



NECAG Coast Protection Assets and Coastal Slope Condition Analysis

Preamble

The North East Coastal Authorities Group (NECAG) comprises the following organisations, each of whom has certain responsibilities for managing the coastline between the River Tyne and Flamborough Head:

- South Tyneside Council;
- Sunderland City Council;
- Easington District Council;
- Hartlepool Borough Council;
- Redcar and Cleveland Borough Council;
- Scarborough Borough Council;
- East Riding of Yorkshire Council;
- Environment Agency;
- North York Moors National Park;
- Natural England;
- The National Trust.

Collectively, NECAG produced a 'second generation' Shoreline Management Plan (or 'SMP2') for its coastal frontage in 2007. In this SMP2, recommendations were made for condition assessments of the coastal protection assets and coastal cliffs and slopes along this frontage, as part of a broader coastal monitoring programme.

To this end, Scarborough Borough Council, acting as the 'lead authority' for NECAG, commissioned a team from Royal Haskoning and Halcrow to undertake the '*NECAG Coastal Protection Assets and Coastal Slope Condition Analysis*' between August 2008 and January 2009. Fieldwork was undertaken in the summer to autumn of 2008.

The joint team approach between Royal Haskoning and Halcrow has enabled skilled staff with previous expertise of the specific stretches of frontage to work together and offer best value to NECAG. The asset and slope inspectors have included Chartered Engineers (focusing mainly on the built coastal protection structures) and Engineering Geomorphologists (focusing mainly on the natural cliffs and coastal slopes) ensuring suitable skills are applied to each length of frontage.

To ensure a consistency of approach in reporting, a standard template has been used for each of the seven Local Authorities within NECAG. In addition, the findings from the inspections have been entered into the Environment Agency's National Flood and Coastal Defence Database (NFCDD) for each identified length of 'defence', be it an engineered structure or a natural cliff/slope. This ensures that each Local Authority is complying with its High Level Target to ensure that the NFCDD is regularly updated.

Following these initial 2008/09 inspections, it is intended that future inspections are undertaken within the recently commissioned Cell One Coastal Monitoring Programme, which again is being undertaken jointly by Royal Haskoning and Halcrow under Scarborough Borough Council's leadership. This ensures that future work will be undertaken by the same teams and that the 2008/09 inspections will provide a baseline against which future changes, such as deterioration of defences or erosion of cliffs, can be compared.

1. Introduction

Methodology

This section presents the approach taken by the slope and asset inspectors respectively for the East Riding of Yorkshire Council coastal frontage.

Coastal Slope Condition Assessment

The cliff condition assessment was undertaken by systematic walk-over inspection of the whole coastline by a team of geomorphologists in August 2008. The inspection involved visual assessment of cliff activity and noting specific areas of activity (e.g. landslides and tension cracks). All observations were documented with photographs and annotated field maps. Each unit was identified, photographed and classified according to the five point activity scale as defined in Table 1.1. This classification scheme is the same as that used in the Staithes to Speeton assessment undertaken by Halcrow for SBC in May 2005 and in May 2002 (Halcrow 2002, Halcrow 2005). Brief descriptions of the condition of the cliffs were also entered into the National Flood and Coastal Defence Database (NFCDD) for all areas of undefended coastline.

Activity Class	Description
Totally Active	Retreating cliffline almost entirely affected by large-scale landsliding or intense erosion
Partly Active	Retreating cliffline with very common smaller-scale landslides or areas of intense erosion
Locally Active	Retreating cliffline with localised small landslides or areas of erosion
Inactive	Relict cliffs or landslides with vegetated slopes and localised erosion of the toe or failure of the headscarp
Dormant	Protected cliffline or landslide complex with no visible evidence of landslide activity

Table 1.1 Cliff activity classes used in the August 2008 assessment

The inspection was primarily conducted from the cliff-top, due to access restrictions and health and safety concerns associated with the cliff toe and beaches along this stretch of coast. In the East Riding of Yorkshire Council region, the coastline is followed for the most part by a cliff top footpath. Where the footpath moved inland the inspection kept to the cliff edge to ensure the whole coastline was observed and activity recorded. The beach and foreshore were only inspected where access could be safely achieved from the cliff top.

The cliff condition assessment walkover survey for the East Riding of Yorkshire Council frontage was conducted between 18th and 19th of August 2008 in a north to south direction. Weather conditions during this time were warm with frequent showers.

Coast Protection Asset Condition Assessment

The structural assessment of assets within the East Riding of Yorkshire Council region was carried out by a team of asset inspectors and structural engineers in September 2008. Assets were graded based on their condition, residual life and urgency of repair work. Observations were photographed and all data were stored 'live' in the NFCDD using onsite laptops.

North Landing was the only site visited along the East Riding of Yorkshire frontage that had coastal assets present. The asset descriptions provide an overview of findings, summarising this locality and identifying any assets of poor condition, failing structures and assets that have the potential to fail. It is anticipated that this will help identify areas for investment, including repair work, replacement or the installation of a different asset type.

Study Area

This report documents the condition of the coastal cliffs and assets from just west of Dulcey Dock in the north to Flamborough Head in the south. This area is characterised by high chalk

cliffs with a till cap. The cliff height is generally constant throughout the study area, but towards the south, the thickness of chalk decreases and the till thickens.

No pre-existing units were available for this length of coastline and therefore, Cliff Behaviour Units (CBUs) were identified using FutureCoast (Halcrow, 2002) and aerial photography. For example for CBU E110/14 the prefix relates to FutureCoast unit E110 and the suffix /14 relates to the specific area as defined in this case by the headlands at Gull Nook and Close Nooks (North of Flamborough village).

2. Overview

Condition Assessment

Coastal Slope Condition Assessment

This area is characterised by high chalk cliffs with a till cap of varying thickness. In total, 40 CBUs were observed of which the majority were classified as Locally Active (Figure 1). Assets along this stretch of coastline include occasional properties, the Lifeboat Station at North Landing, a golf course at Stottle Bank Nook and the Lighthouse at Flamborough Head. A footpath also follows the cliff top throughout the study area.

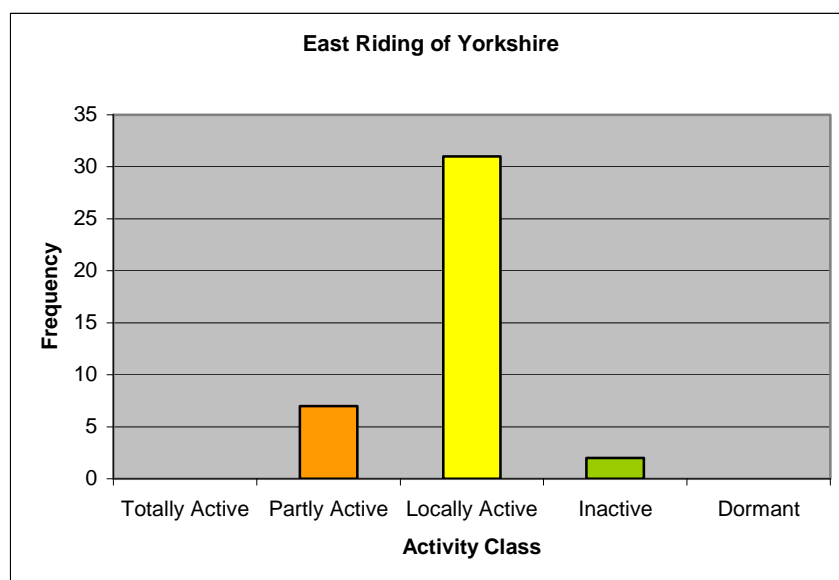


Figure 1. Frequency of cliff activity along the ERYC frontage

The majority of CBUs within this region are classified as Locally Active and pose little risk to the listed assets. The exceptions are the Partly Active areas around Thornwick Nab and Stottle Bank Nook. At both locations diversion of the cliff top footpath has been necessary due to cliff top retreat with the latter involving loss of land at the golf course. Continued monitoring of all units is recommended with more frequent inspection of the more active units at Thornwick Nab and especially Stottle Bank Nook required.

Coast Protection Asset Condition Assessment

The only coastal defence assets within this region are located at North Landing and include the area around the Lifeboat station, a concrete revetment, slipway and associated gabions. The revetment shows some minor cracking and corrosion and the gabions have undergone minor deformation and loss of rock packing in places. However, none of these defects are considered serious. It is recommended that continued monitoring of these assets is undertaken but no specific repair works are required.

Comparison with Previous Assessments and Recommendations

No previous cliff or asset condition assessment data were available. It is anticipated that this survey will form the baseline to which future assessments may be compared.

The whole coastline will be subjected to repeat inspections under the Cell 1 Monitoring Programme recently awarded to Royal Haskoning and Halcrow Group Ltd, but key areas that should be closely monitored include Thornwick Nab and Stottle Bank Nook which are affected by higher levels of activity. There are no specific repair works required to individual coastal assets.

3. Condition Assessment

Coastal Slope Condition Assessment

The Management/Sub-Management Unit divisions which exist for Scarborough Borough Council's coastline do not continue into the East Riding of Yorkshire. Therefore the section of coastline between Dulcey Dock and Flamborough Head is described as a whole, with specific reference to particularly active or inactive CBUs.

The majority of CBUs within the East Riding area are classified as Locally Active. The high chalk cliffs are near vertical and capped by a layer of glacial sediment (till). The till layer is generally well vegetated with grasses and other small plants. For the most part, the till is stable, but there localised small mudslides have developed in places. At the southerly limit of the study area the till layer forms gently undulating slopes which overlie a thinner chalk cliff unit. These probably represent relict mudslides.

The chalk cliff face is vertical and largely devoid of vegetation. The base of the cliffs is subject to marine action but only minor undercutting was observed. In some areas there are stacks and arches (E110/6 Scale Nab, E111/11 just west of Breil Nook and E11/15b below the Lighthouse at Flamborough Head) and evidence of episodic rock fall activity (E109/3 the eastern end of Buckton Cliffs, E110/6 Scale Nab, E110/10 and E110/11 at Dykes End, E110/13 at Gull Nook, E110/1 to E110/4 along Bempton Cliffs).

In places, preferential erosion and weathering along rock joints has resulted in the formation of gully features which cut inland from the cliff (E109/4 the east end of Buckton Cliffs, E110/4 at Crab Rocks and E111/13 near Cradle Head). These features are currently stable, but they are likely to be a focus of erosion and potential instability in the future.

Some areas of cliff are much more heavily vegetated with very little evidence of instability. These include CBU E110/13 near Gull Nook (just east of Danes' Dyke) which supports much vegetation mid-slope and is classified as Inactive. Another example is CBU E111/7 at Holmes Gut which stretches inland and is characterised by densely vegetated gentle slopes.

Cliffs classified as being Partly Active are generally associated with the thicker exposures of till in the south, and include the cliffs around Thornwick Nab (E111/2, E111/3, E111/4, E111/5a), where the till is undergoing failure through small mudslides. Marine action is causing undercutting of the cliff toe and the formation of caves and small gullies within Thornwick Bay. Partly Active cliffs were also recognised at E111/8a, E111/10 and E111/14 where there is localised erosion and instability in the till near Stottle Bank Nook. This has impacted on the adjacent golf course. Evidence of a retreating fence position and diversion of the footpath indicates that the problem is ongoing at this location.



E110/3 looking eastwards from Bartlett Nab, Bempton Cliffs (Locally Active)



E109/4 early beginnings of block detachment in the high chalk cliffs at the west end of Bempton Cliffs (Locally Active)



E110/13 looking northwest near Gull Nook (Inactive)



E111/7 densely vegetated slopes at Holmes Gut (Inactive)



E111/3 looking southeast towards Thornwick Bay (Partly Active)



E111/14 erosion of the till cap near Stottle Bank Nook (Partly Active)

Coast Protection Asset Condition Assessment

The only coastal assets within this area are located at North Landing and are associated with the Lifeboat Station. They include a concrete revetment (Asset Ref No. 1221D901D1803C02) and a slipway with associated gabions.

The concrete revetment, constructed with horizontal steel bars set approximately 1.5m apart, is present to the west of the Lifeboat Station. This structure features a set of steps on its eastern side giving pedestrian access to the beach and is used for mooring boats. There are only slight defects to the revetment, such as minor cracking and corrosion.

The Lifeboat Station slipway is protected on the east side with a series of gabions, retaining the earth bank behind. There is some evidence of slipping at the lower end of the gabions. Several of the baskets show deformation and have been repaired in a make-shift fashion. Loss of rock packing seems to have occurred in places and there is evidence of earth from the bank behind slipping onto the gabions. There is also a 450mm diameter clay service pipe exiting from the base of the slipway.



Lifeboat Station, slipway and revetment at North Landing (Asset Ref No. 1231D901D3201C02)



Gabions along edge of Lifeboat slipway (Asset Ref No. 1231D901D3201C03)



Concrete revetment (Asset Ref No. 1221D901D1803C02)

4. Comparison with Previous Assessments

Coastal Slope Condition Assessment

No previous cliff condition assessment data is available for this area and this survey will form the baseline against which future assessments will be compared.

Coast Protection Asset Condition Assessment

No previous asset condition assessment data was available for this area. It is anticipated that this inspection survey will form the baseline to which future assessments will be compared.

5. Problems Encountered and Uncertainty in Analysis

Coastal Slope Condition Assessment

No significant problems were encountered in the cliff condition assessment. A limited view of the cliff was afforded at a small number of CBUs, but in all cases, sufficient lengths of the cliff could be seen to assess its condition. Alternative approaches include inspection via a boat or use of remote sensing, such as aerial photographs, to assess conditions and measure change.

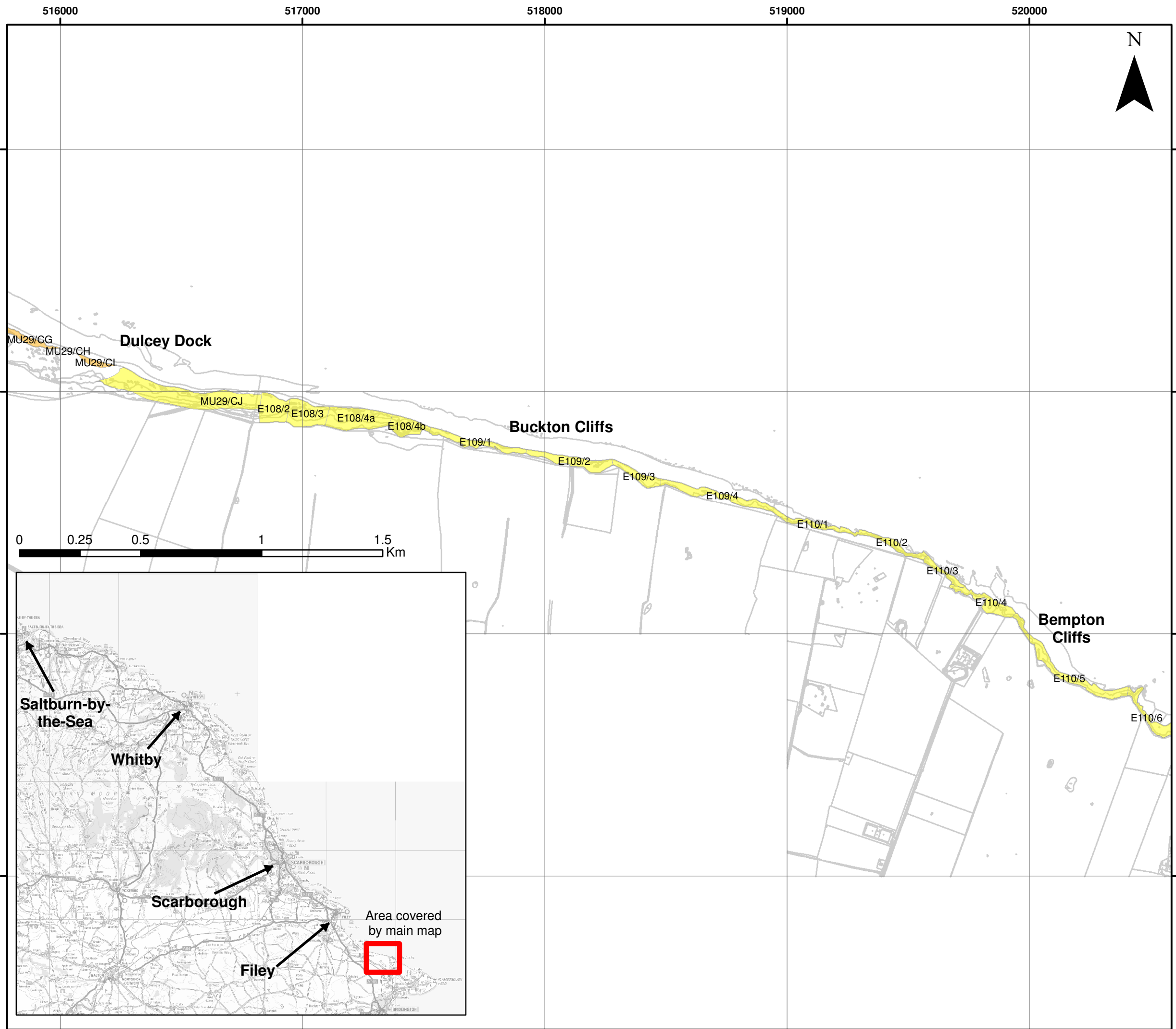
Coast Protection Asset Condition Assessment

Very few problems were encountered onsite during the asset condition assessment. All assets were located in public spaces and were easily accessible. Local tides tables provided key information for the appropriate planning of the inspections. It would not be recommended to attempt further inspections during very high tides.

6. Conclusions and Recommended Actions

Most of the cliff units along this stretch of coastline are classified as Locally Active and are undergoing minor erosion in line with the natural evolution of the coast. Continued monitoring of these, and the few less active units is recommended. The cliff units around Thornwick Nab and Stottle Bank Nook are demonstrating higher levels of activity, with the loss of land and disruption to the cliff top footpath already occurring at the latter. Consequently it is recommended that more frequent monitoring of these sites is undertaken.

There are no specific repair works required to individual coastal assets, however, it is recommended that continued monitoring of coastal assets within the East Riding of Yorkshire area is undertaken.



- Legend**
- Cliff Activity Status 2008**
- Dormant
 - Inactive
 - Locally Active
 - Partly Active
 - Totally Active



Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 1 - Dulcey Dock to Bempton Cliffs

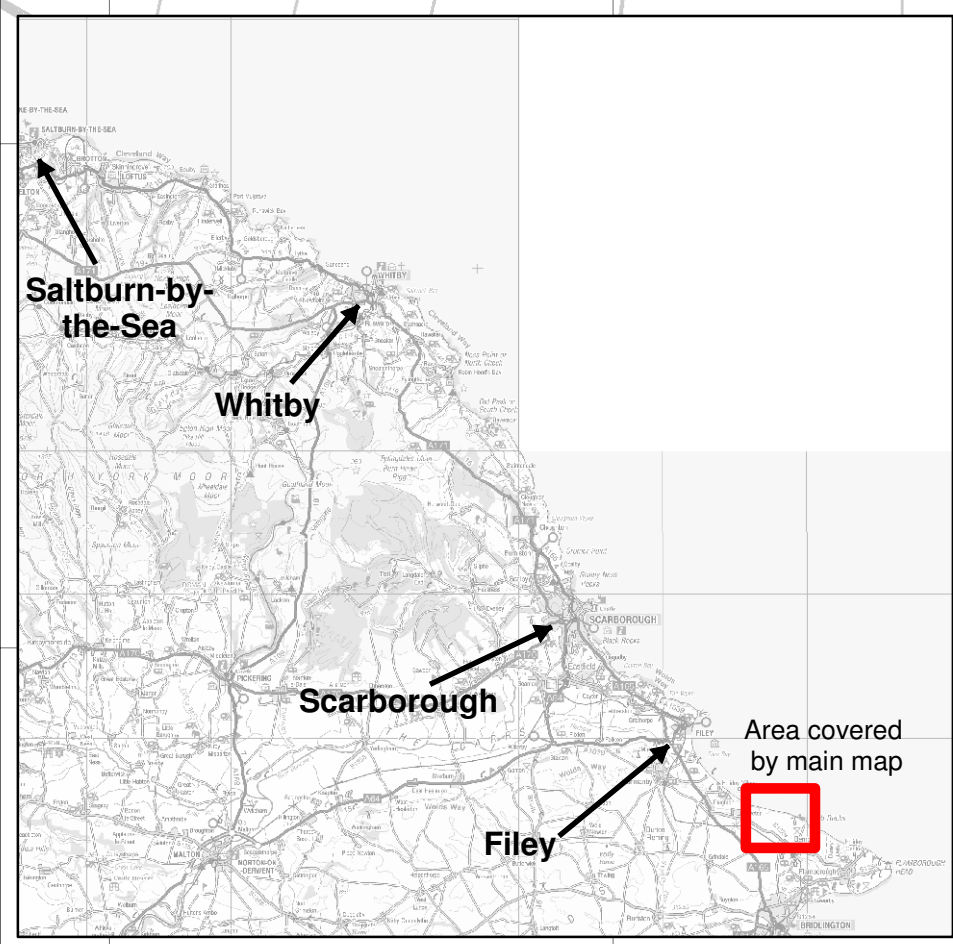
Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

Drawn by: AW	Date: Nov 2008
Checked by: PRF	Date: 19 Jan 2009
Approved by: PRF	Date: 19 Jan 2009

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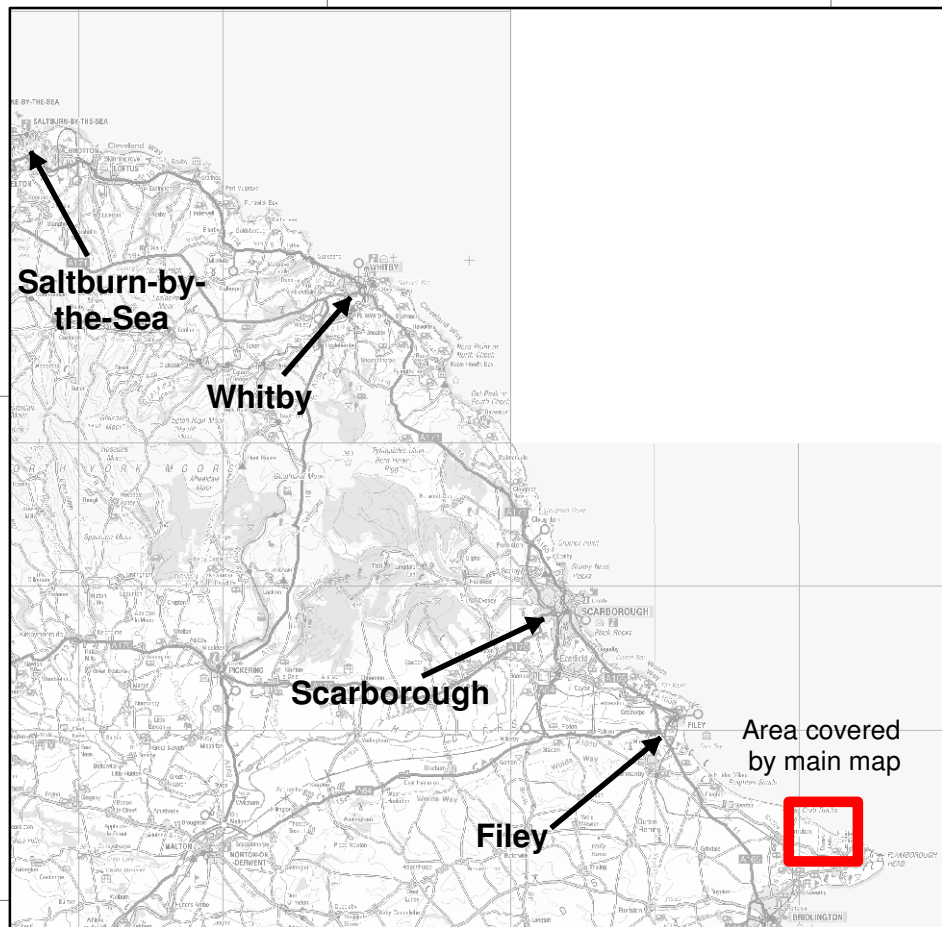
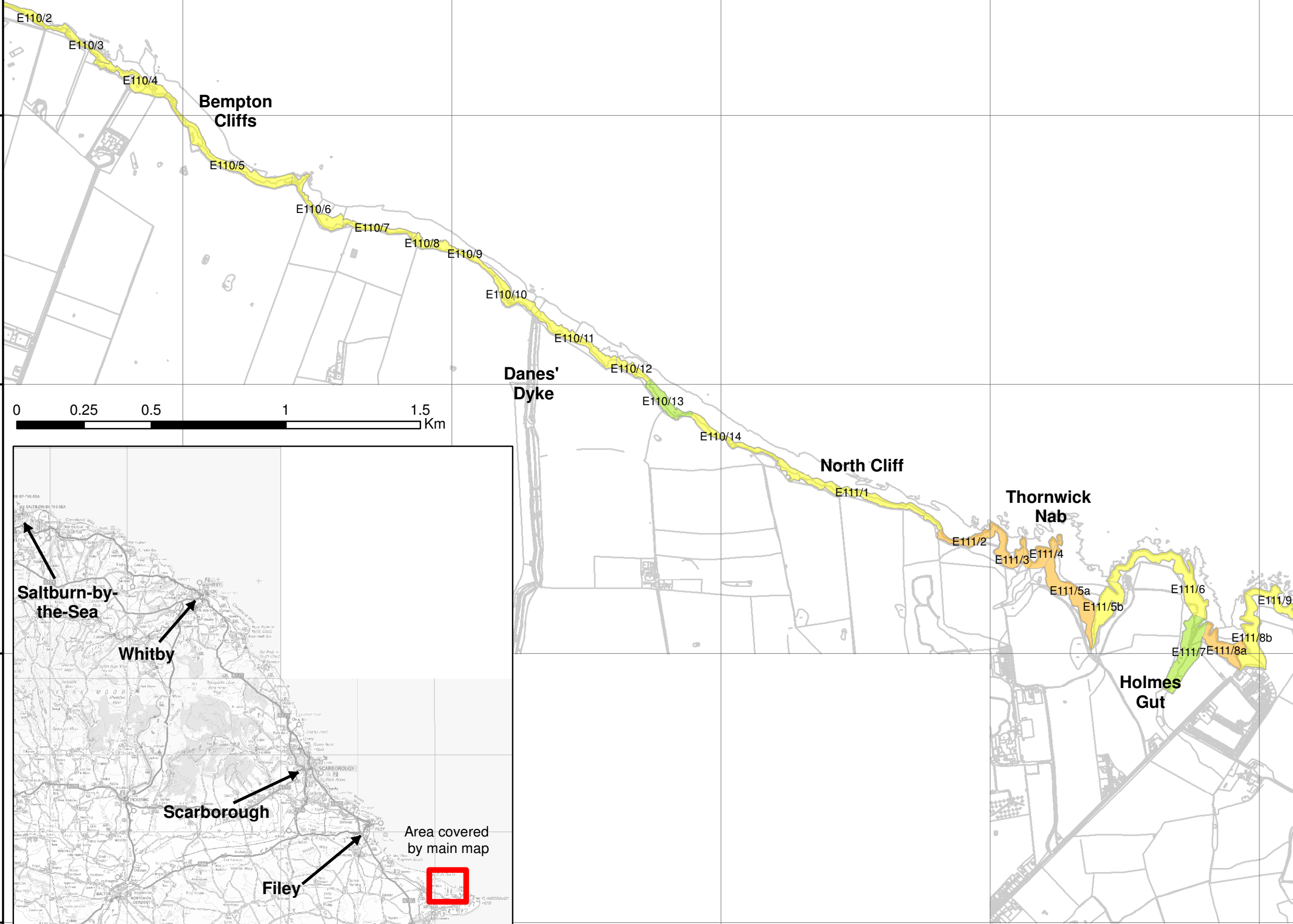
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Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active



Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 2 - Bempton Cliffs to Holmes Gut

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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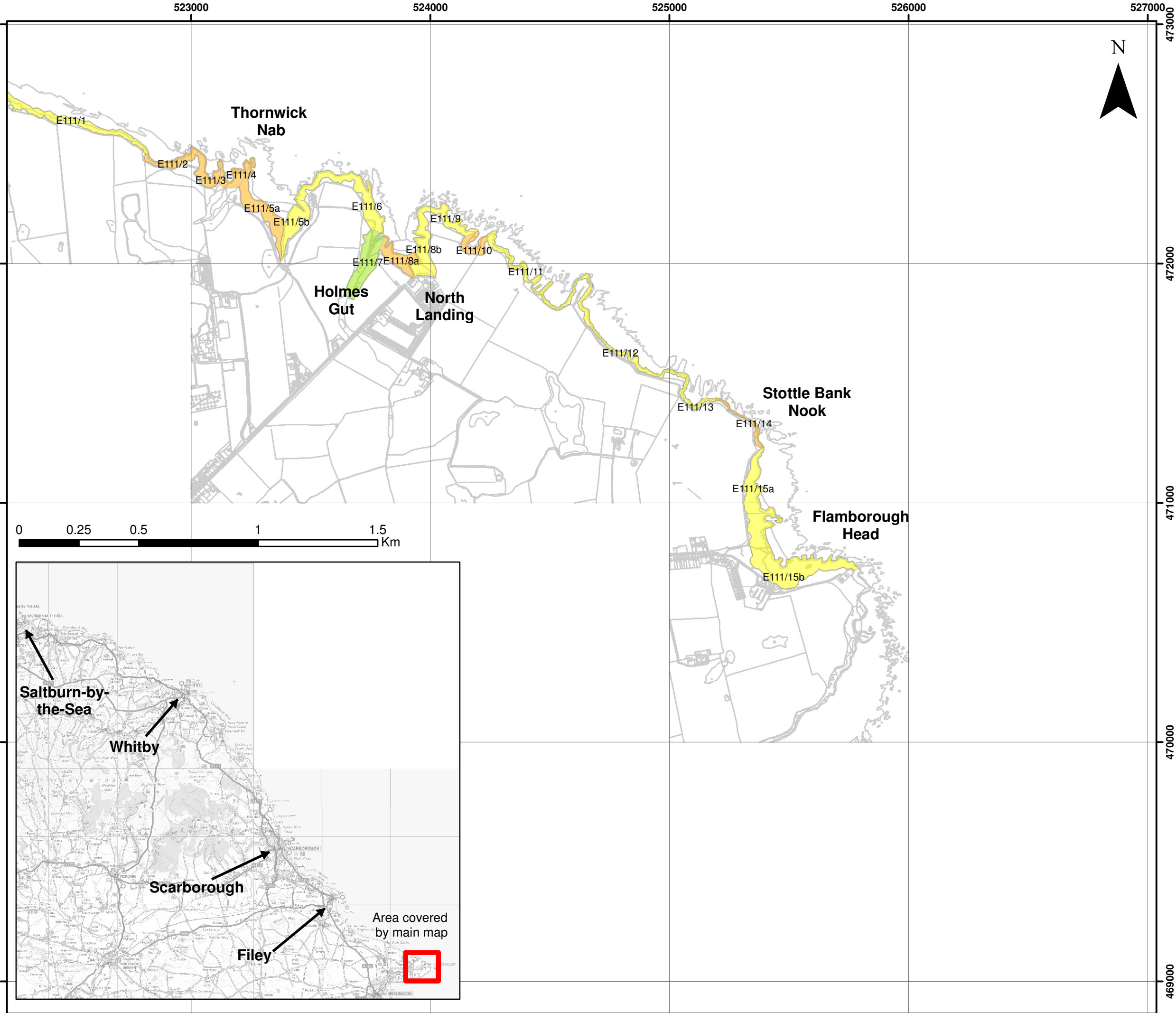
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- Legend**
- Cliff Activity Status 2008**
- Dormant
 - Inactive
 - Locally Active
 - Partly Active
 - Totally Active



Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 3 - Holmes Gut to Flamborough Head
Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

Drawn by: AW	Date: Nov 2008
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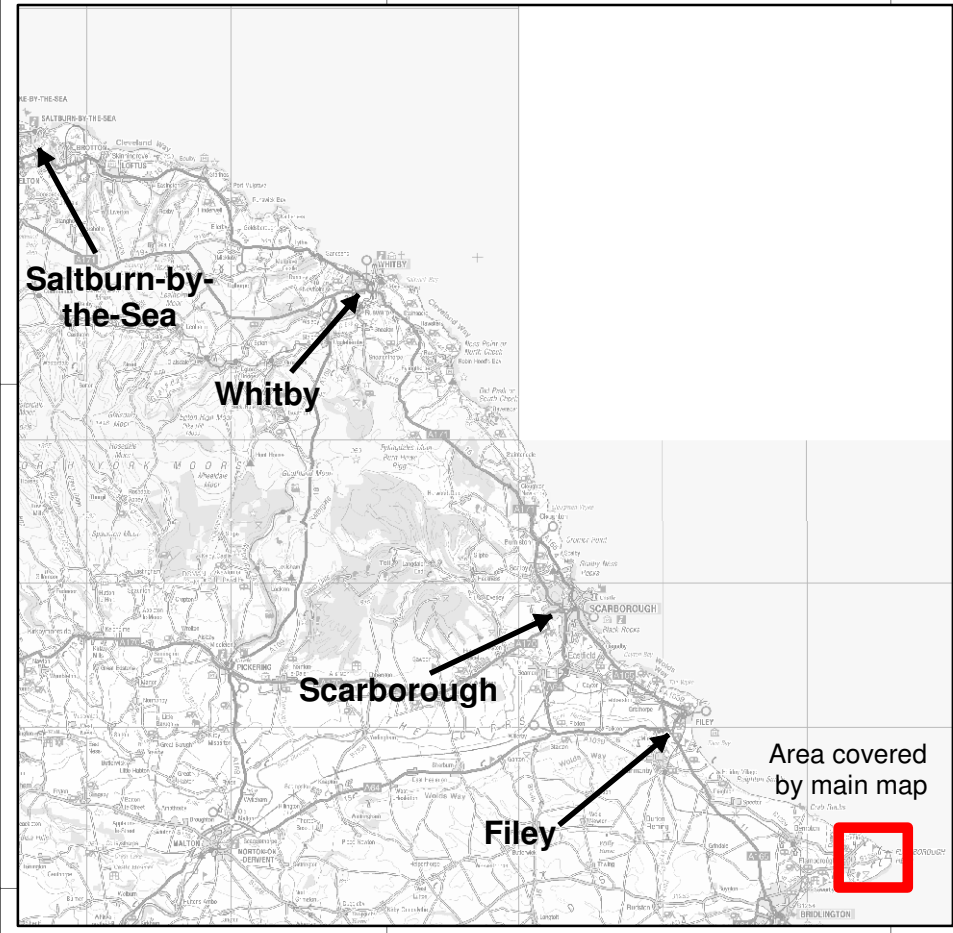
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Asset location
NFCDD Asset Number



Client: North East Coastal Authorities Group
Project: Coastal slope and asset condition inspection, summer 2008

Map 1 - East Riding Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

Drawn by: TC Date: 06/04/2009
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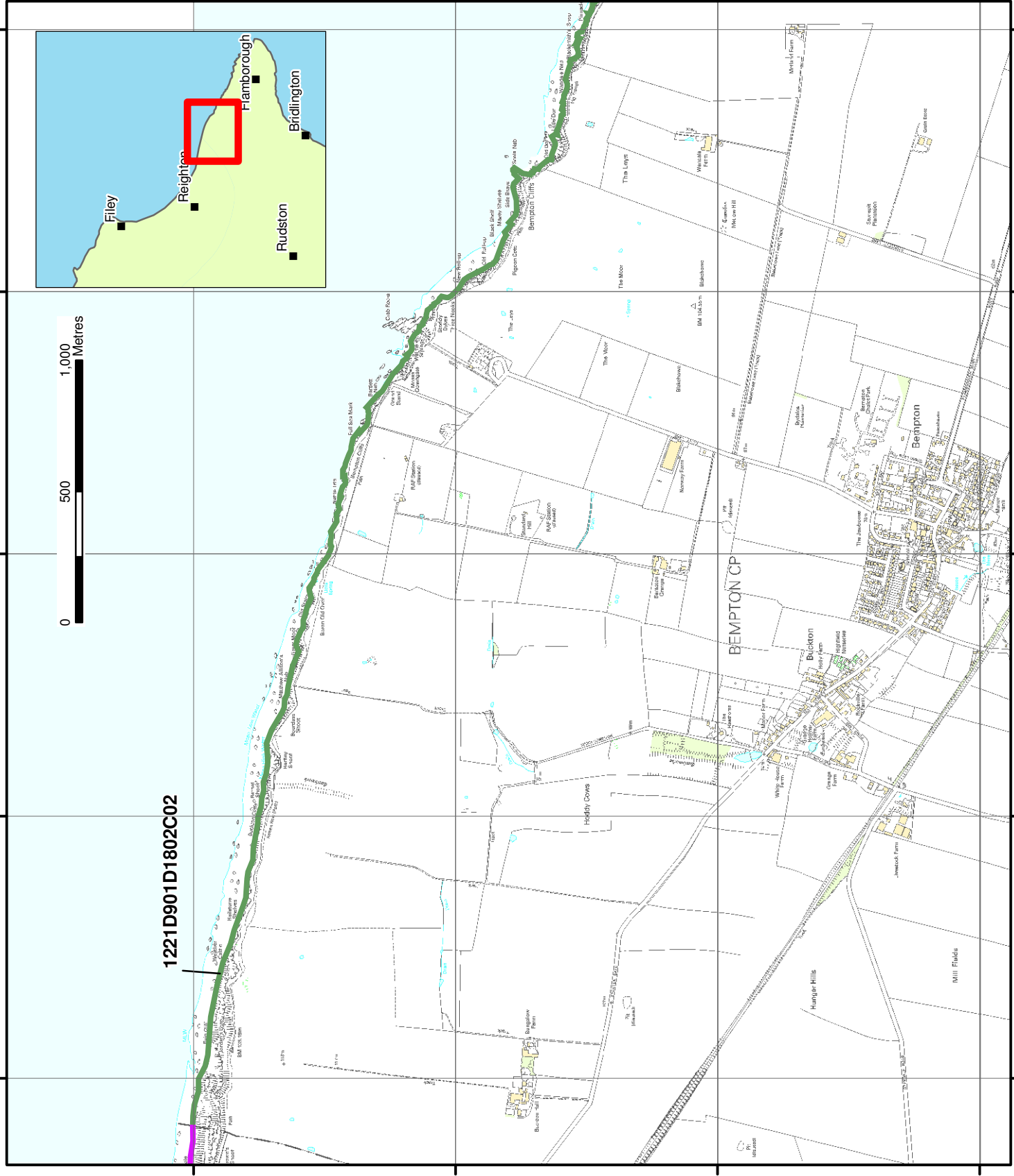
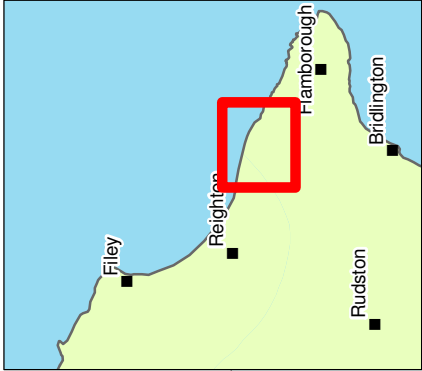
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1221D901D1802C02



Asset location
NFCDD Asset Number



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Map 2 - East Riding Council Frontage

Asset Condition 2008

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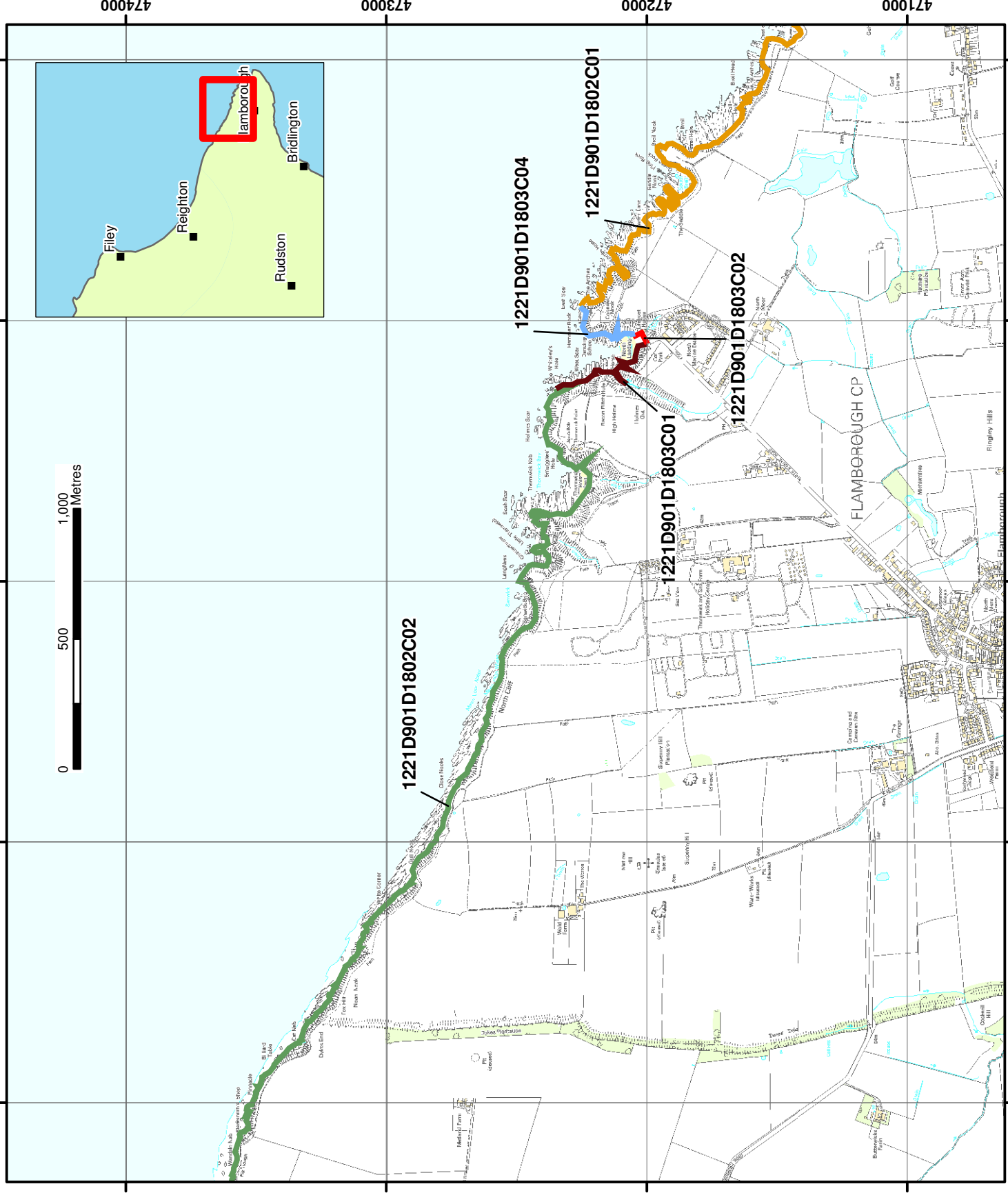


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Asset location
NFCDD Asset Number



Client: North East Coastal Authorities Group
Project: Coastal slope and asset condition inspection, summer 2008

Map 3 - East Riding Council Frontage

Asset Condition 2008

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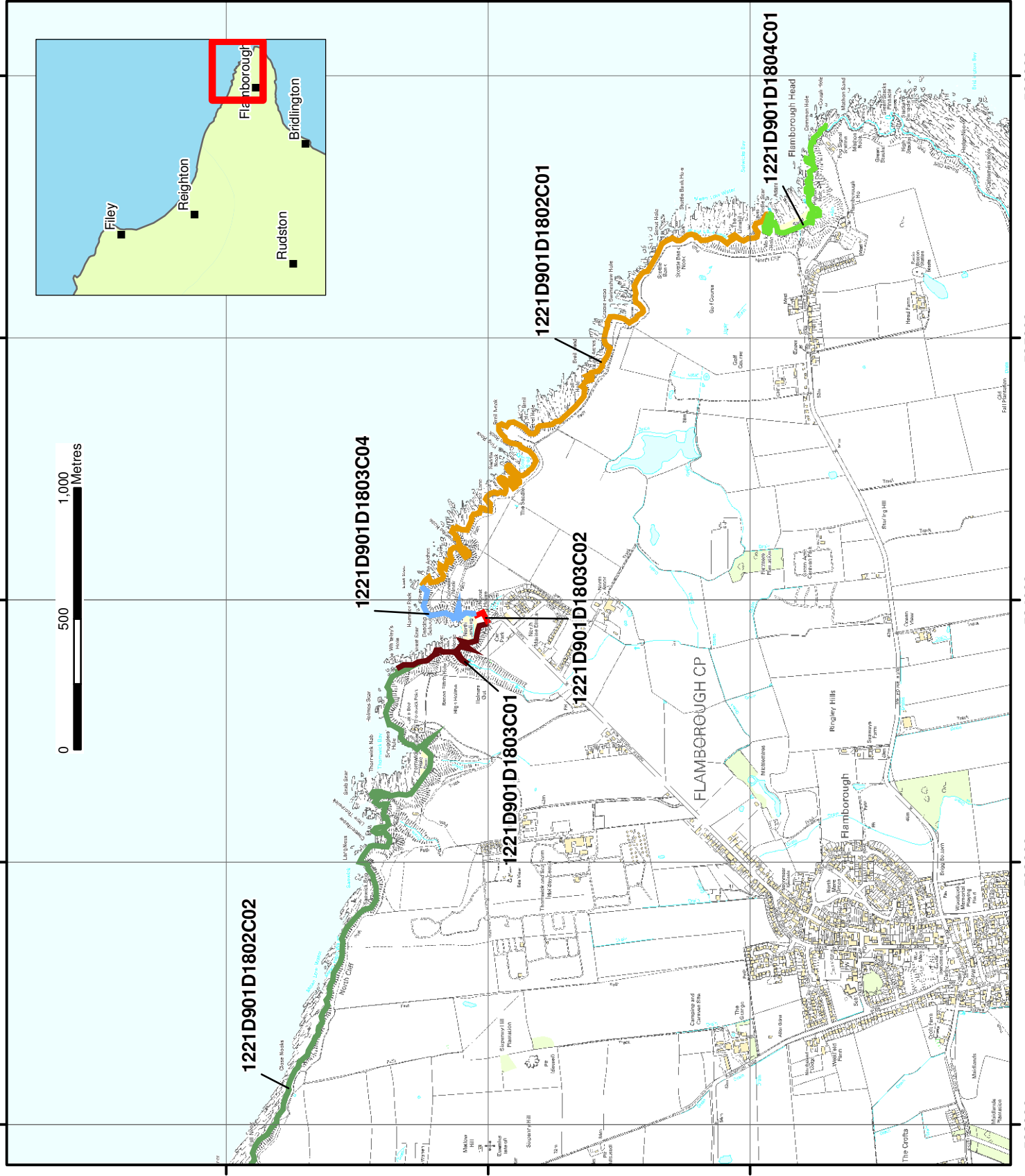


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