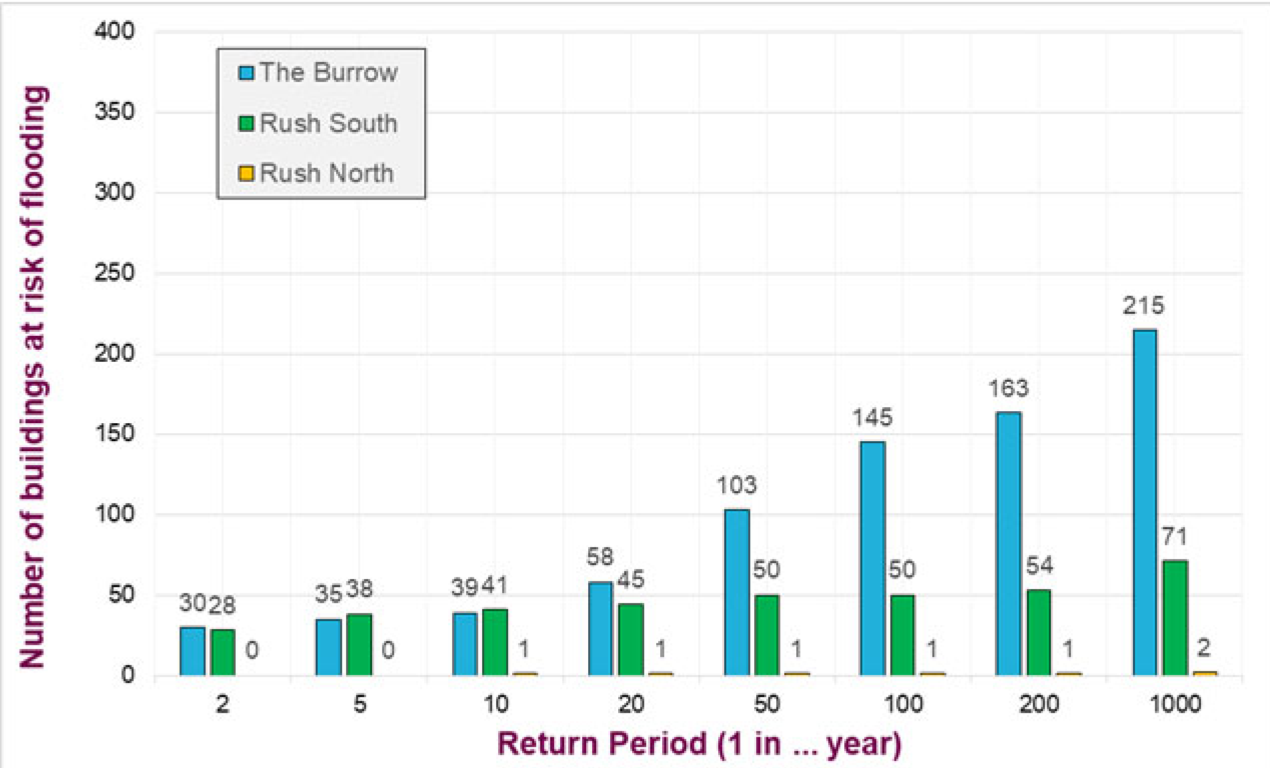

Figure 5.3: Total number of buildings at risk from coastal flooding by 2050 based on HEFS water levels and corresponding erosion extents.

5.4 Potential Flood Risk by 2100

RPS considered the impact of sea level rise by 2100 on coastal flooding based on the following two scenarios:

1. The **Medium Range Future Scenario (MRFS)** whereby sea levels are expected to rise by +0.50m by 2100;
2. The **High End Future Scenario (HEFS)** whereby sea levels are expected to rise by +1.00m by 2100.

Based on the 2100 flood risk, RPS found that:

- Even during a 1 in 10 year event a significant proportion of the Burrow is inundated by coastal flooding. This is in part due to a breach in the dune system that enables the tide to flow inland.
- The number of buildings at risk of flooding at the Burrow could increase significantly from *c.* 28 to *c.* 267 during a 1 in 200 year event depending on future climate change.
- The number of buildings at risk of flooding at Rush South could increase from *c.* 39 to *c.*111 during a 1 in 200 year event depending on future climate change.
- Up to 13 buildings could be affected by flooding at Rush North during the most extreme events.

The number of buildings expected to be at risk from flooding by 2100 based on the MRFS and HEFS is summarised in Figure 5.4 and Figure 5.5 respectively.

The coastal flood risk across the study areas based on the MRFS where sea levels are expected to increase by +0.50m by 2100 are presented in Figure 5.4 to Figure 5.7.

Similar maps for the HEFS whereby sea levels are expected to rise by +1.00m by 2100 can be found in the main CFERM Stage 1 Technical report.

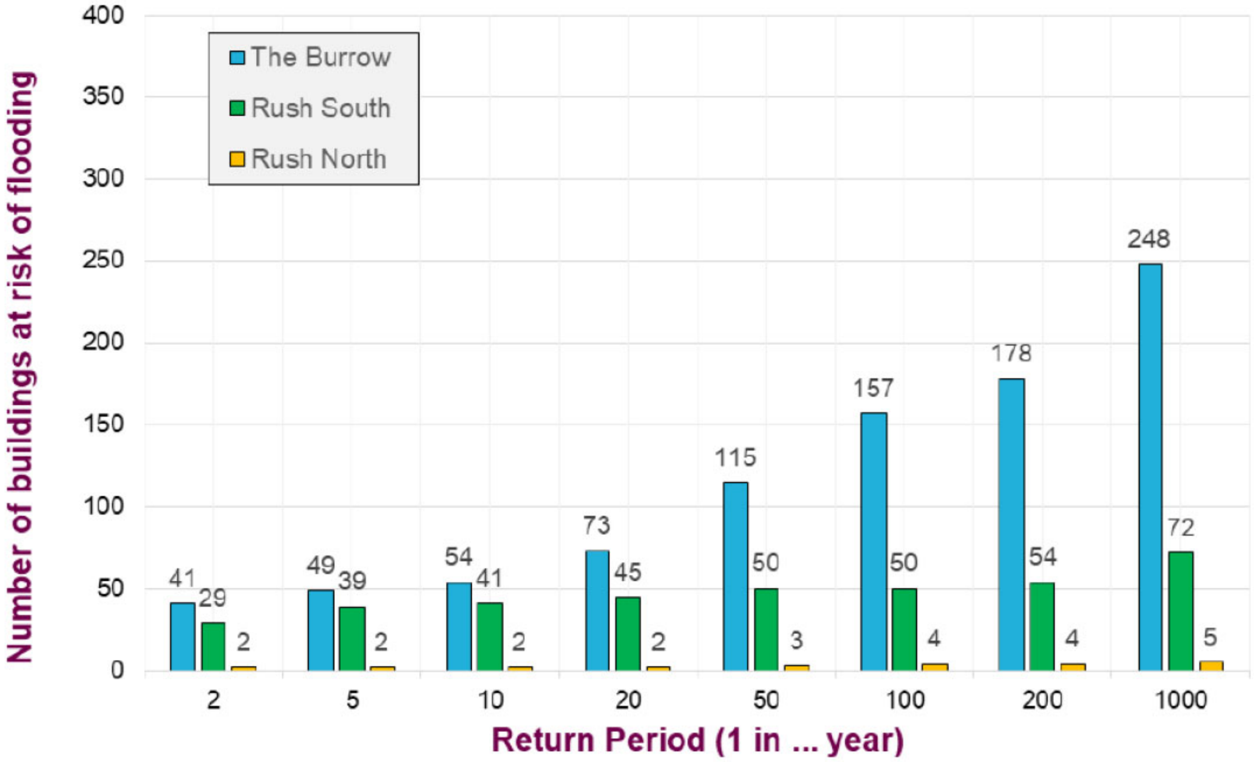

Figure 5.4: Total number of buildings at risk from coastal flooding by 2100 based on MRFS water levels and corresponding erosion extents.

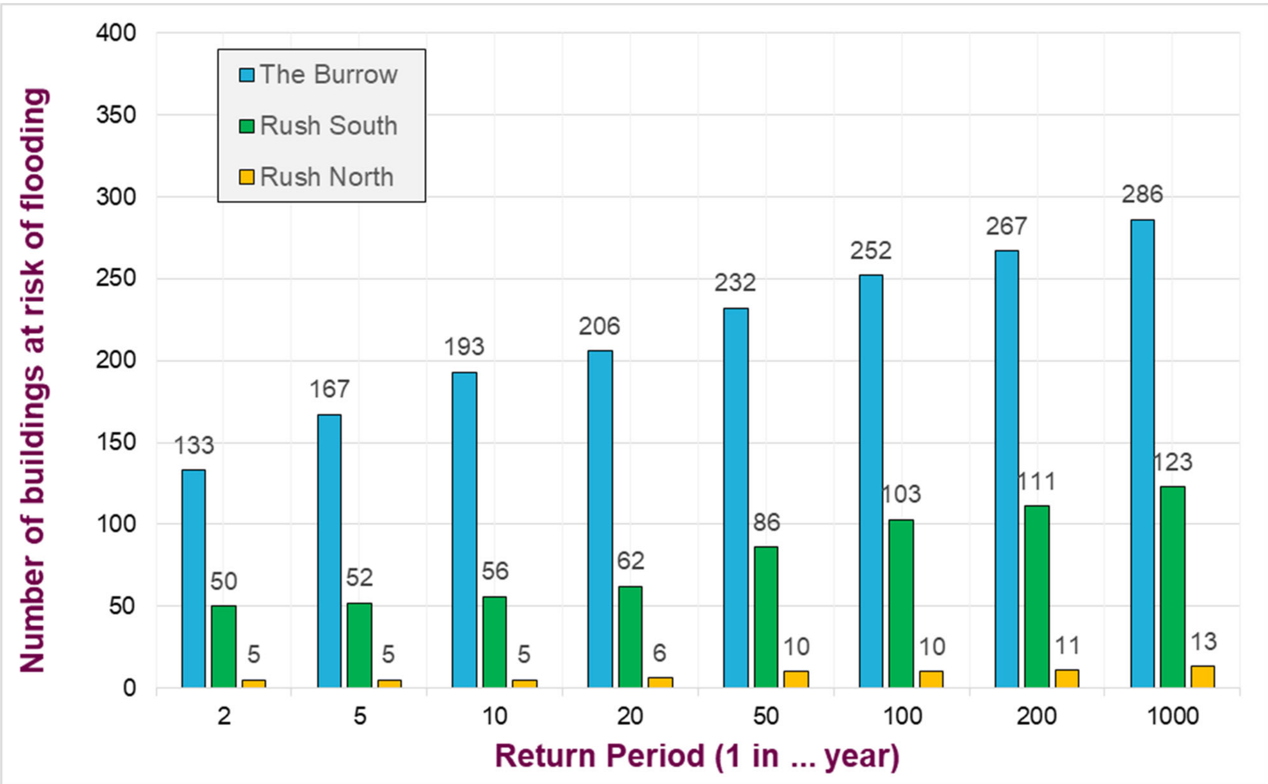

Figure 5.5: Total number of buildings at risk from coastal flooding by 2100 based on HEFS water levels and corresponding erosion extents.

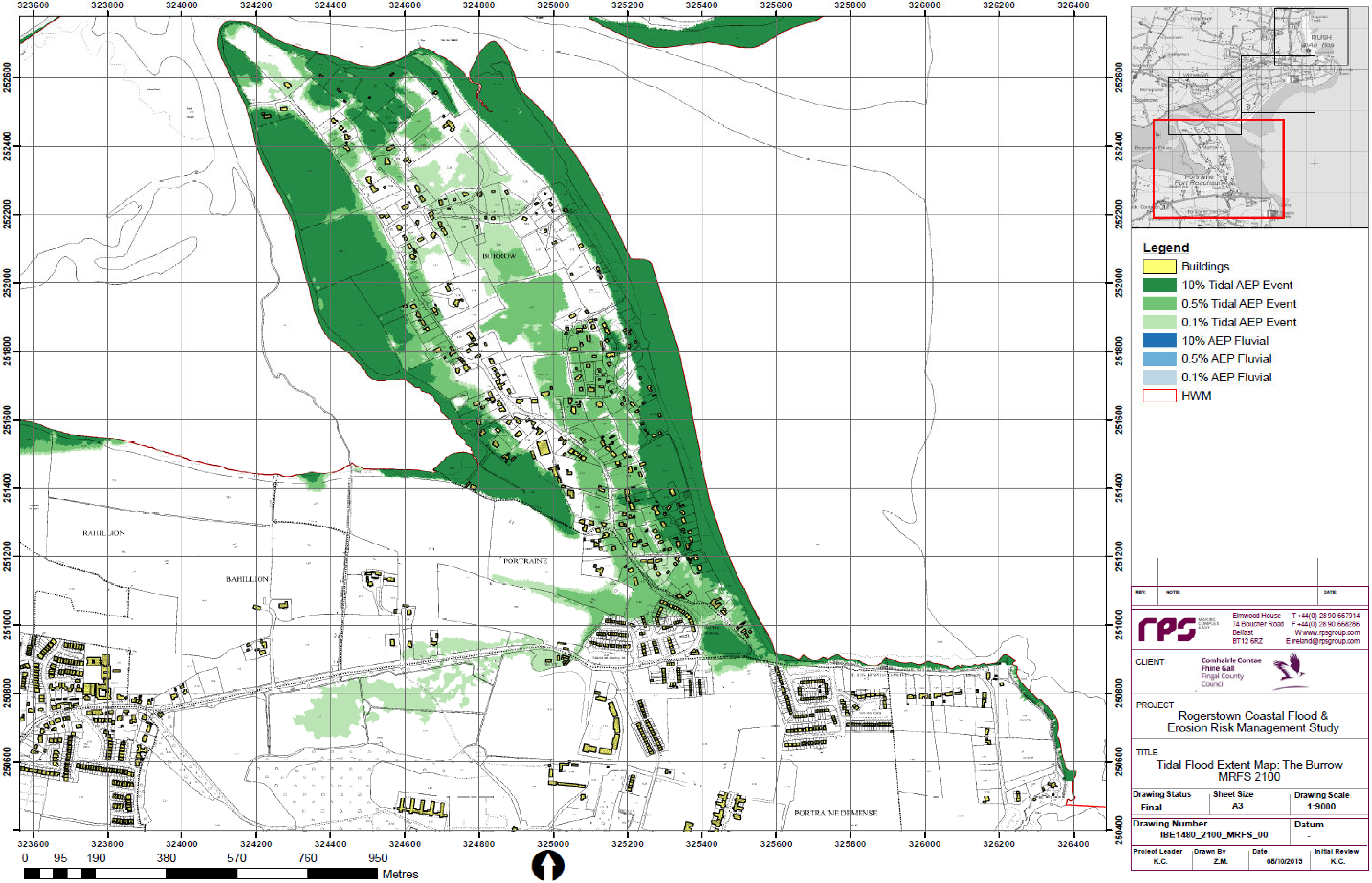

Figure 5.6: Tidal Flood Extent Map: The Burrow - 2100 Medium Range Future Scenario (i.e. +0.50m sea level rise and *c*.68m of coastal retreat)

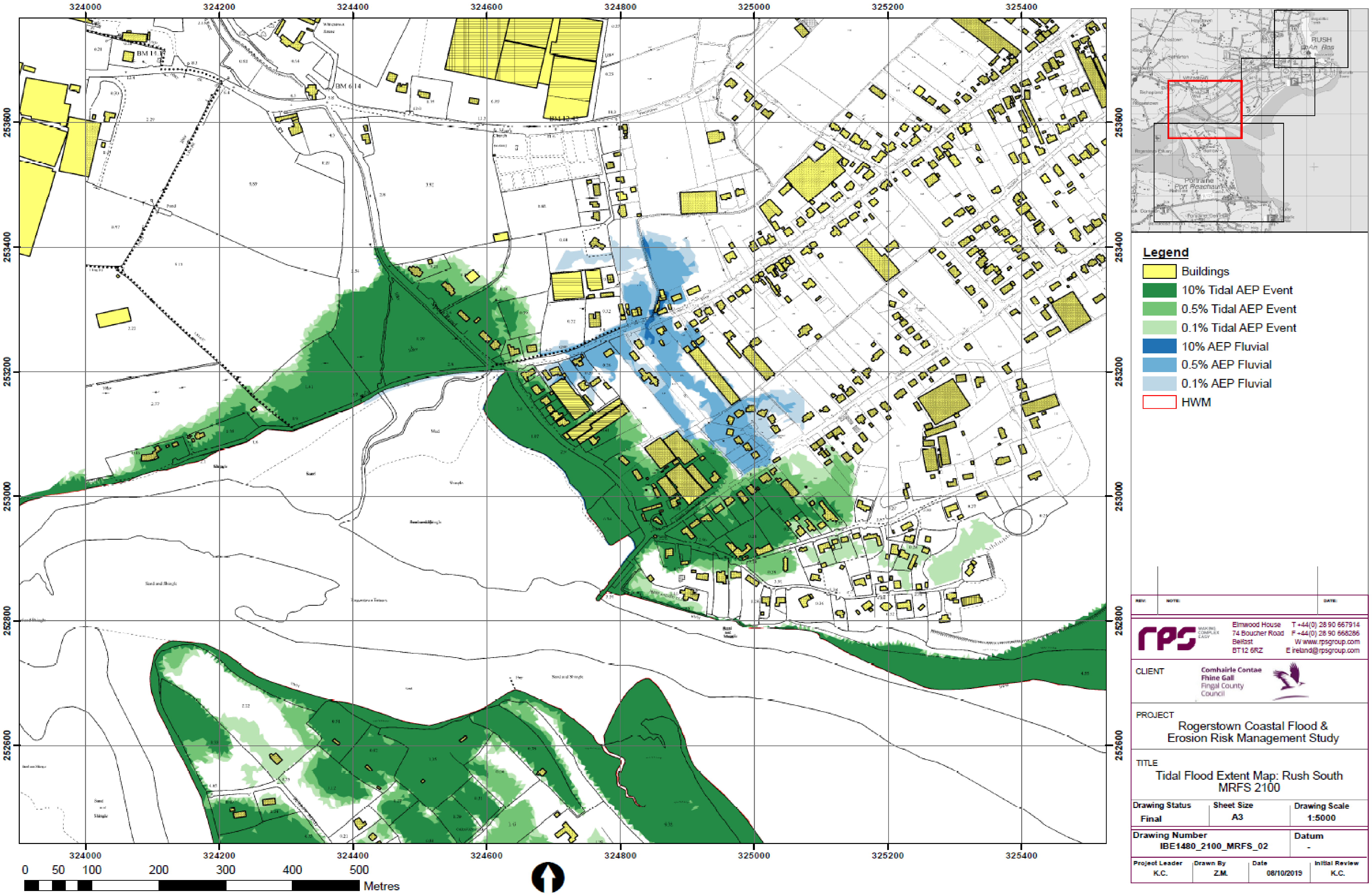

Figure 5.7: Tidal Flood Extent Map: Rush South (1) - 2100 Medium Range Future Scenario (i.e. +0.50m sea level rise and *c.*50m of coastal retreat at Rush Golf Club)

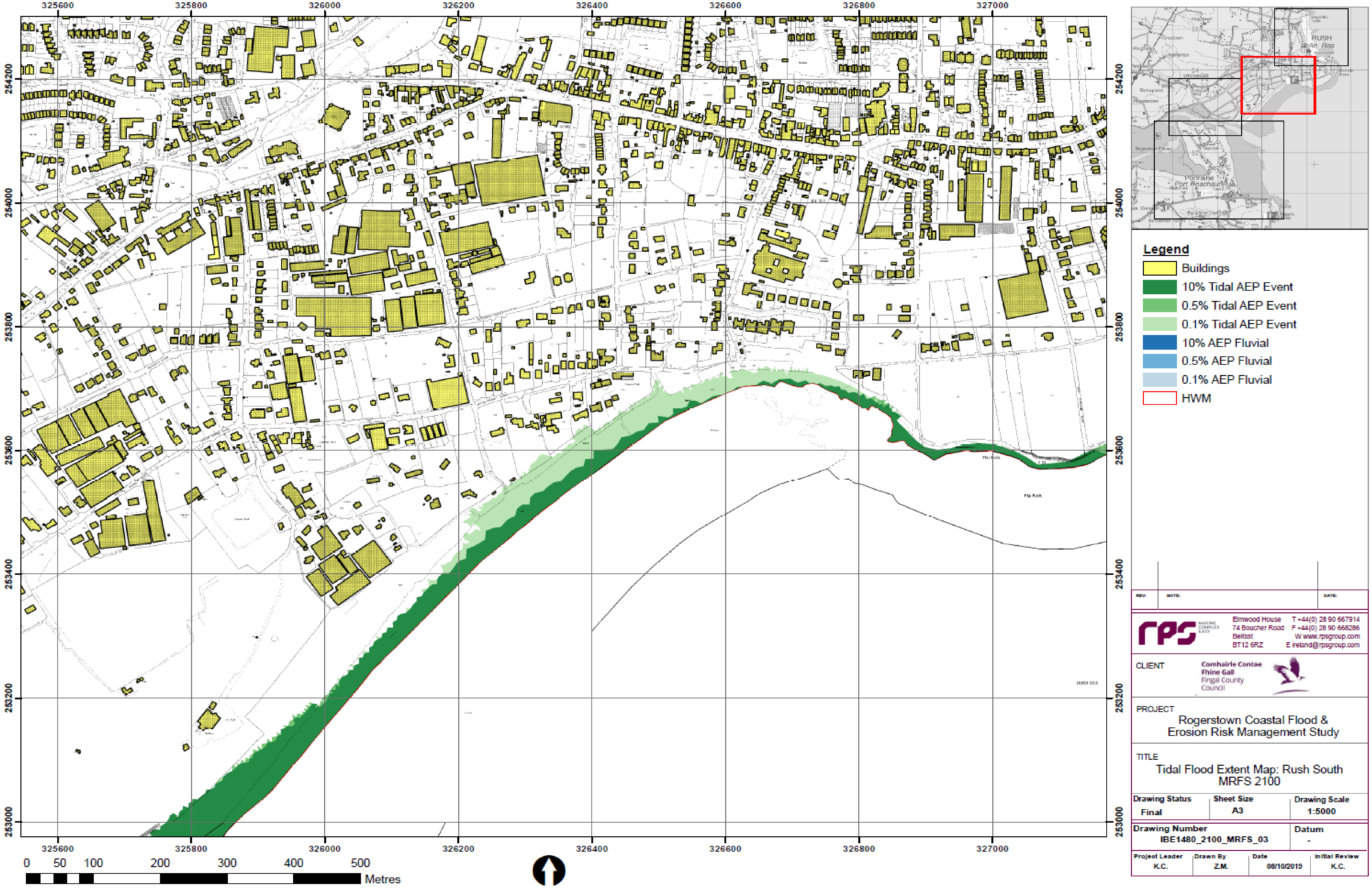

Figure 5.8: Tidal Flood Extent Map: Rush South (2) - Medium Range Future Scenario (i.e. +0.50m sea level rise and *c.*50m of coastal retreat)

Figure 5.9: Tidal Flood Extent Map: Rush North - 2100 Medium Range Future Scenario (i.e. +0.50m sea level rise and *c.*4m of coastal retreat)

6 CONCLUSION

In agreement with evidence reported by statutory authorities and groups such as the Fingal Coastal Liaison Group, this assessment concluded that the most pressing and immediate issue affecting the Rogerstown estuary area is the substantial risk of coastal erosion at the Burrow and coastal flooding at Rush.

Depending on future climate change, up to c.50 buildings were found to be at risk from coastal erosion by 2100. Many of these are expected to be at risk within the next few decades. A significant number of properties across the Burrow and Rush South are already at substantial risk of flooding under current climate conditions.

Furthermore, RPS are acutely aware that recent events indicate a potential “turning point” in the coastal processes along the Burrow and that rates of coastal erosion could be significantly greater than those reported in this study. However, without sufficient long-term data it is not possible to determine if recent events are unique outliers or the beginning of a new long-term trend.

In the long term, when compared to the risk of erosion it is clear that coastal flooding generally poses greater risk to the Rogerstown Estuary area. But it is important to note that erosion of the existing dune system along the Burrow significantly enhances the coastal flood risk by creating additional flood routes.

Future climate change will undoubtedly pose the greatest challenge to the Rogerstown Estuary area over the coming decades. It is highly likely that an increase in sea levels and changes in storm conditions will worsen existing erosion issues along the Burrow and result in more frequent flooding of the Burrow and Rush south.

Given these risks, it is imperative that an effective and sustainable management plan is implemented at the Burrow and Rush South without delay. The technical, economic and environmental assessment of a complete range of management strategies is the focus of an individual CFERM Optioneering report which accompanies this document.