FLOOD RISK ASSESSMENT

and

DRAINAGE STRATEGY

for

Mr ATTWOOD

PROPOSED EXTENSION OF HOLIDAY PARK

at

HARBOUR LIGHTS HOLIDAY PARK

STEEL GREEN, HAVERIGG, MILLOM, LA18 4LG

AUGUST 2022

REFORD

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1. INTRODUCTION

1.1 This flood risk assessment and drainage strategy has been produced on behalf of Mr Attwood in support of a variation of condition application to amend the layout of the extant scheme for a proposed extension of the existing holiday village at Harbour Lights Holiday Park, Steel Green, Haverigg, Millom, LA18 4LG. A location plan is included within Appendix A.

1.2 The scheme obtained planning approval in 2010. However the local authority have requested that the flood risk assessment, produced by Hamilton Technical Services that was submitted and approved in support of the 2010 planning approval, is updated given the passage of time since the original application back in 2010.

1.3 The Flood Risk Assessment (FRA) is compliant with the requirements set out in the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (NPPG) in relation to Flood Risk and Coastal Change, and describes the existing site conditions and proposed development. It assesses the potential sources of flooding to the site from tidal, fluvial, groundwater, surface water and other sources, taking a risk based approach in accordance with National Policy.

1.4 The drainage strategy assesses the potential impact of proposals on existing drainage and includes a proposed strategy for the provision of new drainage to serve the proposed development.

Site summary

Site Name	Harbour Lights Holiday Park
Location	Steel Green, Haverigg, Millom, LA18 4LG
NGR (approx.)	SD164788
Application site area	6.7 ha (approx.)
Development type	Holiday park
Vulnerability	More Vulnerable
Indicative Flood Zone	Flood Zones 1 and 3 defended
Local Planning Authority	Copeland Borough Council

2. DESCRIPTION OF THE SITE

Existing site

2.1 The proposal relates to land (approx. 6.7 hectares) at Harbour Lights Holiday Park, Steel Green, Haverigg, Millom, LA18 4LG.

2.2 The site lies approximately 450 to 500m east of Haverigg village. Millom town centre is located just over 1km to the northeast of the site and Barrow-in-Furness is located beyond Duddon Sands almost 10km to the south

2.3 The development site lies to the east of the established site. Access is taken from the roads that lie to the west and south of the site.

2.4 The Haverigg Pool watercourse lies 400 to 450m to the west of the site and flows to the south to discharge into the estuary.

2.5 The existing site comprises grassland. A pond lies within the centre of the site.

2.6 The site has a general fall from the north, east and south towards the centre of the site.

Proposed development

2.7 It is proposed that the development will comprise a proposed extension of the existing holiday village to provide 100no. static caravan pitches, 20no. motor home pitches, 30no. touring caravan pitches, camping area for up to 20no. tents, communal facilities building, 2no. shower and toilet blocks, park maintenance compound, tourist information building incorporating café and public toilets, associated landscaping and infrastructure works.

2.8 The site layout plan is shown on drawing D2R-MST-01-D accompanying the planning application.

2.9 It is proposed that the vehicle access into the developed site will be from the existing site access from Haverigg Road that lies to the west of the site.

3. SCOPE OF THE ASSESSMENT

Flood risk planning policy

3.1 The National Planning Policy Framework (NPPF) sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. Supporting Planning Practice Guidance is also available.

3.2 The NPPF sets out the vulnerability to flooding of different land uses. It encourages development to be located away from areas at highest risk (whether existing or future), and states that where development is necessary in such areas, the development should be made safe for its lifetime. It also stresses the importance of preventing increases in flood risk offsite to the wider catchment area.

3.3 The NPPF also states that alternative sources of flooding, other than fluvial (river flooding), should also be considered when preparing a Flood Risk Assessment.

3.4 As set out in NPPF, local planning authorities should only consider development in flood risk areas appropriate where informed by a site specific Flood Risk Assessment. This document will identify and assess the risk associated with all forms of flooding to and from the development. Where necessary it will demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

3.5 This Flood Risk Assessment is written in accordance with the NPPF and the Planning Practice Guidance in relation to Flood Risk and Coastal Change.

Flood zones

3.6 In investigating the flood risk relating to the site, the Environment Agency flood zone mapping identifies the majority of the proposed development site lying within Flood Zone 3 defended with the northern part of the site lying within Flood Zone 1. Flood Zone 3 is identified as land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the

sea (>0.5%). Flood Zone 1 is the lowest risk and is identified as land assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1%).

3.7 An extract from the Environment Agency's Flood Zone Map for Planning is shown below with an approx. site boundary.

Strategic Flood Risk Assessment

3.8 The site is within the area covered by the South Lakeland District Strategic Flood Risk Assessment (SFRA), October 2007.

4. CONSULTATIONS AND DATA ACQUISITIONS

Environment Agency

4.1 The Environment Agency's flood zone mapping confirms that the majority of the proposed development site lies within Flood Zone 3 defended with the northern part of the site lying within Flood Zone 1.

4.2 The Haverigg Pool watercourse lies 400 to 450m to the west of the site and flows to the south to discharge into the estuary. Defences lie along the banks of the Haverigg Pool and provide a standard of protection to the site of 100 years.

4.3 Product 4 and Product 8 information was requested from the Environment Agency. Modelled flood levels for the development site have been provided. Information with regards the defences have also been provided. Breach information was not provided. The information is included within Appendix B.

4.4 The information provides the following modelled tidal flood levels within the site. There is no fluvial flood risk to the site.

Return Period	Undefended	Defended
1%	6.04m AOD	Not affected
0.5%	6.16m AOD	Not affected
0.5% + 600mm	6.84m AOD	5.76m AOD
0.1%	6.42m AOD	Not affected

4.5 The defended scenarios without climate change do not affect the site.

4.6 The site has not been identified as previously flooding from the Historic Flood Mapping on the gov.uk website.

4.7 The site is in an area benefitting from the Environment Agency's flood warning service, which warn people that flooding is expected and informing them to take immediate action.

United Utilities

4.8 United Utilities sewer mapping identifies the public combined sewer network lying within Haverigg Road that lies to the west of the site. The sewer network flows to the north towards Millom.

Topographical Survey

4.9 A topographical survey has been carried out for this site. The site has a general fall from the north, east and south towards the centre of the site where the level is just below 5.5m AOD.

Site Investigation

4.10 Site investigations have not been carried out for the site.

4.11 The online Soilscapes viewer has identified that the geology encountered will be the following:

- Loamy and clayey soils of coastal flats with naturally high groundwater within the west of the site.
- Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils with impeded drainage within the east of the site.

4.12 Based upon the ground conditions identified, infiltration is unlikely to provide a viable drainage solution for surface water runoff generated by the site. Infiltration tests have therefore not been carried out.

5. SOURCES OF FLOOD RISK

Potential Sources of Flood Risk

5.1 Potential sources of flood risk to the site are identified below. The significance of these sources is investigated further into Section 6.

Tidal flooding

5.2 The Environment Agency's flood zone mapping confirms that the majority of the proposed development site lies within Flood Zone 3 defended with the northern part of the site lying within Flood Zone 1.

5.3 Modelling Outputs from the Environment Agency gave the following flood levels within the site for the following tidal events:

Return Period	Undefended	Defended
1%	6.04m AOD	Not affected
0.5%	6.16m AOD	Not affected
0.5% + 600mm	6.84m AOD	5.76m AOD
0.1%	6.42m AOD	Not affected

5.4 The site is in an area benefitting from the Environment Agency's flood warning service, which warn people that flooding is expected and informing them to take immediate action.

Fluvial flooding

5.5 The site is unaffected by fluvial flooding.

Canals, reservoirs and other artificial sources

5.6 There are no canals or other artificial sources local to the site.

5.7 The Environment Agency risk of flooding from reservoirs map identifies the site is not at risk.

Groundwater

5.8 Groundwater flooding tends to occur after much longer periods of sustained high rainfall. The areas that are at risk tend to be those low-lying areas where the water table is shallow. Flooding tends to occur in areas that are underlain by major aquifers, although groundwater flooding is also noted in localised floodplain sands and gravels. The main causes of groundwater flooding are:

- Natural groundwater rising due to tidal influence, or exceptionally wet periods leading to rapid recharge;
- Groundwater rebound due to cessation of abstraction and mine dewatering;
- Existence of confined aquifers and springs.

Sewers

5.9 Flooding from a drainage system occurs when flow entering a system exceeds its discharge capacity, the system becomes blocked or, in the case of surface water sewers, it cannot discharge due to high water level in the receiving watercourse. Sewer flooding is often caused by surface water discharging into the combined sewerage system, sewer capacity is exceeded in large rainfall events causing backing up of flood waters within properties or discharging through manholes.

5.10 There are no public sewers within the development site. The nearest public sewer lies within Haverigg Road that lies to the west of the site. The sewer network flows to the north towards Millom.

Pluvial runoff

5.11 The Environment Agency Risk of Flooding from Surface Water map indicates the majority of the site is at a very low risk of surface water flooding. A medium to high risk is identified within the centre of the site where the ground levels are at their lowest. A very low risk means that each year this area has a chance of flooding of less than 1 in 1000 (0.1%). A high risk means that each year this area has a chance of flooding of greater than 1 in 30 (3.3%).

5.12 It should be noted that surface water flooding can be difficult to predict, much more so than river or sea flooding as it is hard to forecast exactly where or how much rain will fall in any storm. In addition, local features can greatly affect the chance and severity of flooding.

Development drainage

5.13 Surface water (including the risk of sewers and culverted watercourses surcharging) poses the highest risk of more frequent flooding. Surface water drainage from new developments is critical in reducing the risk of localised flooding.

5.14 If surface water runoff is not managed appropriately, there may be an increased risk presented elsewhere from development drainage, and the aim should be to implement appropriate sustainable drainage systems (SuDS) to treat and contain flows and mimic the existing conditions.

5.15 Where possible the preference for dealing with surface water runoff from the developed site is for it to infiltrate back into the ground or alternatively to a waterbody or watercourse. Only if it is not possible for either of these options is surface water from the development to be allowed into public sewers.

5.16 The proposed development will increase the area of impermeable hardstanding on site, which has the potential to significantly alter the surface water runoff regime of the site and have an adverse effect on flood risk elsewhere in the wider catchment.

6. FLOOD RISK ASSESSMENT

6.1 This section of the Flood Risk Assessment looks at the flood risk to the site before any mitigation measures are put into place and hence identifies where mitigation will be required. Section 7 continues to explain the mitigation measures proposed and the residual risk following implementation of any proposed mitigation.

Risk of Flooding to Proposed Development

Tidal Flood Risk

6.2 The main risk of flooding within the development site is from tidal sources. The Environment Agency's flood zone mapping confirms that the majority of the proposed development site lies within Flood Zone 3 defended with the northern part of the site lying within Flood Zone 1.

6.3 Modelling Outputs from the Environment Agency gave the following flood levels within the site for the following tidal events:

Return Period	Undefended	Defended
1%	6.04m AOD	Not affected
0.5%	6.16m AOD	Not affected
0.5% + 600mm	6.84m AOD	5.76m AOD
0.1%	6.42m AOD	Not affected

6.4 A topographical survey has been carried out for this site. The site has a general fall from the north, east and south towards the centre of the site where the level is just below 5.5m AOD.

6.5 The defended scenarios without climate change do not affect the site. Should the 0.5% plus climate change (+600mm) event occur then the development site would be affected with a modelled depth of water of approx. 500mm

6.6 All undefended events will affect the development site, the maximum modelled depth of water being approx. 1m for the undefended 0.1% event and approx. 1.5m for the 0.5% plus 600mm event.

6.7 Defences lie along the banks of the Haverigg Pool that lies 400 to 450m to the west of the site and flows to the south to discharge into the estuary, and provide a standard of protection to the site of 100 years. The current condition of the majority of the defences is classified as good.

6.8 In the unlikely event that there is a major breach of the flood defences occurring during a major storm event then large volumes of flood water could enter the Zone 3 flood plain shown on the flood map. This flood water could pass through the breach area at significant depths and high speeds to produce very dangerous conditions for people in the vicinity of the ingress. Flood water would then spread out from the breach location in a generally easterly direction, but as it spread it would reduce in depth and speed.

6.9 In the absence of modelled breach information being available from the Environment Agency, a method of determining the risk from a breach using a simple overview of hazard to people based on the head of water compared to floodplain levels and distance from defences. Table 12.2 danger to people from breaching relative to distance from defence in the document FD2320 – Flood Risk Assessment Guidance for New Development has been used to determine the risk.

6.10 The results identified the risk from the breach assessment using the simple method as 'Danger for Some'. The assessment is included within Appendix C.

6.11 The site is in an area benefitting from the Environment Agency's flood warning service, which warn people that flooding is expected and informing them to take immediate action.

6.12 Based on the above it is considered that the risk of tidal flooding to the proposed development is low as also identified on the long term flood risk mapping.

Canals, reservoirs and other artificial sources

6.13 There are no canals or other artificial sources that are local to or affect the site.

6.14 The Environment Agency's risk of flooding from reservoirs mapping identifies no risk of flooding from reservoirs.

6.15 As such the risk of flooding from canals, reservoirs and other artificial sources is low.

Groundwater

6.16 There are no recorded incidents of flooding associated with groundwater levels within the site.

6.17 The risk from groundwater flooding is therefore considered to be low.

Sewer Flooding and Pluvial Runoff

6.18 There are no public sewers within the development site. The nearest public sewer lies within Haverigg Road that lies to the west of the site. The sewer network flows to the north towards Millom.

6.19 The Environment Agency Risk of Flooding from Surface Water map indicates the majority of the site is at a very low risk of surface water flooding. A medium to high risk is identified within the centre of the site where the ground levels are at their lowest. A very low risk means that each year this area has a chance of flooding of less than 1 in 1000 (0.1%). A high risk means that each year this area has a chance of flooding of greater than 1 in 30 (3.3%).

6.20 The development masterplan identifies ponds to be located within this area of the development site.

6.21 As such the risk to the development is low from sewer flooding and pluvial runoff.

Effect of the Development on the Wider Catchment

Development Drainage

6.22 The proposed development will introduce an area of impermeable hardstanding on site, which has the potential to significantly alter the surface water runoff regime of the site and have an adverse effect on flood risk elsewhere in the wider catchment.

6.23 The ground is not conducive to infiltration.

6.24 Surface water runoff from the development site will follow the general fall of the ground towards the centre of the development site and the west.

6.25 It is intended that surface water runoff from the developed site will be dealt with by means of sustainable drainage systems, in particular with the new ponds lying within the centre of the site, designed as permanent water features.

6.26 On the occasions that the pond system is unable to cope with major rainfall runoff, a small surface water pumping facility will be constructed and will be used to transfer water from the ponds into the main lagoon lying to the south-west of the site.

6.27 As such there will be no change to the flood risk upstream or downstream of this location.

6.28 As a result of the mitigation measures, the risk of flooding from the development drainage is low.

7. PREDICTED IMPACTS AND MITIGATION

7.1 This section of the FRA sets out the mitigation measures recommended to reduce the risk of flooding to the proposed development and outlines any residual impacts.

Site arrangements

Access / Egress

7.2 If an extreme event was to occur, occupiers will leave the site by the eastern boundary and use the public right of way that goes northwards to join Haverigg Road approx. 600m to the north of the site. The route lies within Flood Zone 1. Emergency instruction leaflets will be provided to all occupiers using the campsite showing the emergency escape route and the assembly point.

Upstream and downstream effects

7.3 There is no material effect on the floodplain due to the proposed development.

7.4 It is intended that surface water runoff from the developed site will be dealt with by means of sustainable drainage systems, in particular with the new ponds lying within the centre of the site, designed as permanent water features. On the occasions that the pond system is unable to cope with major rainfall runoff, a small surface water pumping facility will be constructed and will be used to transfer water from the ponds into the main lagoon lying to the south-west of the site. There will, therefore, be no additional risk to upstream or downstream properties.

Mitigation measures

7.5 A proposed landscaped bund is identified along the western site boundary. This bund is intended to perform three functions:

- to allow new planting to screen the development and provide shelter from prevailing winds;
- to prevent the flow of water off the site onto adjoining land in extreme rainfall events thus reducing the level of downstream flooding and;

- to slow down the flow of flood water into the site in the event of a major flood event.

7.6 It is intended that the bund will help protect the site by reducing the volume of water that can flow onto the site in all but the most extreme circumstances. The bund cannot be constructed to prevent all water flow onto the site as the low sections of the land form part of the local flood plain in extreme circumstances and must continue to do so. The lower section of bund will allow the flood plain to act as required whilst also acting as a brake on inundation of the site. The low portion of the bund has also been positioned so that any ingress of flood water will be directed into the pond system thus reducing again the effects of flooding on the remainder of the camp site. These design measures will act to allow significantly longer times for evacuation of the camp site should this become necessary, as well as possibly reducing the area of the site that will become flooded.

8. DRAINAGE STRATEGY

Surface water drainage

8.1 Surface water (including the risk of sewers and culverted watercourses surcharging) poses the highest risk of more frequent flooding. Surface water drainage from new developments is critical in reducing the risk of localised flooding.

8.2 Flooding from drainage system occurs when flow entering a system exceeds its discharge capacity, the system becomes blocked or, in the case of surface water sewers, it cannot discharge due to high water level in the receiving watercourse. Sewer flooding is often caused by surface water discharging into the combined sewerage system, sewer capacity is exceeded in large rainfall events causing backing up of flood waters within properties or discharging through manholes.

8.3 Guidance for the disposal of surface water from a development site is for soakaways to be considered as the primary solution. If this is not practical, discharge to a waterbody or watercourse is to be considered as the next available alternative. Only if neither of these options is available, and other sustainable drainage methods not possible, should the use of the public sewerage system be considered.

8.4 The flood risk assessment produced by Hamilton Technical Services that was submitted in support of the 2010 planning application and was approved, detailed the surface water drainage strategy as follows:

- All of the surface water runoff from the developed site will be dealt with by means of sustainable drainage systems. These will be of a number of different types such as new ponds, swales, soakaways, permeable surfaces, infiltration trenches and rainwater harvesting systems. The ponds will provide several benefits to the site including new and varied wildlife habitats, full surface water attenuation and visitor amenity. These new ponds can be seen on the proposed development plan and will be designed as permanent water features. The levels in and around the ponds will be designed to facilitate wildlife use and to hold all the surface water runoff from the site during storm events.

- The runoff from the various new hard standings and roof areas will be dealt with by a combination of sustainable drainage methods. The roof water from the buildings will be directed to below ground harvesting systems that will provide water for flushing of toilets and urinals within the buildings and also for occasional landscape irrigation. This will reduce the on-site demand for potable water from the mains system and will reduce the volume of runoff from the site. Runoff from new roads will be directed onto adjacent grassed areas and in some locations infiltration trenches and swales will be introduced to increase control and dissipation of these flows.
- Car parking areas will be surfaced using Grasscrete or similar paving thus allowing the rainfall to soak into the ground to replenish the water table. This system will also control the rate of runoff from these areas at present day levels whilst allowing the water to eventually enter the ponds and ground by more natural means.
- Whilst the pond systems will be designed to cope with major rainfall runoff, there may be occasions when their ability to disperse water through evaporation and also back into the water table will not be fully adequate. In the event of prolonged periods of very wet weather, water levels in the ponds may begin to encroach on the surrounding campsite areas, leading to a need to reduce the water levels by non-natural means. For these occasions a small surface water pumping facility will be constructed close to the ponds and adjacent to the new site access road as indicated on the site plan. This pumping facility will be used to transfer water from the ponds into the main lagoon lying to the south-west of the site. This lagoon is of such size and capacity that the transfer of water from the site ponds would have no significant effect on water levels within the lagoon itself.

8.5 It is intended that this surface water strategy be adopted.

Foul water drainage

8.6 United Utilities sewer mapping identifies the public combined sewer network lying within Haverigg Road that lies to the west of the site. The sewer network flows to the north towards Millom.

8.7 A new foul effluent pumping station is to be located within the development site to enable foul effluent to be pumped to the public combined sewer network lying within Haverigg Road that lies to the west of the site.

9. CONCLUSIONS

9.1 This flood risk assessment and drainage strategy has been produced on behalf of Mr Attwood in support of a variation of condition application to amend the layout of the extant scheme for a proposed extension of the existing holiday village at Harbour Lights Holiday Park, Steel Green, Haverigg, Millom, LA18 4LG.

9.2 The Environment Agency's flood zone mapping confirms that the majority of the proposed development site lies within Flood Zone 3 defended with the northern part of the site lying within Flood Zone 1.

9.3 The risk of tidal flooding is low.

9.4 The site is unaffected by fluvial flooding.

9.5 There are no recorded instances of historic flooding at the site.

9.6 The risk of flooding from canals, reservoirs and other artificial sources is low.

9.7 The flood risk from groundwater is low.

9.8 The risk from sewer flooding and pluvial runoff is low.

9.9 The risk of flooding from the development drainage is low.

9.10 It is intended that surface water runoff from the developed site will be dealt with by means of sustainable drainage systems, in particular with the new ponds lying within the centre of the site, designed as permanent water features. On the occasions that the pond system is unable to cope with major rainfall runoff, a small surface water pumping facility will be constructed and will be used to transfer water from the ponds into the main lagoon lying to the south-west of the site.

9.11 A new foul effluent pumping station is to be located within the development site to enable foul effluent to be pumped to the public combined sewer network lying within Haverigg Road that lies to the west of the site.

APPENDIX A

LOCATION PLAN

APPENDIX B

Flood defences and attributes

The flood defences map shows the location of the flood defences present.

The flood defences data table shows the type of defences, their condition and the standard of protection. It shows the height above sea level of the top of the flood defence (crest level). The height is In mAOD which is the metres above the mean sea level at Newlyn, Cornwall.

It's important to remember that flood defence data may not be updated on a regular basis. The information here is based on the best available data.

Environment Agency

Flood defences

Location (easting/northing)
316674/478895

Scale
1:5,000

Created
5 May 2022

Selected area
Main river
Flood defence

0 50 100 150 200 250
metres

Flood defences data

Label	Asset ID	Asset Type	Standard of protection (years)	Current condition	Downstream actual crest level (mAOD)	Upstream actual crest level (mAOD)	Effective crest level (mAOD)
1	79170	Wall	100	Good	6.52	6.53	6.52
2	162818	Embankment	100	Good	6.53	6.59	6.53
3	127465	Wall		Good	3.30	4.36	3.30
4	79142	Wall	100	Good	6.59	6.59	6.59
5	79173	Wall	100	Good	6.52	6.51	6.51
6	79533	Embankment	100	Good	6.56	6.43	6.43
7	55126	Embankment	50	Fair	5.88	5.88	5.88
8	79172	Wall	100	Fair	6.49	6.49	6.49

Any blank cells show where a particular value has not been recorded for an asset.

Modelled data

This section provides details of different scenarios we have modelled and includes the following (where available):

- outline maps showing the area at risk from flooding in different modelled scenarios
- modelled node point map(s) showing the points used to get the data to model the scenarios and table(s) providing details of the flood risk for different return periods
- map(s) showing the approximate water levels for the return period with the largest flood extent for a scenario and table(s) of sample points providing details of the flood risk for different return periods

Climate change

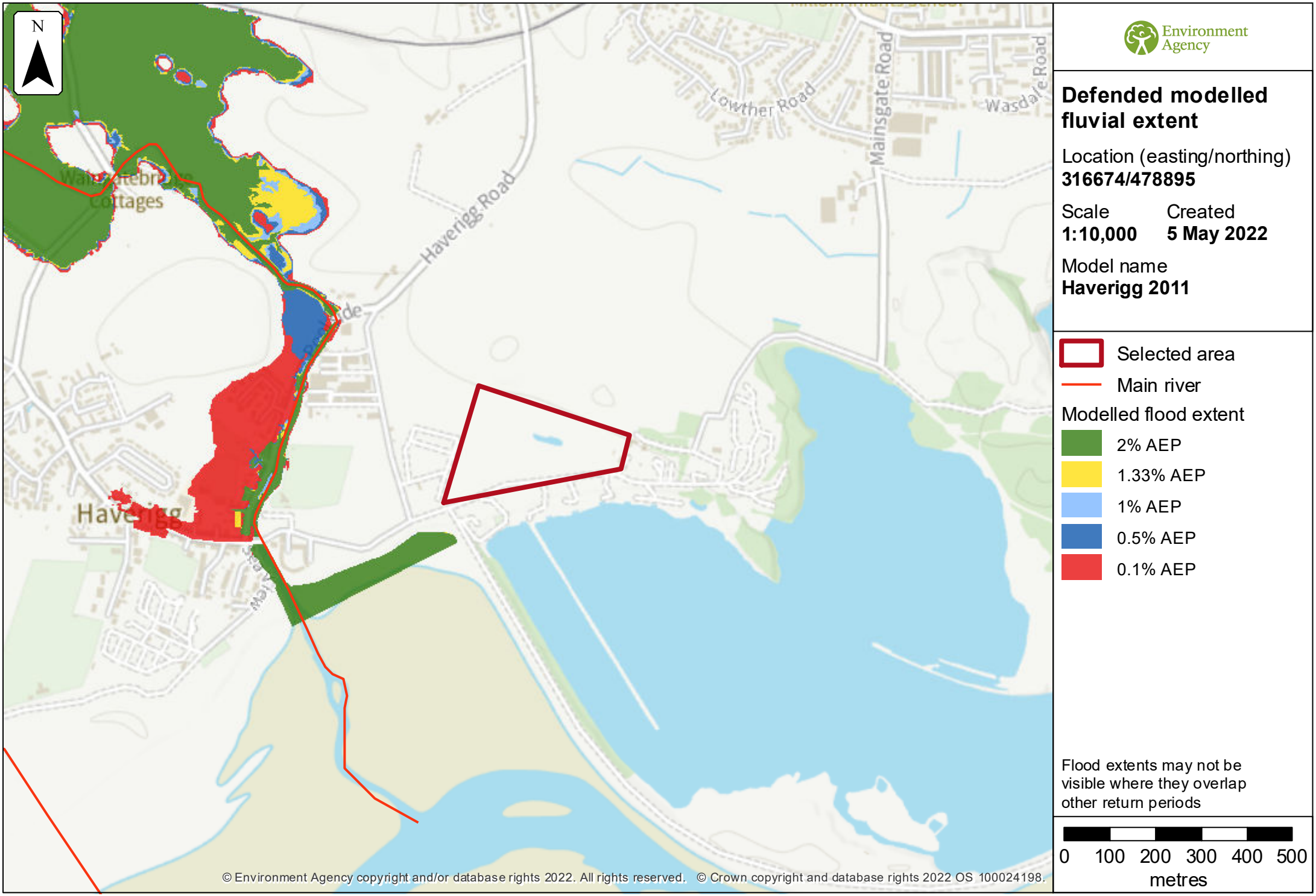
The climate change data included in the models may not include the latest flood risk assessment climate change allowances. Where the new allowances are not available you will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding.

The Environment Agency will incorporate the new allowances into future modelling studies. For now, it's your responsibility to demonstrate that new developments will be safe in flood risk terms for their lifetime.

Modelled scenarios

The following scenarios are included:

- Defended modelled fluvial: risk of flooding from rivers where there are flood defences
- Defences removed modelled fluvial: risk of flooding from rivers where flood defences have been removed
- Defended modelled tidal: risk of flooding from the sea where there are flood defences
- Defences removed modelled tidal: risk of flooding from the sea where flood defences have been removed
- Defended climate change modelled fluvial: risk of flooding from rivers where there are flood defences, including estimated impact of climate change
- Defences removed climate change modelled fluvial: risk of flooding from rivers where flood defences have been removed, including estimated impact of climate change
- Defended climate change modelled tidal: risk of flooding from the sea where there are flood defences, including estimated impact of climate change
- Defences removed climate change modelled tidal: risk of flooding from the sea where flood defences have been removed, including estimated impact of climate change


N
Haverigg Road
Lowther Road
Mainsgate Road
Wasdale Road
Haverigg
Environment Agency
Defended modelled fluvial extent
Location (easting/northing)
316674/478895
Scale
1:10,000
Created
5 May 2022
Model name
Haverigg 2011
Selected area
Main river
Modelled flood extent
2% AEP
1.33% AEP
1% AEP
0.5% AEP
0.1% AEP
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
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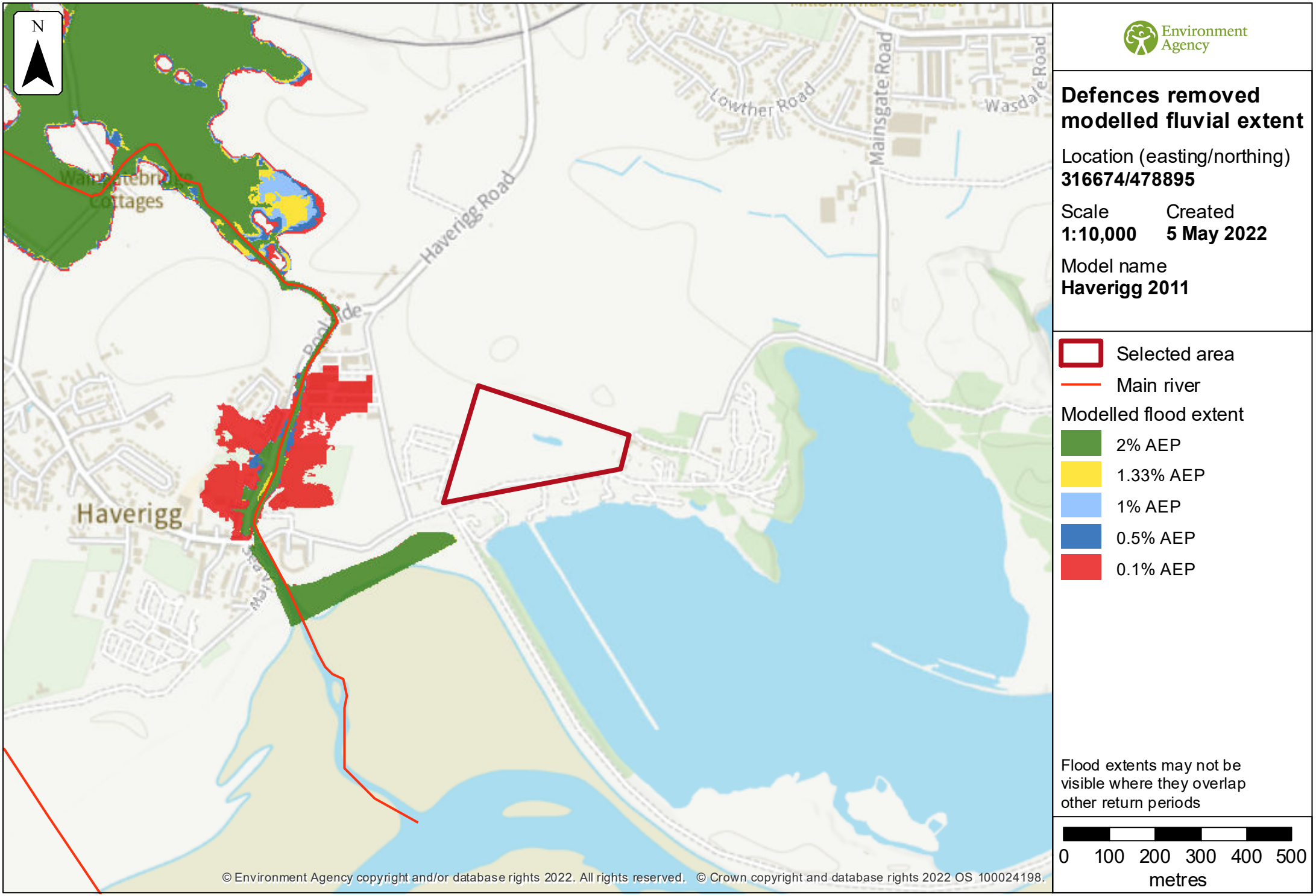
N
Haverigg Road
Lowther Road
Mainsgate Road
Haverigg
Environment Agency
Defences removed modelled fluvial extent
Location (easting/northing)
316674/478895
Scale
1:10,000
Created
5 May 2022
Model name
Haverigg 2011
Selected area
Main river
Modelled flood extent
2% AEP
1.33% AEP
1% AEP
0.5% AEP
0.1% AEP
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
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N
Lowther Road
Mainsgate Road
Wasdale Road
Haverigg Road
Poolside
Haverigg
Environment Agency
Defended climate change modelled fluvial extent
Location (easting/northing)
316674/478895
Scale
1:10,000
Created
5 May 2022
Model name
Haverigg 2011
Selected area
Main river
Modelled flood extent
1.0% AEP (+20%)
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
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N
Lowther Road
Mainsgate Road
Wasdale Road
Haverigg Road
Poolside
Haverigg
Environment Agency
Defences removed climate change modelled fluvial extent
Location (easting/northing)
316674/478895
Scale
1:10,000
Created
5 May 2022
Model name
Haverigg 2011
Selected area
Main river
Modelled flood extent
1.0% AEP (+20%)
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
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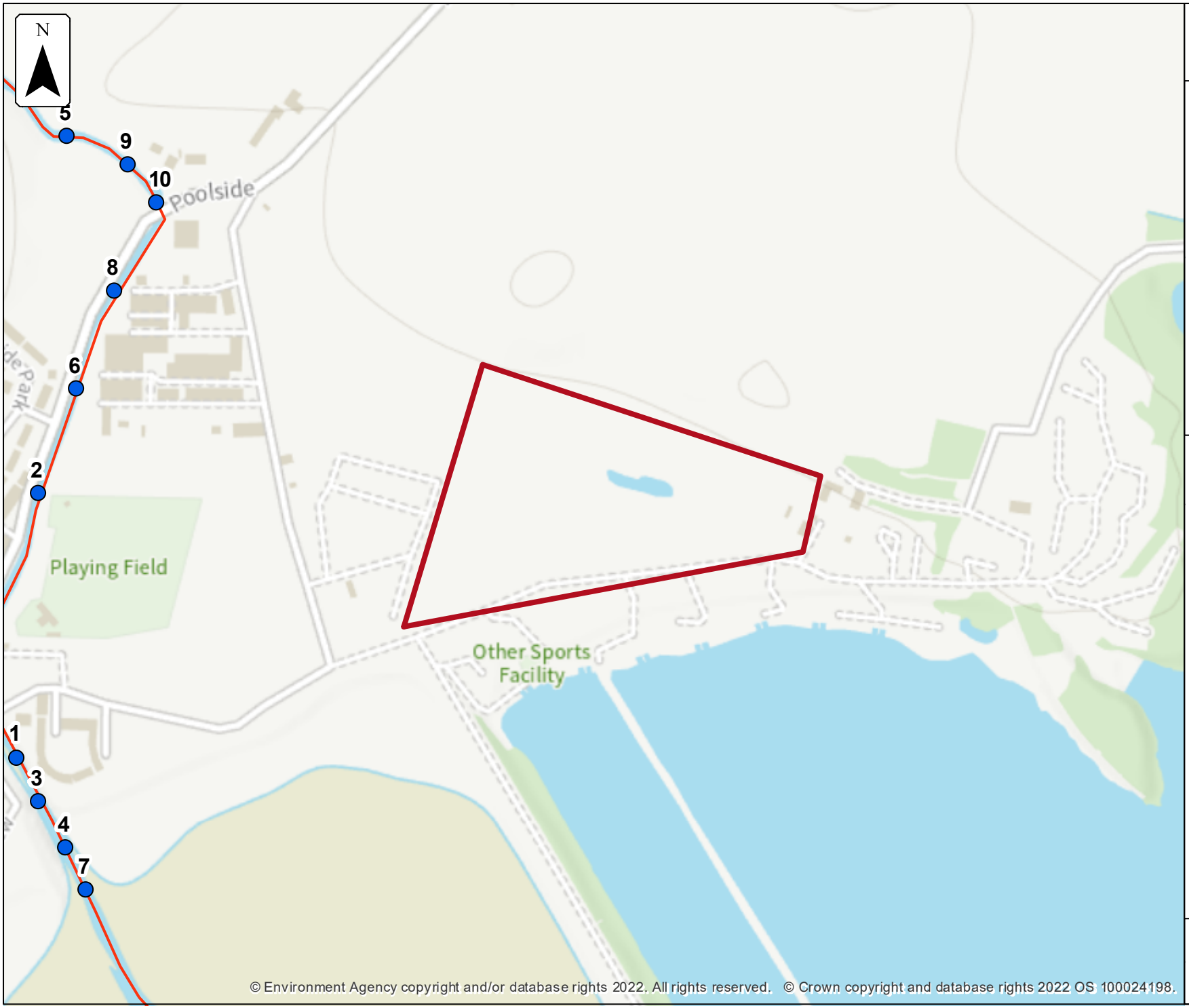


Environment Agency

Defences removed modelled fluvial node locations

Location (easting/northing)
316674/478895

Scale
1:5,000

Created
5 May 2022

Model name
Haverigg 2011

Selected area
Modelled location
Main river

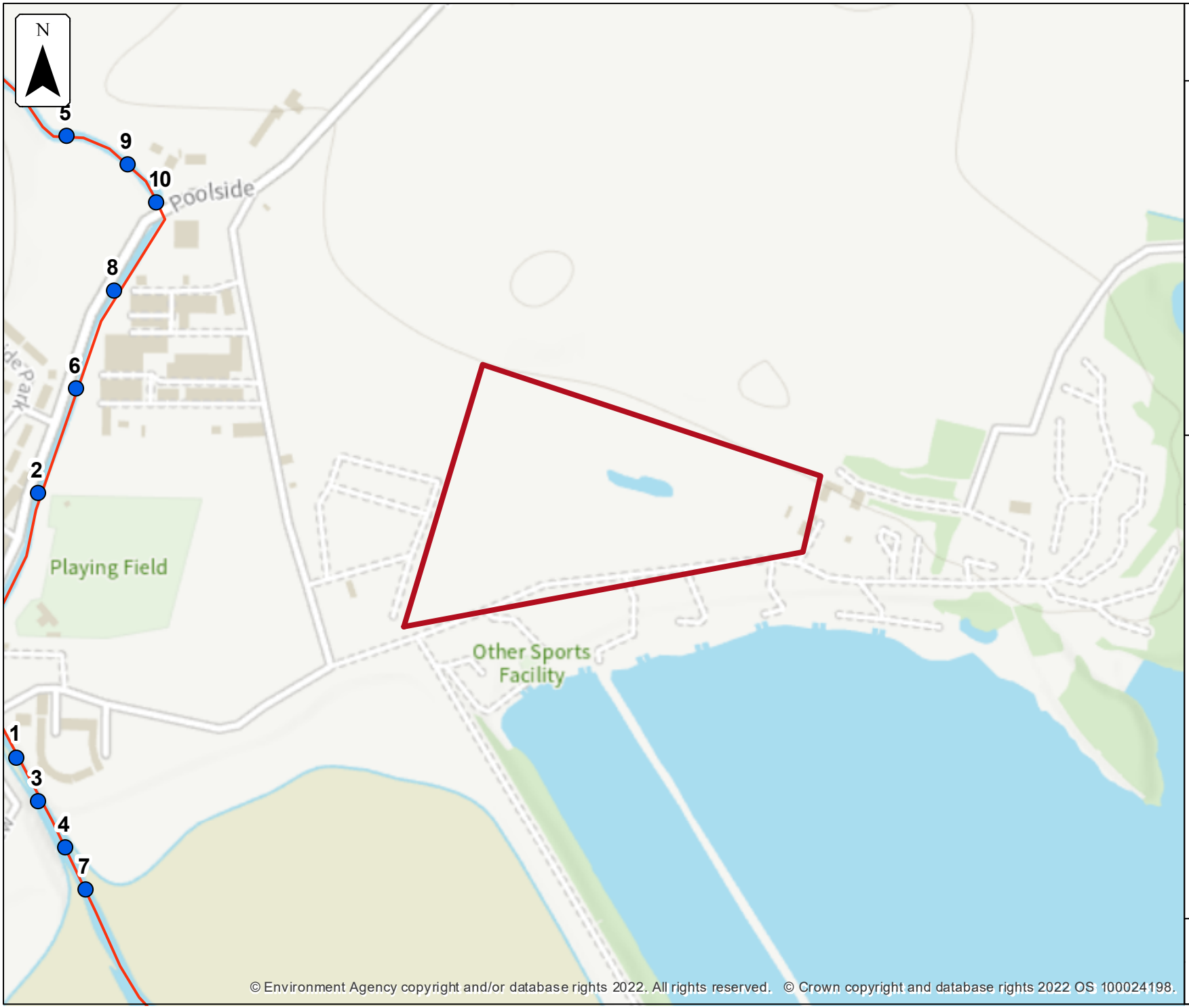
0 50 100 150 200 250
metres

Modelled node locations data

Defences removed

Label	Modelled location ID	Easting	Northing	4% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	1013550	316112	478647	4.65	21.62	4.65	23.57	4.65	25.32	4.65	26.76	4.65	31.83	4.64	45.39
2	1013557	316133	478905	4.76	20.98	4.77	23.40	4.78	24.48	4.79	24.38	4.82	24.31	5.19	24.23
3	1013552	316133	478605	4.65	21.91	4.65	23.86	4.65	25.55	4.65	26.83	4.64	31.95	4.64	45.43
4	1013560	316160	478559	4.65	23.89	4.65	25.84	4.65	27.42	4.65	28.35	4.65	33.39	4.65	46.87
5	1013546	316162	479252	5.22	20.98	5.35	23.52	5.42	25.33	5.49	26.79	5.56	31.96	5.65	46.15
6	1013565	316170	479007	4.86	20.98	4.88	23.41	4.90	24.48	4.91	24.36	4.96	24.29	5.19	24.19
7	1013561	316180	478518	4.65	29.30	4.65	31.32	4.65	32.90	4.65	33.85	4.65	38.42	4.65	51.36
8	1013547	316207	479101	4.99	20.98	5.06	23.41	5.12	24.52	5.13	24.39	5.14	24.34	5.27	24.74
9	1013556	316221	479224	5.13	20.98	5.25	23.42	5.34	24.58	5.44	24.39	5.53	25.68	5.67	32.97
10	1013558	316249	479188	5.11	20.98	5.23	23.42	5.32	24.52	5.44	24.40	5.54	24.34	5.71	25.0

Data in this table comes from the Haverigg 2011 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.



Environment Agency

Defences removed climate change modelled fluvial node locations

Location (easting/northing)
316674/478895

Scale
1:5,000

Created
5 May 2022

Model name
Haverigg 2011

Selected area
Modelled location
Main river

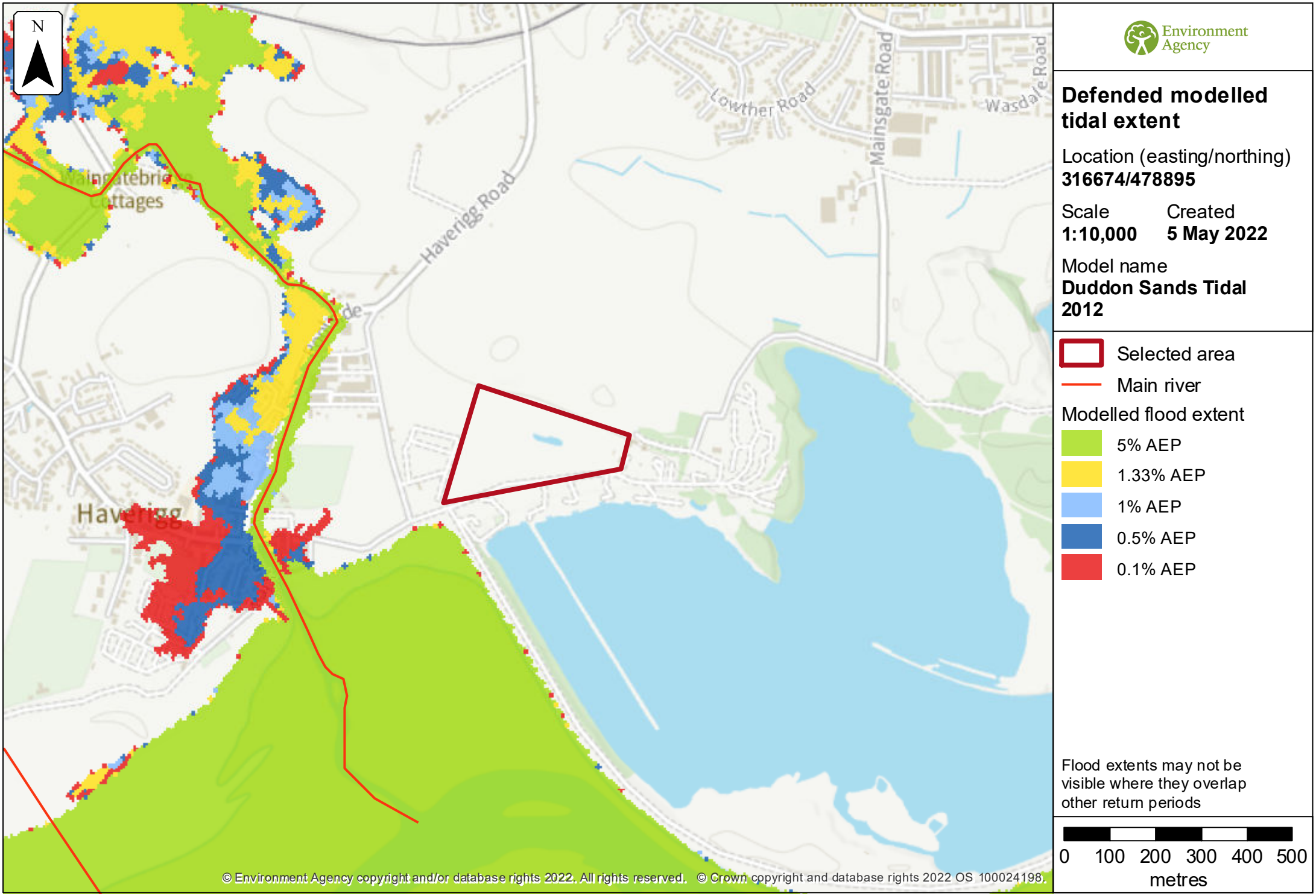
0 50 100 150 200 250
metres

Modelled node locations data

Defences removed climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+20%)	
				Level	Flow
1	1013550	316112	478647	4.65	33.60
2	1013557	316133	478905	4.85	24.31
3	1013552	316133	478605	4.64	33.78
4	1013560	316160	478559	4.65	35.45
5	1013546	316162	479252	5.59	34.22
6	1013565	316170	479007	4.98	24.28
7	1013561	316180	478518	4.65	40.66
8	1013547	316207	479101	5.16	24.31
9	1013556	316221	479224	5.56	26.78
10	1013558	316249	479188	5.57	24.35

Data in this table comes from the Haverigg 2011 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.


N
Lowther Road
Mainsgate Road
Wasdale Road
Haverigg Road
Haverigg
Environment Agency
Defended modelled tidal extent
Location (easting/northing)
316674/478895
Scale
1:10,000
Created
5 May 2022
Model name
Duddon Sands Tidal 2012
Selected area
Main river
Modelled flood extent
5% AEP
1.33% AEP
1% AEP
0.5% AEP
0.1% AEP
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
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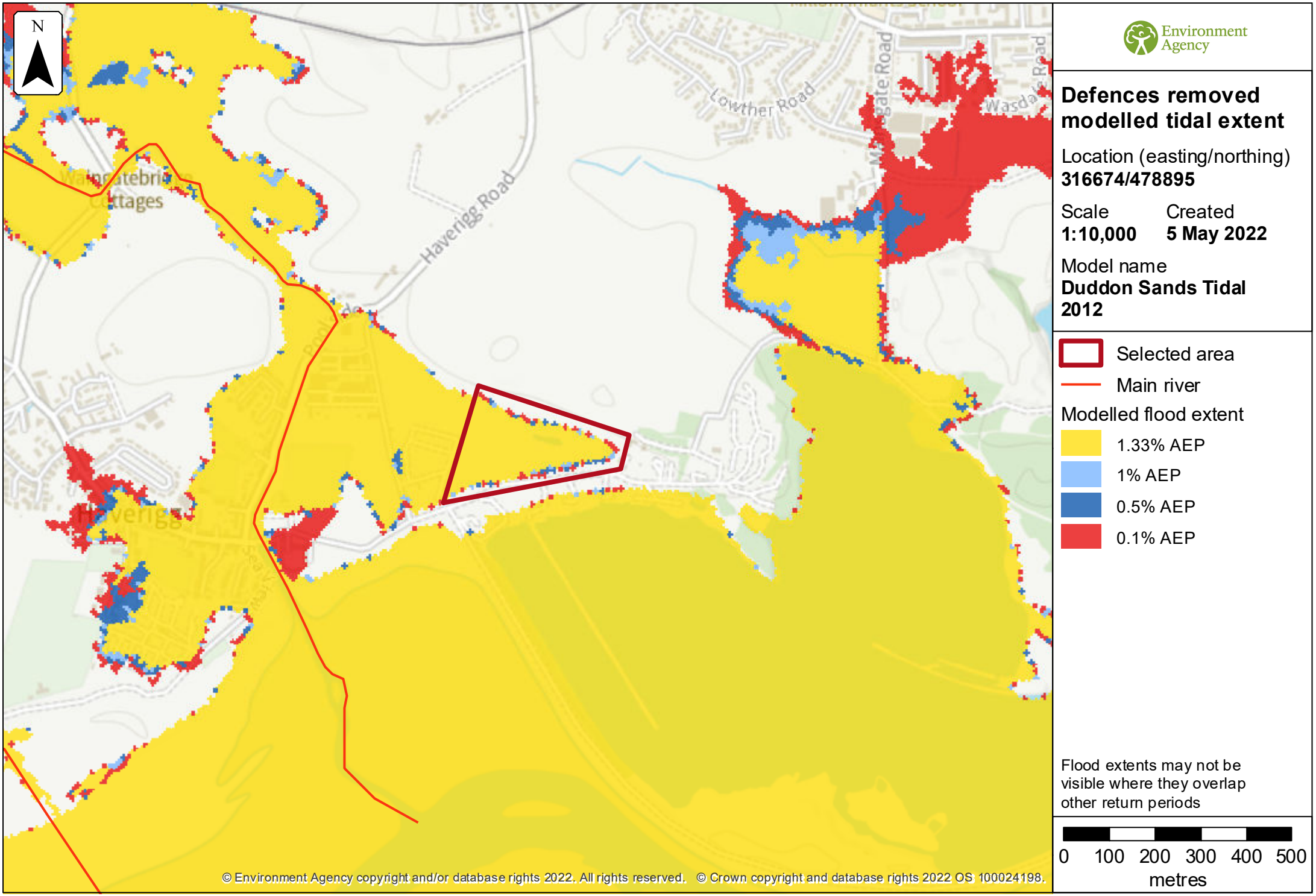
N
Lowther Road
Haverigg Road
Environment Agency
Defences removed modelled tidal extent
Location (easting/northing)
316674/478895
Scale
1:10,000
Created
5 May 2022
Model name
Duddon Sands Tidal 2012
Selected area
Main river
Modelled flood extent
1.33% AEP
1% AEP
0.5% AEP
0.1% AEP
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
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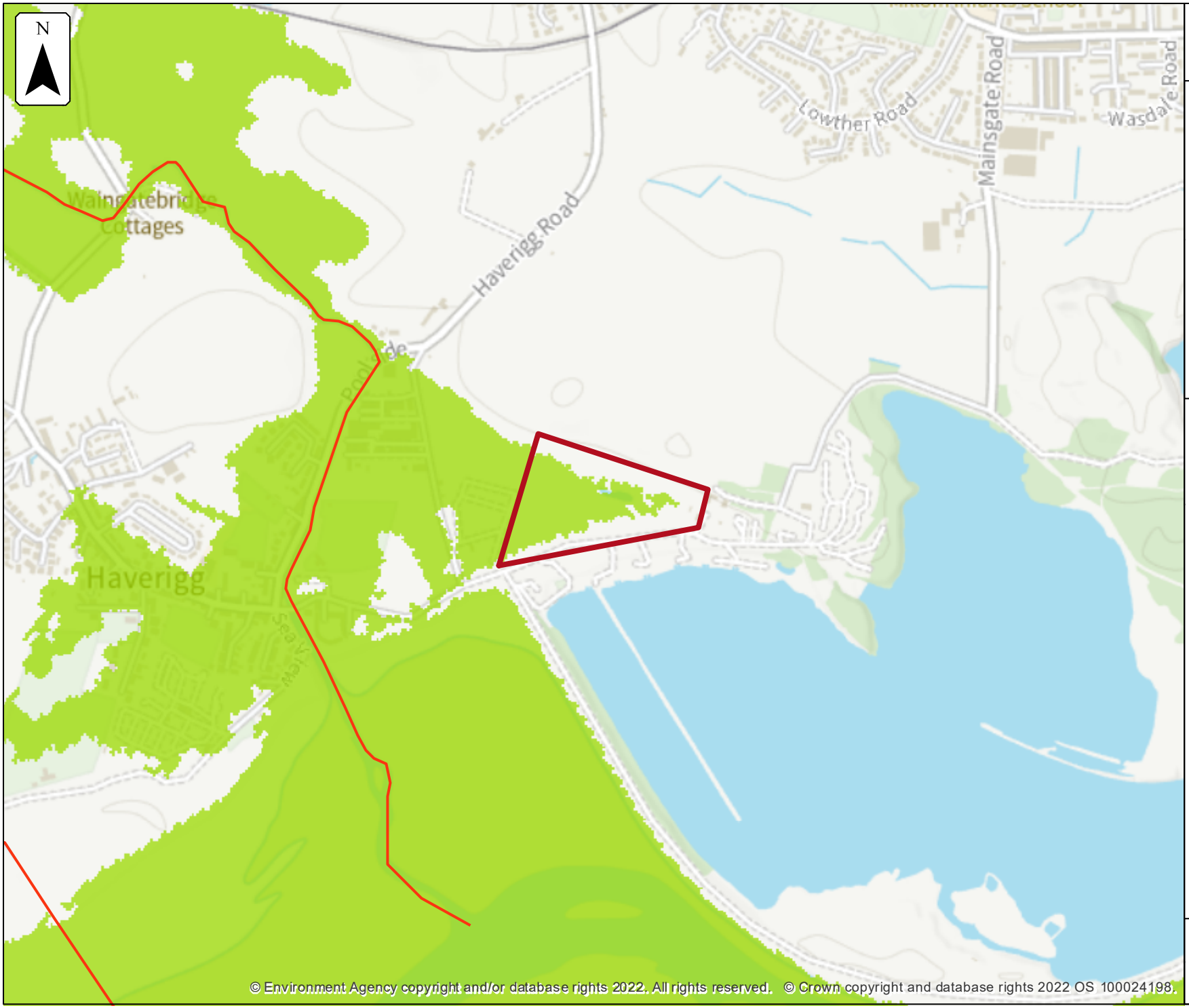
N
Lowther Road
Mainsgate Road
Wasdale Road
Haverigg Road
Haverigg
Environment Agency
Defended climate change modelled tidal extent
Location (easting/northing)
316674/478895
Scale
1:10,000
Created
5 May 2022
Model name
Duddon Sands Tidal 2012
Selected area
Main river
Modelled flood extent
0.5% AEP (+600mm)
Flood extents may not be visible where they overlap other return periods
0 100 200 300 400 500
metres
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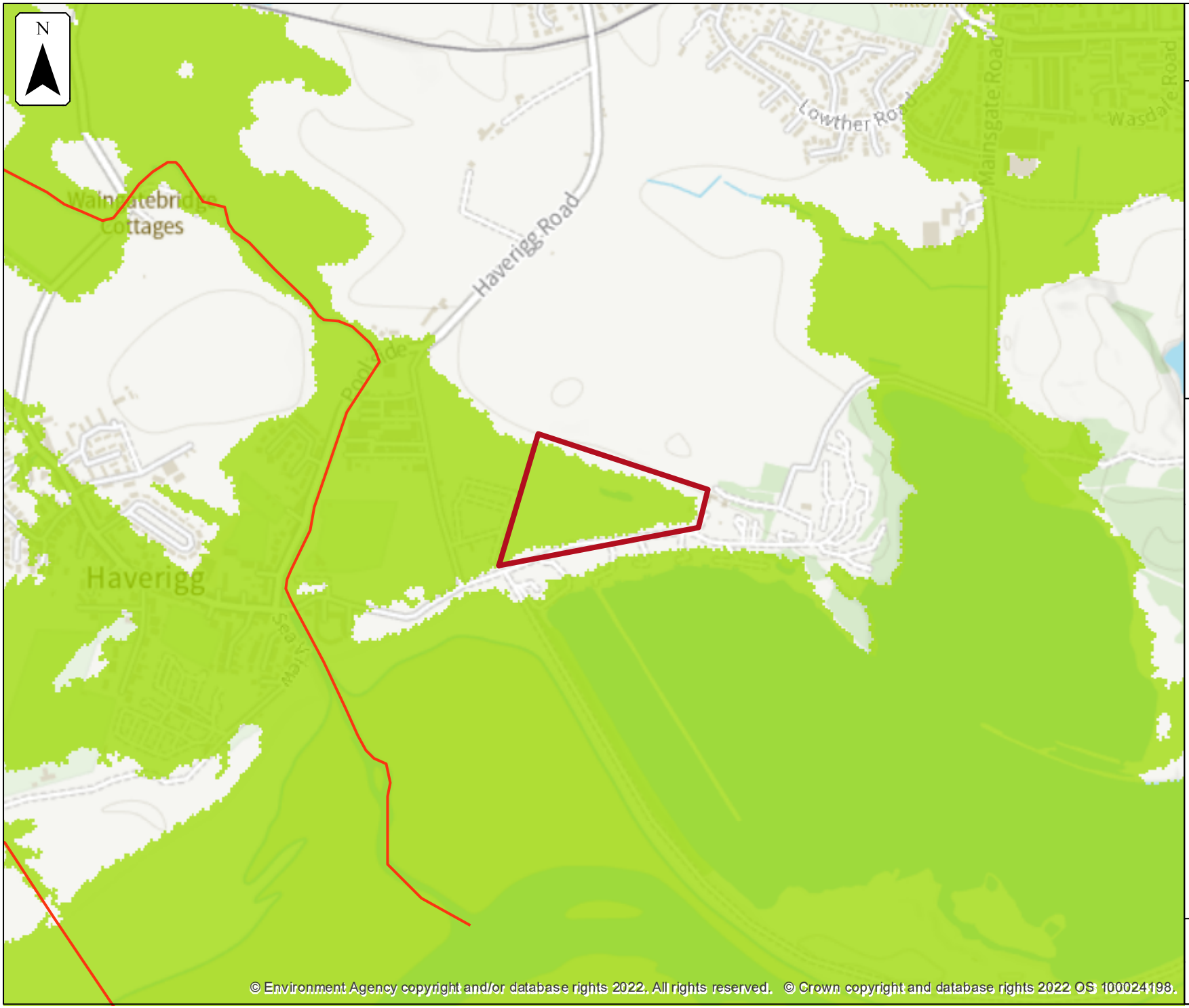


Environment Agency

Defences removed climate change modelled tidal extent

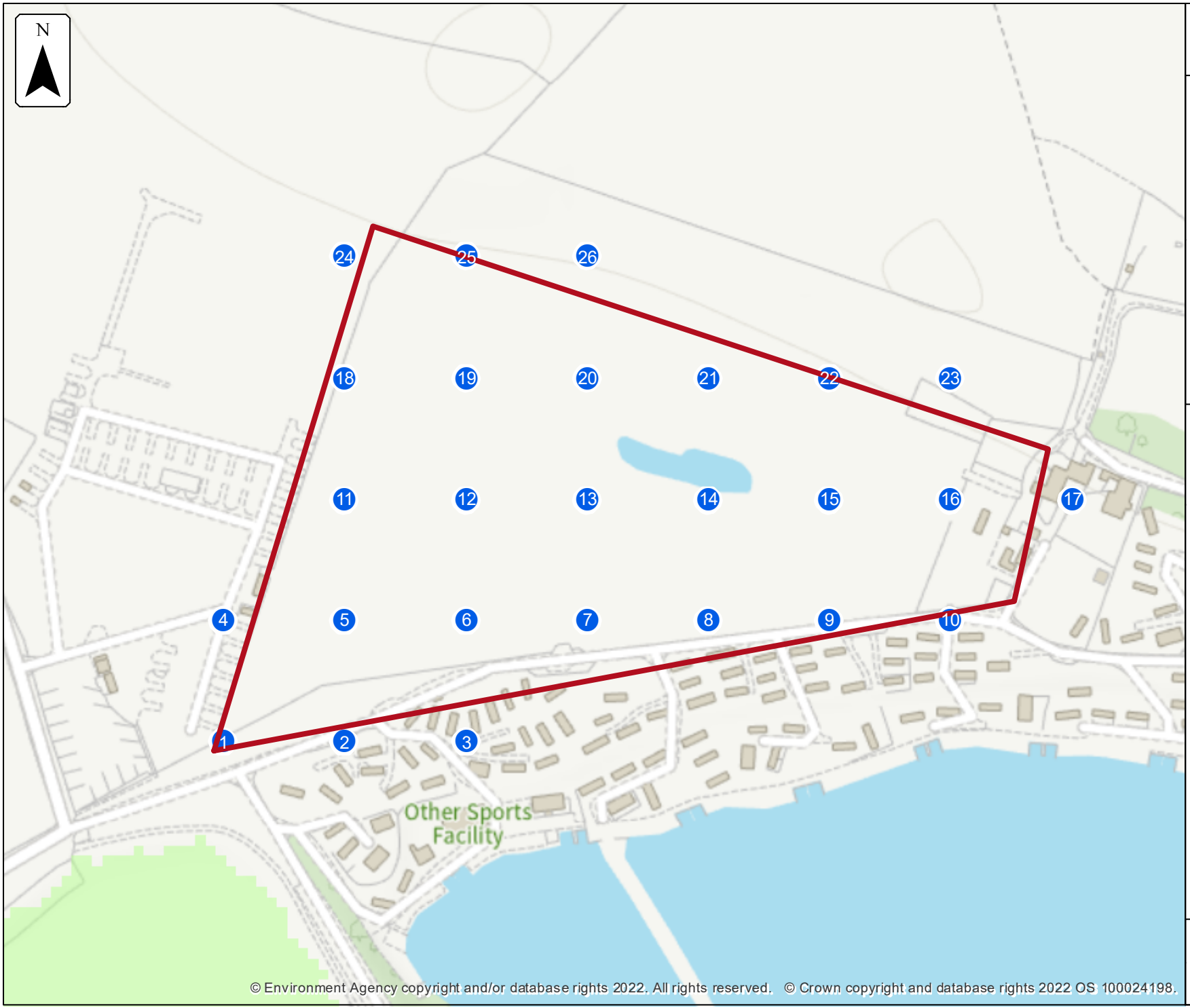
Location (easting/northing)
316674/478895

Scale
1:10,000

Created
5 May 2022

Model name
Duddon Sands Tidal 2012

Flood extents may not be visible where they overlap other return periods



Environment Agency

Defended modelled tidal extent and height

Location (easting/northing)
316674/478895

Scale
1:2,500

Created
5 May 2022

Model name
Duddon Sands Tidal 2012

Selected area

Main river

Modelled 2D grid

Water level in mAOD

- 0 - 6.0
- 6.0 - 6.125
- 6.125 - 6.25
- 6.25 - 6.375
- 6.375 - 6.5
- 6.5 - 6.625
- 6.625 - 6.75
- 6.75 - 6.875
- 6.875 - 7.0

This map shows the 0.1% AEP height data

0 25 50 75 100
metres

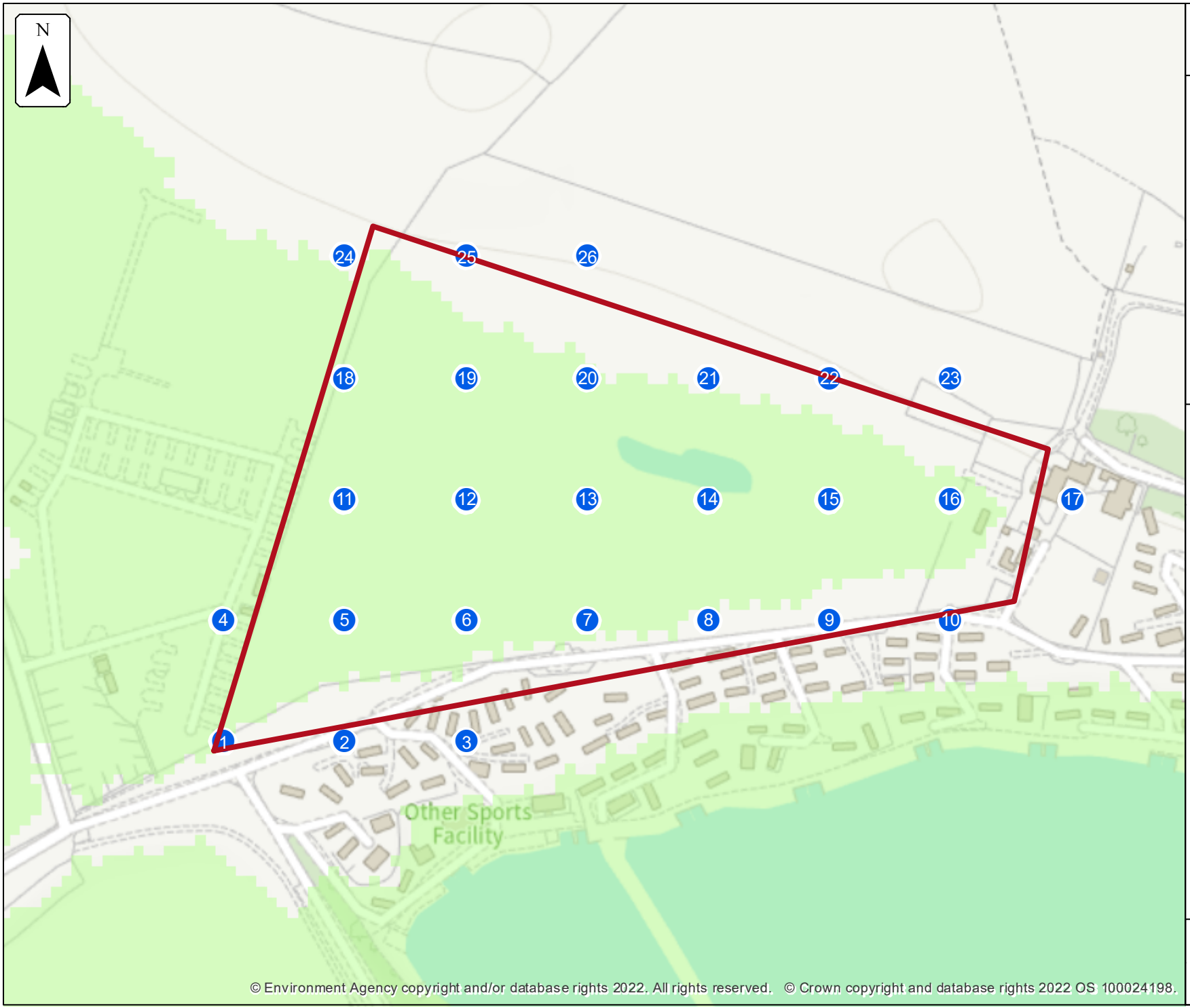
Sample point data

Defended

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
1	316494	478779	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
2	316553	478779	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
3	316612	478779	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
4	316494	478838	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
5	316553	478838	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
6	316612	478838	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
7	316671	478838	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
8	316730	478838	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
9	316789	478838	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
10	316848	478838	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
11	316553	478897	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
12	316612	478897	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
13	316671	478897	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
14	316730	478897	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
15	316789	478897	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
16	316848	478897	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
17	316907	478897	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
18	316553	478956	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
19	316612	478956	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
20	316671	478956	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
21	316730	478956	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
22	316789	478956	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
23	316848	478956	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
24	316553	479015	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
25	316612	479015	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
26	316671	479015	NoData	NoData			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData

Data in this table comes from the Duddon Sands Tidal 2012 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Environment Agency

Defences removed modelled tidal extent and height

Location (easting/northing)
316674/478895

Scale
1:2,500

Created
5 May 2022

Model name
Duddon Sands Tidal 2012

Selected area

Main river

Modelled 2D grid

Water level in mAOD

- 0 - 6.0
- 6.0 - 6.125
- 6.125 - 6.25
- 6.25 - 6.375
- 6.375 - 6.5
- 6.5 - 6.625
- 6.625 - 6.75
- 6.75 - 6.875
- 6.875 - 7.0

This map shows the 0.1% AEP height data

0 25 50 75 100
metres

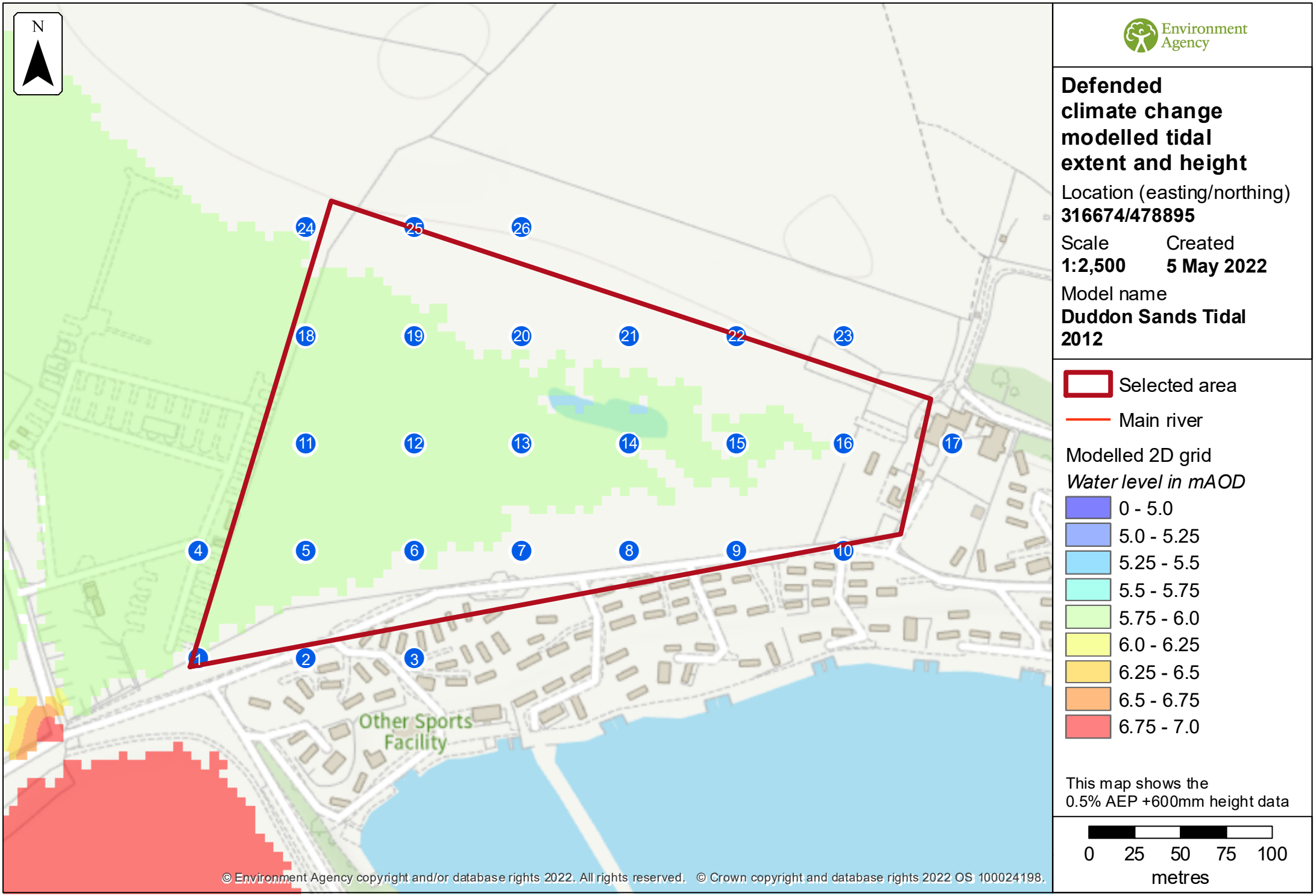
Sample point data

Defences removed

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
1	316494	478779					0.06	5.97	0.07	6.03	0.09	6.15	0.17	6.41
2	316553	478779					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
3	316612	478779					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
4	316494	478838					0.61	5.97	0.67	6.03	0.79	6.15	1.05	6.41
5	316553	478838					0.36	5.97	0.42	6.03	0.54	6.15	0.80	6.41
6	316612	478838					0.24	5.97	0.31	6.04	0.42	6.15	0.68	6.41
7	316671	478838					0.00	5.97	0.02	6.04	0.08	6.16	0.31	6.42
8	316730	478838					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
9	316789	478838					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
10	316848	478838					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
11	316553	478897					0.57	5.97	0.64	6.03	0.76	6.15	1.01	6.41
12	316612	478897					0.54	5.97	0.60	6.04	0.72	6.15	0.98	6.41
13	316671	478897					0.37	5.97	0.43	6.04	0.55	6.15	0.81	6.41
14	316730	478897					0.33	5.97	0.40	6.04	0.52	6.16	0.78	6.42
15	316789	478897					0.33	5.98	0.40	6.04	0.51	6.16	0.78	6.42
16	316848	478897					0.16	5.98	0.22	6.04	0.33	6.16	0.59	6.42

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
17	316907	478897					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
18	316553	478956					0.76	5.97	0.82	6.03	0.94	6.15	1.20	6.41
19	316612	478956					0.46	5.97	0.52	6.04	0.64	6.15	0.90	6.41
20	316671	478956					NoData	NoData	NoData	NoData	NoData	NoData	0.33	6.41
21	316730	478956					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
22	316789	478956					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
23	316848	478956					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
24	316553	479015					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
25	316612	479015					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
26	316671	479015					NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData

Data in this table comes from the Duddon Sands Tidal 2012 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Environment Agency

Defended climate change modelled tidal extent and height

Location (easting/northing)
316674/478895

Scale
1:2,500

Created
5 May 2022

Model name
Duddon Sands Tidal 2012

Selected area

Main river

Modelled 2D grid
Water level in mAOD

- 0 - 5.0
- 5.0 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6.0
- 6.0 - 6.25
- 6.25 - 6.5
- 6.5 - 6.75
- 6.75 - 7.0

This map shows the 0.5% AEP +600mm height data

0 25 50 75 100
metres

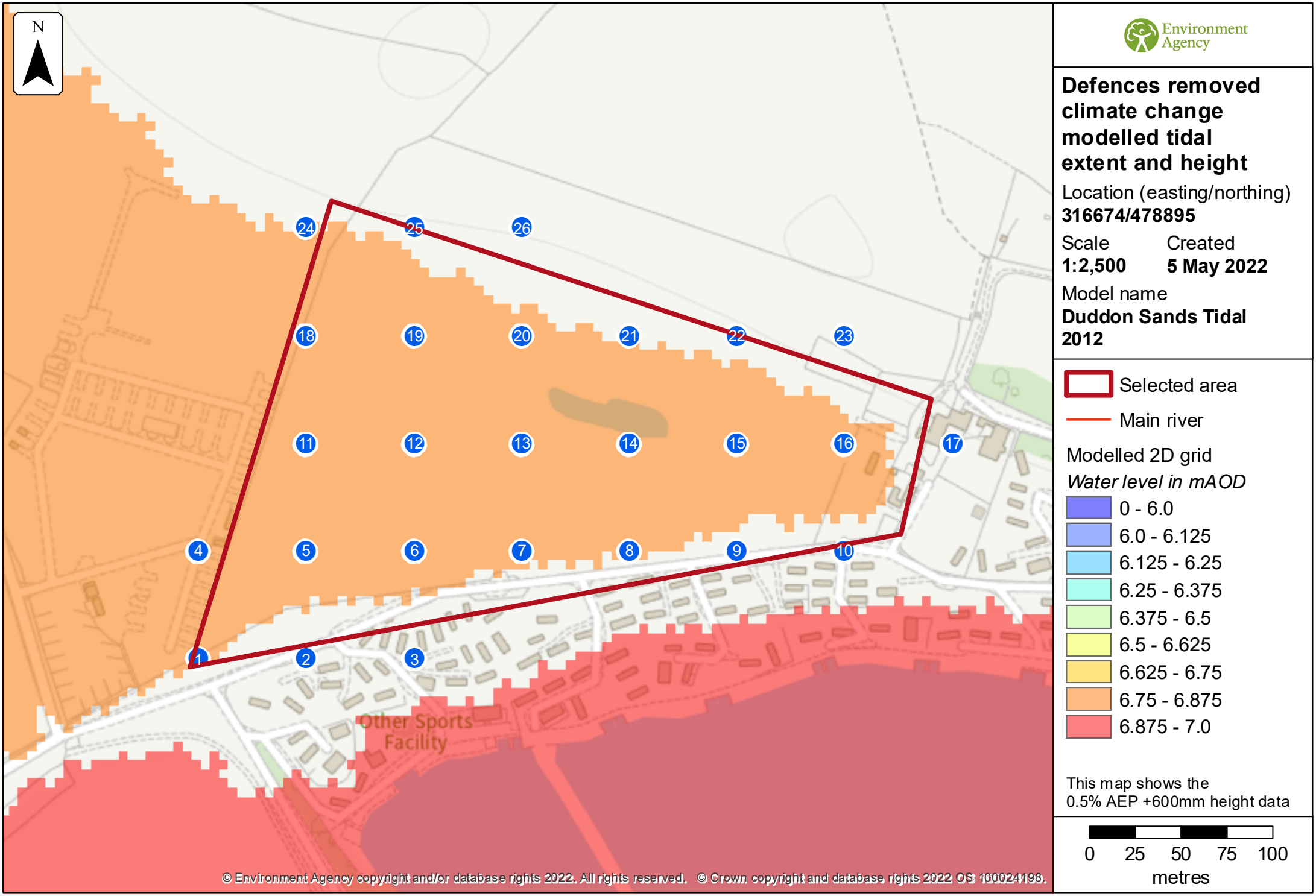
Sample point data

Defended climate change

Label	Easting	Northing	0.5% AEP (+600mm)	
			Depth	Height
1	316494	478779	NoData	NoData
2	316553	478779	NoData	NoData
3	316612	478779	NoData	NoData
4	316494	478838	0.40	5.76
5	316553	478838	0.14	5.76
6	316612	478838	0.03	5.76
7	316671	478838	NoData	NoData
8	316730	478838	NoData	NoData
9	316789	478838	NoData	NoData
10	316848	478838	NoData	NoData
11	316553	478897	0.36	5.76
12	316612	478897	0.32	5.76
13	316671	478897	0.15	5.76
14	316730	478897	0.12	5.76
15	316789	478897	NoData	NoData
16	316848	478897	NoData	NoData

Label	Easting	Northing	0.5% AEP (+600mm)	
			Depth	Height
17	316907	478897	NoData	NoData
18	316553	478956	0.55	5.76
19	316612	478956	0.24	5.76
20	316671	478956	NoData	NoData
21	316730	478956	NoData	NoData
22	316789	478956	NoData	NoData
23	316848	478956	NoData	NoData
24	316553	479015	NoData	NoData
25	316612	479015	NoData	NoData
26	316671	479015	NoData	NoData

Data in this table comes from the Duddon Sands Tidal 2012 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Environment Agency

Defences removed climate change modelled tidal extent and height

Location (easting/northing)
316674/478895

Scale
1:2,500

Created
5 May 2022

Model name
Duddon Sands Tidal 2012

Selected area

Main river

Modelled 2D grid
Water level in mAOD

- 0 - 6.0
- 6.0 - 6.125
- 6.125 - 6.25
- 6.25 - 6.375
- 6.375 - 6.5
- 6.5 - 6.625
- 6.625 - 6.75
- 6.75 - 6.875
- 6.875 - 7.0

This map shows the 0.5% AEP +600mm height data

0 25 50 75 100
metres

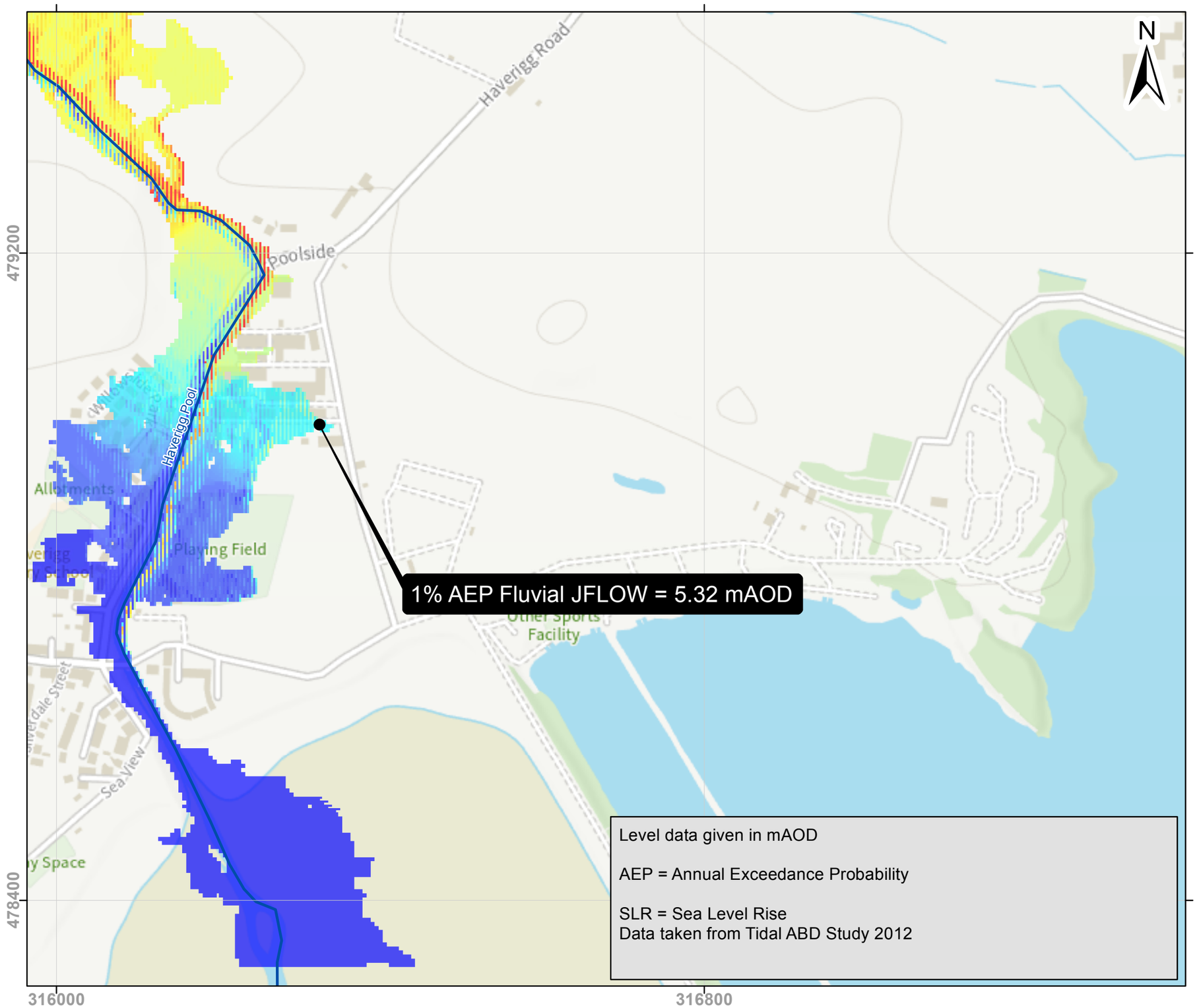
Sample point data

Defences removed climate change

Label	Easting	Northing	0.5% AEP (+600mm)	
			Depth	Height
1	316494	478779	0.43	6.84
2	316553	478779	NoData	NoData
3	316612	478779	NoData	NoData
4	316494	478838	1.48	6.84
5	316553	478838	1.23	6.84
6	316612	478838	1.11	6.84
7	316671	478838	0.74	6.84
8	316730	478838	NoData	NoData
9	316789	478838	NoData	NoData
10	316848	478838	NoData	NoData
11	316553	478897	1.44	6.84
12	316612	478897	1.40	6.84
13	316671	478897	1.23	6.84
14	316730	478897	1.20	6.84
15	316789	478897	1.20	6.84
16	316848	478897	1.01	6.84

Label	Easting	Northing	0.5% AEP (+600mm)	
			Depth	Height
17	316907	478897	NoData	NoData
18	316553	478956	1.63	6.84
19	316612	478956	1.33	6.84
20	316671	478956	0.75	6.84
21	316730	478956	NoData	NoData
22	316789	478956	NoData	NoData
23	316848	478956	NoData	NoData
24	316553	479015	NoData	NoData
25	316612	479015	NoData	NoData
26	316671	479015	NoData	NoData

Data in this table comes from the Duddon Sands Tidal 2012 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Level data given in mAOD

AEP = Annual Exceedance Probability

SLR = Sea Level Rise
Data taken from Tidal ABD Study 2012

Environment Agency

Modelled 2D Data
JFLOW Map

Key

Main River

Tidal Fluvial JFLOW
1% AEP Scenario

mAOD

High : 6

Low : 5

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Modelled 2D Data
JFLOW Map

Key

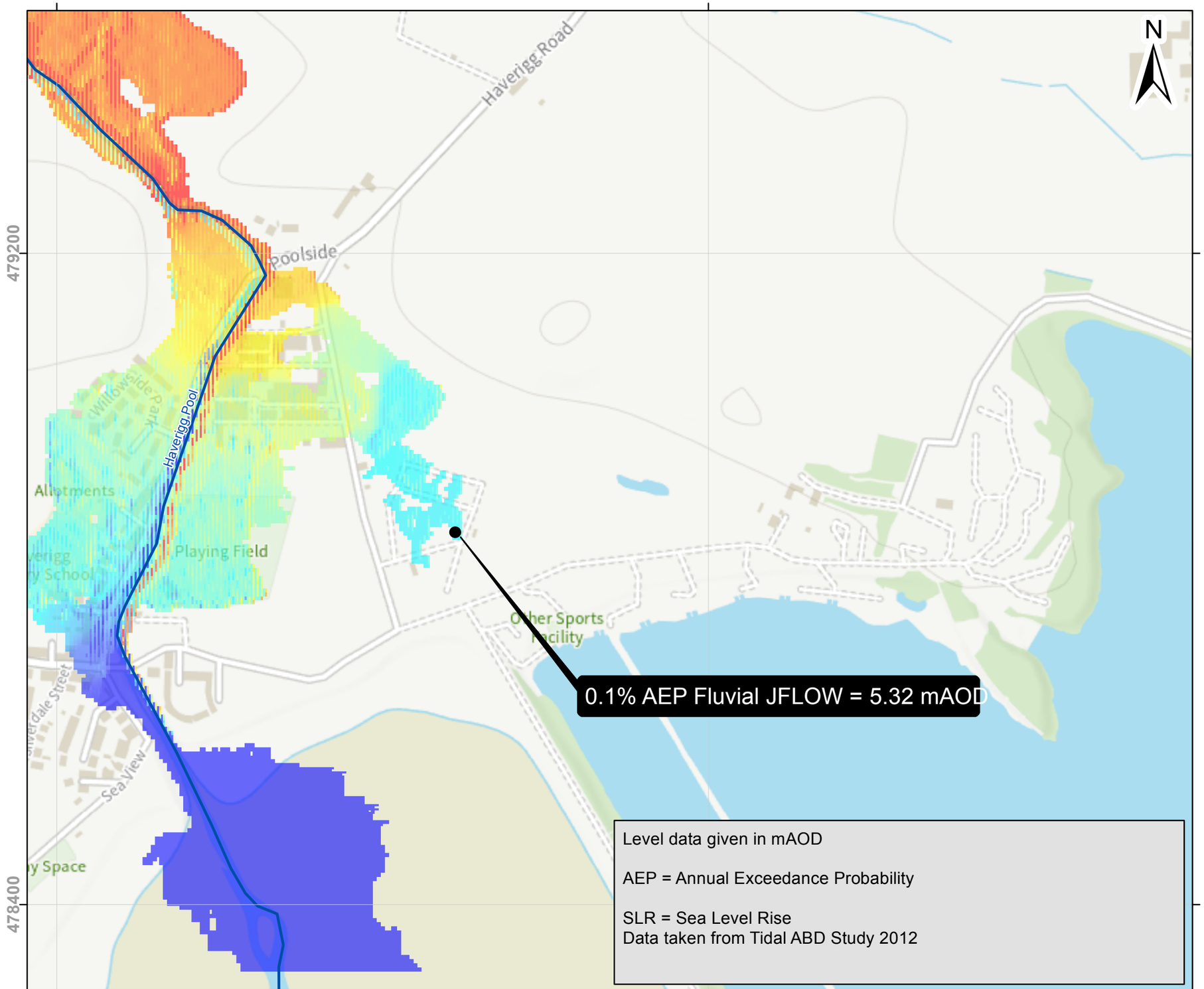
Main River

Tidal Fluvial JFLOW
0.1% AEP Scenario

mAOD

High : 6

Low : 5



Level data given in mAOD

AEP = Annual Exceedance Probability

SLR = Sea Level Rise
Data taken from Tidal ABD Study 2012

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APPENDIX C

Breach assessment

Effective crest level of the defence is 6.43m AOD.

Mean site level 5.4m AOD

Head above site level is 6.43 – 5.4 = 1.03m

Distance from breach is 400m

Conclusion – Danger for some

Table 12.2 - Danger to people from breaching relative to distance from defence

Distance from breach (m)	Head above floodplain (m)						
	0.5	1	2	3	4	5	6
100							
250							
500							
1000							
1500							
2000							
2500							
3000							
3500							
4000							
4500							
5000							

Key:

- Danger for some
- Danger for most
- Danger for all