ENVIRONMENTAL STATEMENT: 6.3 APPENDIX 11-2: FLOOD RISK ASSESSMENT

DECARBONISATION

Cory Decarbonisation Project

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EXECUTIVE SUMMARY

WSP has been commissioned by Cory Environmental Holdings Limited (hereafter referred to as the Applicant) to prepare a Flood Risk Assessment (FRA) for the Cory Decarbonisation Project (the Proposed Scheme) to be located at Norman Road, Belvedere in the London Borough of Bexley (LBB) (National Grid Reference (NGR) 549572, 180512).

This FRA has been developed in accordance with the guidelines set out in the National Policy Statement (NPS) for Energy Infrastructure EN-1[1], the National Planning Policy Framework (NPPF)[2] updated in December 2023 along with other relevant local and national guidance.

A high level summary of the findings of this FRA is provided in **Table 1** below.

Table 1: Assessment Overview

Item	Overview
Site Location	The Proposed Scheme is located at Norman Road, Belvedere in the London Borough of Bexley. The grid reference for the Site is 549572, 180512.
Proposed Scheme	The Proposed Scheme comprises five key components: • the Carbon Capture Facility (including its associated Supporting Plant and Ancillary Infrastructure); • the Proposed Jetty; • the Mitigation and Enhancement Area; • Temporary Construction Compounds; and • Utilities Connections and Access.
Environment Agency Flood Zone(s)	The Site is located in Flood Zone 3, based on the Environment Agency's Flood Map for Planning[3]. Flood Zone 3 is the undefended tidal flood extent of the 1 in 200 year event (0.5% Annual Exceedance Probability (AEP)). This map excludes the presence of flood defences, however, there are significant flood defences located along the River Thames. These defences are adjacent to and partly within the Site. These defences provide the Site with a reduction in flood risk, as shown by the Environment Agency's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset.
Vulnerability Classification(s)	Essential Infrastructure under Annex 3 of the NPPF[2].
Marsh Dykes/Surface Water Flood Risk	Hydraulic modelling of the Marsh Dykes has been undertaken for present day baseline conditions and for the proposed post-development scenario.

Item	Overview
	The inclusion of the representation of the drainage strategies across Riverside 1 and 2 along with the Proposed Scheme, demonstrates that there is limited fluvial/pluvial flooding on the area of the Carbon Capture Facility and this can be appropriately mitigated through the inclusion of mitigation within the detailed design of the Proposed Scheme.
Tidal Flood Risk	The Site is at risk of flooding in an event of a breach of the River Thames Flood Defences. This will be mitigated through the raising of the Carbon Capture Facility above the modelled maximum breach level for the 1 in 200 year event. Modelling has demonstrated that the Proposed Scheme will not result in significant increased flood risk elsewhere.
Groundwater Flood Risk	Based on the underlying geological conditions, there is potential for groundwater flooding to locally cause adverse effects during construction where groundwater levels are relatively close to the ground surface and construction would involve excavation i.e., sheet pile wall installation. The operation phase effects are expected to be limited to shallow groundwater affecting flow within the superficial deposit aquifers. See **Appendix 11-3: Groundwater Impact Assessment (Volume 3)**.
Sewer Flood Risk	There is a risk of flooding associated with the failure of Crossness Sewage Treatment Works which is owned and managed by Thames Water Utilities Limited. However, it is considered that this is a residual risk and that the flood levels would be less than the maximum flood level associated with a breach of the River Thames Flood Defences (as described above).
Artificial Flood Risk	The Environment Agency's Risk of Flooding from Reservoirs Map[4] shows that there is no risk of flooding to the Proposed Scheme as a result of reservoir flooding in either assessed scenario (when river levels are normal or when there is also flooding from rivers).
Sequential and Exception Test	The Proposed Scheme is classified as Essential Infrastructure under Annex 3 of the NPPF[2]. The location of Essential Infrastructure within Flood Zone 3 requires the Sequential Test and Exception Test to be passed. There are no other sites identified by the **Terrestrial Site Alternatives Report (Document Reference 7.5)** located in an area with a lower probability of flooding that would be appropriate for the Proposed Scheme, given the need for it to be located close to the existing Riverside 1 and forthcoming Riverside 2 facilities in its role as a carbon capture facility for them. All of the other potential sites benefit from the protection offered by the

Item	Overview
	River Thames Flood Defences and the Environment Agency's Great Breach Dyke and Great Breach Pumping Stations. The Sequential Test is therefore deemed to be passed. The Proposed Scheme includes carbon capture technology and provides a sustainable approach to the production of energy, which is environmentally sustainable and aligns with NPS EN-1[1]. NPS EN-1 identifies that carbon capture infrastructure is of critical national priority. This FRA demonstrates that the Proposed Scheme will be safe for its lifetime taking into account the vulnerability of its users and will not result in significant increased flood risk elsewhere.

1. INTRODUCTION

1.1. PROJECT BACKGROUND

1.1.1. WSP has been commissioned by Cory Environmental Holdings Limited (hereafter referred to as the Applicant) to prepare a Flood Risk Assessment (FRA) for the Cory Decarbonisation Project (hereafter referred to as the Proposed Scheme) to be located at Norman Road, Belvedere in the London Borough of Bexley (LBB); National Grid Reference (NGR) 549572, 180512. The following figures are also available in the Environment Statement (ES) which illustrate the Site:

- **Figure 1-1: Site Boundary Location Plan (Volume 2)**; and
- **Figure 1-2: Satellite Imagery of the Site Boundary Plan (Volume 2)**.

1.1.2. The Applicant intends to construct and operate the Proposed Scheme to be linked with the River Thames. It comprises of the following key components, which are described below, and further detail is provided within **Chapter 2: Site and Proposed Scheme Description (Volume 1)**:

- The Carbon Capture Facility (including its associated Supporting Plant and Ancillary Infrastructure): the construction of infrastructure to capture a minimum of 95% of carbon dioxide (CO_2) emissions from Riverside 1 and 95% of CO_2 emissions from Riverside 2 once operational, which is equivalent to approximately 1.3Mt CO_2 per year. The Carbon Capture Facility will be one of the largest carbon capture projects in the UK.
- The Proposed Jetty: a new and dedicated export structure within the River Thames as required to export the CO_2 captured as part of the Carbon Capture Facility.
- The Mitigation and Enhancement Area: land identified as part of the **Outline LaBARDS (Document Reference 7.9)** to provide improved access to open land, habitat mitigation, compensation and enhancement (including forming part of the drainage system and Biodiversity Net Gain delivery proposed for the Proposed Scheme) and planting. The Mitigation and Enhancement Area provides the opportunity to improve access to outdoor space and to extend the area managed as the Crossness LNR.
- Temporary Construction Compounds: areas to be used during the construction phases for activities including, but not limited to office space, warehouses, workshops, open air storage and car parking, as shown on the **Works Plans (Document Reference 2.3)**. These include the core Temporary Construction Compound, the western Temporary Construction Compound and the Proposed Jetty Temporary Construction Compound.
- Utilities Connections and Site Access Works: The undergrounding of utilities required for the Proposed Scheme in Norman Road and the creation of new, or the improvement of existing, access points to the Carbon Capture Facility from Norman Road.

1.1.3. Together, the Carbon Capture Facility (including its associated Supporting Plant and Ancillary Infrastructure), the Proposed Jetty, the Mitigation and Enhancement Area, the Temporary Construction Compounds and the Utilities Connections and Site Access Works are referred to as the 'Proposed Scheme'. The land upon which the Proposed Scheme is to be located is referred to as the 'Site' and the edge of this land referred to as the 'Site Boundary'. The Site Boundary represents the Order Limits for the Proposed Scheme as shown on the **Works Plans (Document Reference 2.3)**.

1.2. PURPOSE OF THIS REPORT

1.2.1. This FRA has been prepared in accordance with the Overarching National Policy Statement for Energy (NPS EN-1)[1] and the National Planning Policy Framework (NPPF)[2] providing a quantitative analysis of flood risk to support the Development Consent Order (DCO) application. The assessment includes the following:

- review of the relevant policy, legislation and guidance;
- review of the availability and adequacy of the existing information related to risk of flooding;
- confirmation of the sources of flooding that may affect the Proposed Scheme;
- a quantitative assessment of the risk of flooding to the proposal and to the adjacent sites as a result of the Proposed Scheme; and
- provision of appropriate flood mitigation measures.

1.2.2. The FRA is supported by five annexes:

- **Annex A: Table 7.1 and Table 7.2 of the Thames Estuary 2100 Plan (TE2100 Plan)**;
- **Annex B: Breach Modelling Methodology**;
- **Annex C: Flood Risk Assessment Drawings**;
- **Annex D: Environment Agency's Marsh Dykes Model Comments**; and
- **Annex E: Flood Risk Assessment Figures**.

1.2.3. This FRA has been informed by the parameters of assessment presented in within **Chapter 2: Site and Proposed Scheme Description (Volume 1)** and is supported by the **Outline Drainage Strategy (Document Reference 7.2)**.

2. DATA

2.1. RELEVANT DATA FROM THE APPLICANT

2.1.1. There is a range of flood risk data available to inform this assessment from the previous consent applications Riverside 1 and Riverside 2, these include:

- Riverside 1 (Section 36 consent):
  - Tidal Flood Risk Assessment[5]; and
  - Surface Water Drainage Strategy[6].
- Riverside 2 (Development Consent Order):
  - Flood Risk Assessment[7];
  - Surface Water Drainage Strategy (Appendix G of the Riverside 2 FRA[7]); and
  - River Wall Condition Survey[8] undertaken in February 2022, to fulfil Requirement 20 of the DCO.

2.2. PUBLICLY AVAILABLE DATA

2.2.1. There is a range of flood risk data available to inform this assessment, including that presented in the London Borough of Bexley (LBB) Level 1 Strategic Flood Risk Assessment[9] (SFRA). Consultation has also been undertaken with the Environment Agency and Lead Local Flood Authority (LLFA) (LBB), as described in **Table 11-2** of **Chapter 11: Water Environment and Flood Risk (Volume 1)**, to ensure that the most up to date information has been obtained.

2.2.2. The key sources of information used to determine the baseline flood risk conditions are:

- Environment Agency's online Flood Map for Planning[3];
- Environment Agency's online Long-Term Risk of Flooding[4];
- Environment Agency's online Flood Risk from Reservoirs Map[10];
- Environment Agency's Recorded Flood Outlines Map[11];
- Ordnance Survey Mapping[12];
- Environment Agency's LiDAR Digital Terrain Model[13];
- Department for Environment, Food and Rural Affairs (DEFRA) MAGIC online Mapping[14];
- British Geological Survey (BGS) Geology of Britain Viewer[15];
- Groundsure Report[16];
- London Borough of Bexley Level 1 SFRA[9];
- National Library of Scotland, Historical Mapping[17];
- Flood Estimation Handbook Web Service[18];
- Local bathymetric data of the area immediately surrounding the Site Boundary sourced from the Port of London Authority (PLA) chart 327[19];

- Bathymetric data downstream and upstream of the site boundary sourced from C-MAP Admiralty Chart Data[20]; and
- Current aerial photography[21].

2.3. ENVIRONMENT AGENCY DATA

2.3.1. The Environment Agency has provided the following data to inform this FRA:

- **Thames Estuary Breach Assessment (2018)**[22] – The reports and outputs associated with the Thames Estuary Breach Assessment. This data was received on the 10th May 2023 and is used in the breach assessment (part of this FRA) as detailed in **Section 8.2**;
- **Marsh Dykes Model (2020)**[23] – The Environment Agency's Marsh Dykes Model and associated outputs. The Marsh Dykes Model is an integrated fluvial, surface water and sewer model (the 'Marsh Dykes Model') and was built in 2020 by JBA as part of a mapping and modelling study commissioned by the Environment Agency. There are a range of available outputs, of which the 1 in 100 year plus 40% climate change scenario and the 1 in 1,000 year have been used for the fluvial/pluvial flood risk assessment. The breach scenarios at Great Breach Dyke and the Green Level Pumping Stations have been used for informing the breach flood risk assessment. This data was received on the 13th July 2023 and 27th September 2023. **Section 8.2** and **Section 8.5** detail how the Marsh Dykes Model and its outputs have been used in the fluvial/pluvial and breach assessments of this FRA;
- **2008 TE2100 In-channel Extreme Water Levels (2008)**[24] – The Thames Estuary 2100[24] (TE2100) In-channel Extreme Water Levels from its 2008 model for the 1 in 200 year event for the years of 2065 and 2100. This data was received on the 10th May 2023, with interpretation guidance received on the 27th June 2023. This data was used to inform the Thames Estuary Breach Assessment as detailed in **Section 8.2**;
- **2021 TE2100 In-channel Extreme Water Levels**[25] **–** The Environment Agency has undertaken a review of the TE2100 In-channel Extreme Water Levels as part of its TE2100 10 year Review Extreme Water Levels model. However, the Environment Agency confirmed during a meeting on 20th September 2023 that the model and output data has not yet been processed to a suitable level for use in land use planning. As such, this this data cannot be used within this assessment. The suitability of this approach is confirmed in their response to the PEIR (shown in **Table 11.3** of **Chapter 11: Water Environment and Flood Risk (Volume 1)**), which states *"The Environment Agency accept the 2018 breach modelling for new development"*. The 2018 breach modelling referenced by the Environment Agency is the Thames Estuary Breach Assessment (2018)[22] described above in the first bullet point; and

- The Environment Agency's TE2100 Interpretation Guidance[26] outlines that there is no requirement to consider fluvial dominant flows in the River Thames as part of this FRA, although this FRA recognises that these may be higher than the TE2100 in-channel levels. This guidance was received on the 27th June 2023 from the Environment Agency.

2.4. LEAD LOCAL FLOOD AUTHORITY DATA

2.4.1. The LLFA (LBB) has not provided any pertinent information for use within this FRA, beyond that contained in its Level 1 SFRA[9]. However, LBB has provided information of relevance to the **Outline Drainage Strategy (Document Reference 7.2)** as explained in that document.

3. DEFINITION OF FLOOD RISK

3.1.1. Flood risk is the product of the likelihood or chance of a flood occurring (flood frequency) and the consequence or impact of the flooding (flood consequence).

3.2. FLOOD FREQUENCY

3.2.1. Flood frequency is identified in terms of the return period and annual probability. For example, a 1 in 100 year flood event has a 1% annual exceedance probability (AEP) of occurring. **Table 3-1** below provides a conversion between return periods and annual flood probabilities. In this report the return period convention has been adopted. A return period, also known as a recurrence interval or repeat interval, is an average time or an estimated average time between flood events to occur.

Table 3-1: Flood Probability Conversion Table

Return Period (Years)	2	5	10	30	50	100	200	1000
Annual Exceedance Probability %	50	20	10	3.33	2	1	0.5	0.1

3.2.2. The Flood Risk and Coastal Change Planning Practice Guidance (PPG)[27] identifies flood zones in relation to flood frequency. The zones refer to the probability of river (fluvial) and sea (tidal) flooding, whilst ignoring the presence of defences. **Table 3-2** summarises the relationship between flood zone category and the identified flood probability (as defined in the Flood Risk and Coastal Change PPG[27]).

Table 3-2: Flood Zones

Flood Risk Area	Identification	Annual Probability of Fluvial Flooding	Annual Probability of Tidal Flooding
Zone 1	Low probability	<0.1%	<0.1%
Zone 2	Medium probability	1% - 0.1%	0.5% - 0.1%
Zone 3a	High probability	>1%	>0.5%
Zone 3b	Functional Floodplain	>3.3%	>3.3%

3.3. FLOOD CONSEQUENCES

3.3.1. The consequence of a flood event describes the potential damage, danger and disruption caused by flooding. This is dependent on the mechanism and characteristics of the flood event and the vulnerability of the affected land and the land use.

3.3.2. The NPPF[2] identifies five classifications of flood risk vulnerability and provides recommendations on the incompatibility of each vulnerability classification with the flood zones. Full details of the flood zones and flood risk vulnerability classifications can be found in the Flood Risk and Coastal Change PPG[27] and Annex 3 of the NPPF[2] respectively and are discussed in **Section 4.3**.

4. PLANNING POLICY

4.1. OVERVIEW

4.1.1. This assessment summarises the baseline flood risk information and identifies local flood risk to the Proposed Scheme and potential flood risk to other areas caused by the Proposed Scheme.

4.1.2. Flood risk is assessed in accordance with the NPS EN-1[1], NPPF[2] and development plan policy relevant to the proposed location of the Proposed Scheme. A summary of these policies is provided in this section.

4.2. OVERARCHING NATIONAL POLICY STATEMENT FOR ENERGY (EN-1)

4.2.1. The Overarching National Policy Statement for Energy (EN-1)[1] is part of a suite of NPS designated by the Secretary of State (SoS) of DESNZ in January 2024.

4.2.2. Paragraph 5.16.3 states that where developments are "*likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of, the proposed project on water quality, water resources and physical characteristics of the water environment, and how this might change due to the impact of climate change on rainfall patterns and consequently water availability across the water environment as part of the ES*".

4.2.3. Section 5.8: Flood Risk sets out that developments of 1 hectare or greater in Flood Zone 1 in England and all energy developments located in Flood Zones 2 and 3 in England should be accompanied by an FRA (Paragraph 5.8.13).

4.2.4. In determining an application for development consent, the SoS should be satisfied that, where relevant (Paragraph 5.8.36):

- "*the application is supported by an appropriate FRA;*
- *the Sequential Test has been applied and satisfied as part of site selection;*
- *a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk;*
- *the proposal is in line with any relevant national and local flood risk management strategy;*
- *sustainable Drainage Systems (SuDS) have been used unless there is clear evidence that their use would be inappropriate;*
- *in flood risk areas the project is designed and constructed to remain safe and operational during its lifetime, without increasing flood risk elsewhere (subject to the exceptions set out in Paragraph 5.8.42);*
- *the project includes safe access and escape routes where required, as part of an agreed emergency plan, and that any residual risk can be safely managed over the lifetime of the development; and*

- *land that is likely to be needed for present or future flood risk management infrastructure has been appropriately safeguarded from development to the extent that development would not prevent or hinder its construction, operation or maintenance*."

4.2.5. Paragraphs 5.8.9 to 5.8.11 detail the requirements for the Exception Test, stating that to pass the Exception Test the FRA should demonstrate:

- *"the project would provide wider sustainability benefits to the community that outweigh flood risk; and*
- *the project will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible will reduce flood risk overall."*

4.3. NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

4.3.1. The NPPF[2] and Flood Risk and Coastal Change PPG[27] documents provide guidance on how new developments must take into account flood risk, including allowance for the impacts of climate change.

4.3.2. In relation to flood risk, Section 14 of the NPPF details the requirements for a FRA and encourages decision makers to:

- "*steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding"* (Paragraph 168);
- *ensure that flood risk is not increased elsewhere"* (Paragraph 173);
- *within the site, the most vulnerable development is located in areas of lowest flood risk"* (Paragraph 173);
- *the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment"* (Paragraph 173);
- *it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate"* (Paragraph 173); and
- *using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management)"* (Paragraph 167)."

FLOOD CONSEQUENCE

4.3.3. The consequence of a flood event describes the potential damage, danger and disruption caused by flooding. This is dependent on the mechanism and characteristics of the flood event and the vulnerability of the affected land and land use.

4.3.4. NPPF[2] (Annex 3) presents five classifications of flood risk vulnerability for use within the Sequential Test. Flood Risk and Coastal Change PPG[27] provides guidance on the application of the Sequential Test which includes the incompatibility of each vulnerability classification with the Flood Zones. This is outlined in **Table 4-1**.

Table 4-1: Flood Risk Vulnerability and Flood Zone Incompatibility

Environment Agency Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test Required	✓	✓
Zone 3a	Exception Test Required	✓	×	Exception Test Required	✓
Zone 3b	Exception Test Required	✓	×	×	×

Notes:
✓ Exception test is not required; and
× Development should not be permitted.

4.3.5. In accordance with Annex 3 of the NPPF[27], the Proposed Scheme is considered as 'Essential Infrastructure' and should remain operational during flood events. The Sequential and Exception Tests are addressed in **Section 12**.

4.4. THE FLOOD AND WATER MANAGEMENT ACT 2010

4.4.1. The Flood and Water Management Act 2010[28] created the role of the LLFA to take responsibility for leading the coordination of local flood risk management in their areas. LBB is the LLFA for the Site.

4.4.2. In accordance with the Act:

- the Environment Agency is responsible for the management of risks associated with main rivers (such as the River Thames), the sea and reservoirs; and
- the LLFA is responsible for the management of risks associated with local sources of flooding such as ordinary (smaller) watercourses, surface water and groundwater. The LLFA is also ordinarily the consenting authority for works near or within ordinary watercourses.

4.4.3. Schedule 3 of the Flood and Water Management Act[28] is due to be implemented later in 2024. Consequential to the wording of the **Draft DCO** (**Document Reference 3.1)** which applies the exception given to NSIPs to the Proposed Scheme, the Proposed Scheme does not need to meet the requirements of Schedule 3 of the Flood and Water Management Act[28]. However, the LLFA has been consulted throughout the preparation of the **Outline Drainage Strategy (Document Reference 7.2)** as similar principles have been applied to the Proposed Scheme.

4.5. METROPOLIS MANAGEMENT (THAMES RIVER PREVENTION OF FLOODS) AMENDMENT ACT 1879

4.5.1. The Metropolis Management (Thames River Prevention of Floods) Amendment Act[29] requires riparian owners to maintain their defences to a suitable condition and level dictated by the Environment Agency. This Act has been disapplied in the **Draft DCO (Document Reference 3.1)** in relation to the Applicant's carrying out of, and maintenance of, the Proposed Scheme, to be replaced by the various mechanisms contained within the DCO. However, the act has not been disapplied in general terms in relation to the Applicant's responsibilities as riparian owner.

4.6. SUSTAINABLE DRAINAGE

4.6.1. The Non-Statutory Technical Standards for Sustainable Drainage Systems (SuDs)[30] provides general guidance for the design, maintenance and operation of SuDs. Detailed design and guidance are provided in The SuDS Manual (C753)[31].

4.6.2. In addition, the NPPF[2] promotes SuDS and states that major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- "*take account of advice from the lead local flood authority*;
- *have appropriate proposed minimum operational standards*;
- *have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development*; *and*
- *where possible, provide multifunctional benefits*."

4.7. REVIEW OF RELEVANT DEVELOPMENT PLAN POLICY

THE LONDON PLAN

4.7.1. The London Plan (2021)[32] provides the Spatial Development Strategy for Greater London setting out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth.

4.7.2. Policies SI12 to SI14 detail how the Proposed Scheme will need to take into consideration the local flood risk within and surrounding the Site and use sustainable drainage systems and highlight the importance and strategic role of the River Thames.

BEXLEY LOCAL PLAN

4.7.3. The Bexley Local Plan[33], adopted on 26th April 2023, positively plans for sustainable development across the Borough, including measures to address water supply and quality, flood risk and effects of climate change, amongst others.

4.7.4. The Bexley Local Plan[33] details the flood risk management considerations for developments in:

- Policy DP18: Waterfront development and development including, or close to flood defences – requiring development to protect and enhance the water space;
- Policy DP19: The River Thames and the Thames Policy Area – sets out the development management considerations that relate to the nature conservation and quality of the River Thames;
- Policy DP29: Water quality, supply and treatment – addressing quality of the water environment, impacts on the water supply and wastewater/sewage infrastructure and impacts on sensitive development from Crossness Sewage Treatment Works;
- Policy DP32: Flood risk management – establishing the approach to managing flood risk through new and re-development opportunities in the area;
- Policy DP33: Sustainable drainage systems – outlining the approach to managing sustainable drainage systems through development proposals; and
- Policy SP13: Protecting and enhancing water supply and wastewater infrastructure – addresses managing impacts to local water quality and considerations of the capacity of Crossness Sewerage Treatment Works.

STRATEGIC FLOOD RISK ASSESSMENT LEVEL 1

4.7.5. The purpose of the Bexley Level 1 Strategic Flood Risk Assessment[9] (SFRA) was to collate and analyse the most up to date readily available flood risk information for all sources of flooding and provide an overview of the flood risk issues across Bexley.

4.7.6. The Level 1 SFRA[9] identifies several designated main rivers within the Borough that are located within the Site under the jurisdiction of the Environment Agency and that the Site is protected by flood defences located along the River Thames.

STRATEGIC FLOOD RISK ASSESSMENT LEVEL 2

4.7.7. The Level 2 Bexley SFRA[34] provides evidence to support exception tests for potential sites identified for allocation in the Bexley Local Plan[33] (this excludes the Proposed Scheme). The purpose of the Level 2 SFRA[34] is to ensure that proposed developments which need to be located in areas at risk of flooding, are supported by an exception test showing how flood risk will be managed.

LOCAL FLOOD RISK MANAGEMENT STRATEGY

4.7.8. The Local Flood Risk Management Strategy[35] sets of the processes and procedures for managing surface water, groundwater and ordinary watercourse flooding in LBB.

5. SITE SETTING AND CONTEXT

5.1. RIVERSIDE 1 AND RIVERSIDE 2

5.1.1. Riverside 1 is an Energy from Waste (EfW) facility generating up to 80.5 megawatts (MW) of electricity and has been operational since 2011. Riverside 2 is an EfW facility with a generating capacity of approximately 76MW. It is currently under construction and anticipated to be operational in 2026.

5.1.2. As part of the Section 36 consent and DCO gained respectively for Riverside 1 and Riverside 2, the approach for and the outcomes of the FRA for each of the different facilities were agreed with the Environment Agency. Key information from the FRA for Riverside 1 and Riverside 2 is detailed below.

- Riverside 1[6]:
  - started operation in 2011;
  - the FRA assumed and recommended (these have been taken into account for Riverside 1):
    - an extreme (1 in 1,000 year) in channel water level of 5.971m Above Ordnance Datum (AOD);
    - a maximum water level on site for the 2052 1 in 200 year breach event of 1.81m AOD; and
    - a Finished Floor Level (FFL) of 2.11m AOD or higher.
- Riverside 2[7]:
  - is under construction, expected to start operation in 2026;
  - has a design life of 40 years;
  - the FRA included an assessment of the condition of the flood defences on site;
  - the FRA assumed and recommended (these have been taken into account for Riverside 2):
    - an extreme (1 in 1,000 year) water level of 6.72m AOD;
    - the maximum water level onsite for the 2100 1 in 200 year breach event varies from 2.49m AOD across the majority of the site to 4.56m AOD/ 5.08m AOD within the northeast and northwest corners of the site, respectively; and
    - FFL set at 2.97 m AOD with flood sensitive equipment set a minimum of 400mm above the FFL.

5.2. WATER ENVIRONMENT

SITE DESCRIPTION

5.2.1. The Proposed Scheme is adjacent to and within the River Thames (with the majority of the Site located behind the River Thames Flood Defences but downstream of the Thames Barrier).

5.2.2. The Proposed Scheme is also located in close proximity to the Great Breach Dyke and Great Breach Pumping Stations operated and maintained by the Environment Agency. The pumping stations pump flow from the Marsh Dykes to the River Thames. Each Environment Agency Pumping Station has an accompanying outfall; these are located approximately 80m to the west of the Site Boundary (Great Breach Outfall) and approximately 1.2km to the southeast of the Site Boundary (Green Level Outfall). Upstream of these are open watercourses, there are also a number of culverted watercourses, surface water sewers, combined sewers and lakes.

RIVER THAMES FLOOD DEFENCES

5.2.3. The Environment Agency's Flood Map for Planning[3] shows there are significant flood defences located along the River Thames (River Thames Flood Defences). The River Thames Flood Defences are adjacent to, and located partly within, the Site. The River Thames Flood Defences are defined by the Environment Agency's spatial flood defences database[36]. The location of the defences and the areas that benefit from the defences are shown in **Figure 11-3: Flood Zones (Volume 2)**.

5.2.4. The Environment Agency's TE2100 Plan[37] splits the relevant section of the River Thames into a number of flood cells. The Proposed Scheme is located within the Thamesmead flood cell for which the TE2100 Plan[37] states that the defences will be managed in accordance with Policy 4 which states *"Take further action to keep up with climate and land use change so that flood risk does not increase"*. Table 7.1 of the TE2100 Plan (included in **Annex A)** requires the defences at node 3.9 (the most appropriate node in relation to the Proposed Scheme) to be raised to a level of:

- 7.70m AOD for the plan period 2070 – 2120 (into which the design life of the Proposed Scheme falls); and
- 8.2m AOD for the plan period 2120 – 2170 (which is the period immediately after the period into which the design life of the Proposed Scheme falls).

5.2.5. In this area the flood defences, their maintenance and raising to the specified height is the responsibility of the riparian owner (the adjacent landowner) and is managed by the Environment Agency as outlined in the Metropolis Management (Thames River Prevention of Floods) Amendment Act[29] (further detail is provided in **Chapter 11: Water Environment and Flood Risk (Volume 1)**).

MARSH DYKES FLOOD DEFENCES

5.2.6. The Marsh Dykes area is mostly low-lying land reclaimed from the River Thames estuary and is defended by the River Thames Flood Defences. In the 1960s, the former Greater London Council constructed a system of lakes and canals (Butts Canal, Great Breach Dyke, Green Level Dyke, Horsehead Dyke and Corinthian Dyke) along with fluvial pumping stations to drain this low-lying area.

5.2.7. Some areas are drained to combined sewers which flow into Crossness Sewage Treatment Works. There is one natural watercourse in the catchment called Wickham Valley Watercourse which drains into the Butts Canal.

5.2.8. In the vicinity of the Proposed Scheme the flood risk associated with the Marsh Dykes is managed by the Environment Agency's Pumping Stations at Green Level and Great Breach Dyke (these are shown on **Figure 11-2: Surface Water Features (Volume 2)**).There are further pumping stations at Lake 4 (located approximately 3km to the west of the Site Boundary) and Lake 5 (located approximately 4.2km to the west of the Site Boundary), however, the impact of these on water levels adjacent to the Proposed Scheme is considered not to be significant. These pumping stations by their nature control the water surface elevation and groundwater levels.

5.2.9. The Environment Agency has stated during consultation that the gravity outfall at the Great Breach Pumping Station is no longer working due to sediment blockages within the River Thames. There are no plans to undertake dredging in order to remove the sediment. As a result, water levels may be locally slightly higher than compared to when the pumping station is in operation. However, the impact is not considered to be significant to the surrounding area.

5.2.10. The Environment Agency has also stated during consultation that it has just commenced a programme for the delivery of upgrade works to the Great Breach Pumping Station. This is understood to include silt removal from the gravity culvert and penstock chamber, and replacement of the penstock. Further details on the requirements/timescales/specification of this programme were not available at the time of writing this report.

WATERCOURSES

5.2.11. There are main rivers and ordinary watercourses located within the Site, as summarised below.

5.2.12. The main rivers and ordinary watercourses located within and adjacent to the Site and are labelled in **Figure 11-2: Surface Water Features (Volume 2)**. The main rivers are listed in **Table 5-1** and the ordinary watercourses are listed in **Table 5-2** below.

Table 5-1: Main Rivers

Main River	Local Name	Map Reference	Distance from Site Boundary	Interactions with the Proposed Scheme
River Thames	River Thames	N/A	Located within the Site.	Access Trestle/Proposed Jetty and the potential demolition of the Belvedere Power Station Jetty (disused).
Norman Road Stream	N/A	MR4	Located within the Site.	Located between the Carbon Capture Facility and Norman Road, the watercourse receives surface water runoff from Riverside 1 and Riverside 2.
Norman Road River	Great Breach Dyke North	MR1	Located within the Site.	Located to the upstream of the Great Breach Pumping Station.
Mulberry Way River	N/A	MR3	Located within the Site.	Located to the south of the Carbon Capture Facility and to the east of the Mitigation and Enhancement Area.
Belvedere Stream	N/A	MR5	Located within the Site.	Located on the eastern Site Boundary, no interactions expected with the Proposed Scheme.
Great Breach Lagoon	Great Breach Lagoon	MR2	Located within the Site.	This forms part of the Mitigation and Enhancement Area.
Great Breach Dyke	Great Breach Dyke	MR12	Located within the Site.	This watercourse is located within the Mitigation and Enhancement Area. The watercourse is the rising main from the Great

Main River	Local Name	Map Reference	Distance from Site Boundary	Interactions with the Proposed Scheme
				Breach Pumping Station to the River Thames.
Great Breach Dyke West	Great Breach Dyke West	MR11	Located within the Site.	This watercourse is located within an along the southern boundary of the Mitigation and Enhancement Area.

Table 5-2: Ordinary Watercourses

Ordinary Watercourse	Local Name	Map Reference	Distance from Site Boundary	Interactions with the Proposed Scheme
North Dyke	North Dyke	OW4	Located within the Site.	Forms the northern boundary of the Carbon Capture Facility.
Stable Paddock Ditch	North Dyke	OW6	Located within the Site.	Located within the Mitigation and Enhancement Area.
West Paddock Ditch	West Paddock Ditch	OW3	Located within the Site.	Located within the Mitigation and Enhancement Area.
Borax South	N/A	OW11	Located within the Site.	Forms the western boundary of the Carbon Capture Facility.
Iron Mountain Ditch	N/A	OW7	Located within the Site.	Located within the boundary of the Carbon Capture Facility.
Iron Mountain Ditch	N/A	OW12	Located within the Site.	Located between Riverside 1 and the Site Boundary.

Ordinary Watercourse	Local Name	Map Reference	Distance from Site Boundary	Interactions with the Proposed Scheme
Borax North	N/A	OW15	Located within the Site.	Located within the boundary of the Carbon Capture Facility.
Norman Road Field	N/A	OW16	Located within the Site.	Located within the boundary of the Carbon Capture Facility.
Ditch Thames C	N/A	OW17	Located within the Site.	Located within the boundary of the Carbon Capture Facility.
Horse Head Ditch	Horse Head Dyke	OW5	Partially located approximately within the Site.	Partially located within the Mitigation and Enhancement Area.
Great Breach Ditch	N/A	OW10	Located approximately 10m west from the Site Boundary.	No interaction.
Reedbed Dyke	Reedbed Dyke	OW2	Located approximately 10m west from the Site Boundary.	No interaction.
Reedbed Ditch 1	N/A	OW8	Located approximately 20m west from the Site Boundary.	No interaction.
Reedbed Ditch 2	N/A	OW9	Located approximately 20m west from the Site Boundary.	No interaction.
Eastern Way Ditch	N/A	OW13	Located approximately 60m south from the Site Boundary.	No interaction.

Ordinary Watercourse	Local Name	Map Reference	Distance from Site Boundary	Interactions with the Proposed Scheme
Lidl Ditch	N/A	OW14	Located approximately 225m east from the Site Boundary.	No interaction.

HYDROGEOLOGY

5.2.13. Groundwater was recorded closest to the surface in BH13 (Alluvium) at 0.26 metres below ground level (m bgl) (1.19 metres ordnance datum (m OD)) and BH05 (Taplow Gravel Member) at 0.55m bgl (1.26m OD) in September 2019 and April 2018 respectively (detailed in **Appendix 11-3: Groundwater Impact Assessment (Volume 3)**). On average, and accounting for all discontinuous monitoring data, the average depth to groundwater within the Site is 1.49m bgl (0.43m OD) for the superficial deposits.

5.3. TOPOGRAPHY

5.3.1. The Marsh Dykes is mostly low-lying land reclaimed from the Thames estuary and is defended by the Thames Flood Defences. In the 1960s, the former Greater London Council constructed a system of lakes and canals along with surface water pumping stations to drain this low-lying area. **Figure 5-1** below and **Annex E** shows the local topography of the Site and adjacent areas based upon the Environment Agency's 1m LiDAR Digital Terrain Model[13].

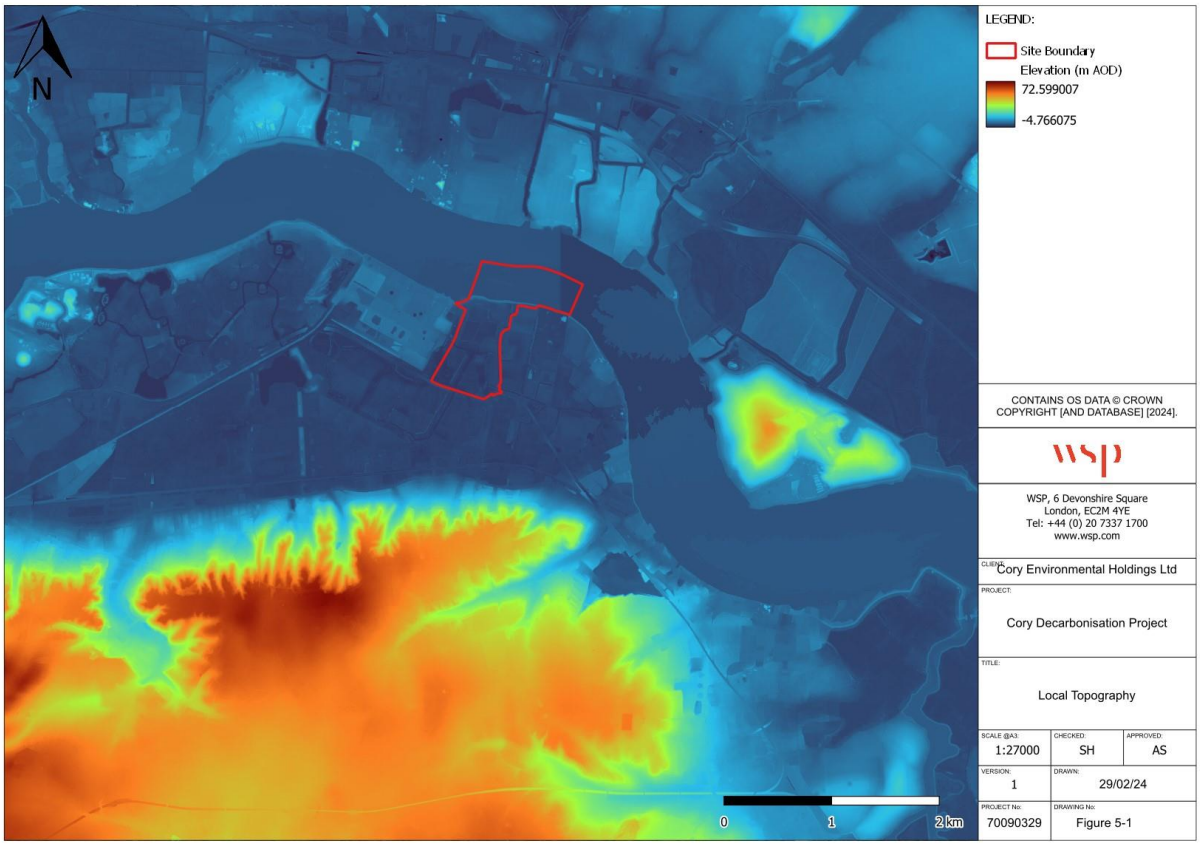

Figure 5-1: Local Topography

5.4. EXISTING DRAINAGE

5.4.1. The Site is predominantly drained by a local watercourse network comprised of boundary and onsite ditches. The area surrounding where Munster Joinery is located within the Carbon Capture Facility, is served by a private surface water drainage network, which outfalls into the Marsh Dykes. This local water network is linked with the Crossness Local Nature Reserve located to the west of the Proposed Scheme, with water ultimately discharged via pumping into the River Thames to the north.

5.4.2. A Drainage Strategy is in place for Riverside 1 and a Surface and Foul Water Drainage Strategy[38] will be in place following the construction of Riverside 2, secured by planning condition/DCO Requirement. Both Riverside 1 and Riverside 2 discharge into surface water features and ditches adjacent to Norman Road (see **Section 5.2** for details), which also receive surface water runoff from the surrounding area.

5.4.3. The majority of the area for the Carbon Capture Facility is currently utilised as the construction compound and laydown area for Riverside 2 and has a temporary drainage network in place which drains to a network for field drains to the Marsh Dykes. The Munster Joinery land also drains to this receptor, although via a permanent drainage system.

6. METHODOLOGY

6.1. METHODOLOGY

6.1.1. A general site walkover was undertaken on the 29th November 2023. The site walkover comprised of a visual inspection of the watercourses, floodplain, flood defences and River Thames in and around the Proposed Scheme.

6.1.2. The methodology adopted in the preparation of this FRA comprises:

- review of available flood risk data to identify existing flood risk from fluvial, tidal, groundwater, surface water and artificial sources;
- review of existing ground conditions onsite to determine groundwater levels, soil permeability and contamination risks through examination of previous land uses and information available from the Environment Agency and the British Geological Survey (BGS);
- review of the Proposed Scheme with respect to the flood risk vulnerability and flood zone compatibility of the Scheme, in accordance with the methodology outlined in NPS EN-1[1] and the NPPF[2];
- assessment of how the Proposed Scheme might affect flood risk to the Site and elsewhere supported by hydraulic modelling of the Proposed Scheme; and
- preparation and assessment of proposals for the appropriate management of flood risk to enable construction and operation of the Proposed Scheme without increasing flood risk elsewhere.

6.2. DESIGN EVENTS

6.2.1. The following design events have been adopted for the Proposed Scheme in accordance with NPPF[2] and Flood Risk and Coastal Change PPG[27]:

- Breach = 1 in 200 year plus climate change;
- Fluvial = 1 in 100 year plus climate change; and
- Pluvial = 1 in 100 year plus climate change.

6.2.2. The **Outline Drainage Strategy (Document Reference 7.2)** details the design parameters and climate change allowances used within the design of the drainage.

6.3. HYDRAULIC MODELLING

6.3.1. Hydraulic modelling has been undertaken to support various aspects of this assessment, the methodology for each modelling exercise is summarised in each relevant section with further details provided in **Annex B**, as required.

BREACH MODELLING GUIDANCE

6.3.2. The Environment Agency (in its response to the PEIR dated 29th November 2023) requested that baseline and Proposed Scheme breach modelling is undertaken to understand the implications on residual flood risk to existing homes, businesses and infrastructure. A 2D hydrodynamic model has been developed by WSP using the MIKE by DHI Flexible Mesh modelling software to provide further information on the flood depth, extent, and hazard under current conditions and during operation of the Proposed Scheme in the event of a breach of the River Thames Flood Defences.

6.3.3. The Environment Agency has published Breach of Defences Guidance[39] as to how modelling of flood defence structures should be undertaken. This has been utilised in both the Environment Agency's and the project specific modelling detailed below.

6.3.4. The key aspects of this guidance which apply to the River Thames Flood Defences adjacent to the Site are:

- the landward toe level was determined as the lowest point within a semicircle centred on the breach crest with a radius equal to the breach width; and
- each breach is 20m wide and open for 18 hours as the defences on an estuary and are of reinforced concrete in an urban environment.

7. DESIGN LIFE AND CLIMATE CHANGE

7.1. DESIGN LIFE

7.1.1. Defining the design life for the Proposed Scheme is key for the flood risk assessment, as it enables determination of the required climate change allowances that have been utilised in the assessment and thus used to define the required mitigation.

7.1.2. The definition of the design life needs to consider the approach in the Flood Risk and Coastal Change PPG[27], and recognises that the design year varies for non-residential developments [paragraph 006]:

"The lifetime of a non-residential development depends on the characteristics of that development but a period of at least 75 years is likely to form a starting point for assessment."

7.1.3. In this case a period of 75 years is not suitable to form the starting point, given the design life of Riverside 1 and Riverside 2, and the life expectancy of the Proposed Scheme. Information on this is provided below and in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**.

7.1.4. The Proposed Scheme is intended to operate for at least 25 years. However, for the purpose of assessing a reasonable worst case scenario it is anticipated that it could have a design life of 50 years, as per typical design life of the civil and structural elements of the Proposed Scheme.

7.1.5. At the end of the design life, the Proposed Scheme may have some residual life remaining, and an investment decision will be made as to whether the operational life of the Proposed Scheme is to be extended. If it is not appropriate to continue operation, the plant will be decommissioned.

7.1.6. For the purposes of this FRA, a fixed design life of 50 years has been assumed, for the setting of the climate change allowances. However, as there remains the potential for the Proposed Scheme to operate beyond the design life assessed within this assessment, the **Draft DCO (Document Reference 3.1)** includes a flood risk requirement for further assessment and implementation of mitigation measures (as appropriate) before the end of the assessed 50 year period to provide the necessary protections at that time for a longer operational life.

7.1.7. The earliest commissioning date completes in Q2 2028 and a latest completes in Q4 2030; therefore, for the purposes of defining the appropriate climate change allowances a commissioning date of Q1 2031 has been assumed. This results in the FRA Design Year for the Carbon Capture Facility and Ancillary Infrastructure being 2081.

7.2. CLIMATE CHANGE ALLOWANCES

7.2.1. The NPS EN-1[1] and the NPPF[2] require that a robust approach to flood risk management is adopted and that this includes the impacts of climate change. The Environment Agency has confirmed that the NPPF climate change allowances[42] are based on:

- sea level rise allowances are based on RCP (Representative Concentration Pathways) 8.5 for the 70th (higher central) and 95th (upper end) percentiles;
- peak river flow allowances are based on based on RCP8.5 50th (central), 70th (higher central) and 95th (upper end) percentiles; and
- peak rainfall allowances are based on based on RCP8.5 50th (central) and 95th (upper end) percentiles.

7.2.2. This approach is more conservative than that adopted in the UK Climate Change Risk Assessment 2022[40], as the supporting Technical Report[41] states:

"Many, but not all, projections with RCP8.5 are considered as low-likelihood, high-impact outcomes and not included in the main assessment."

7.2.3. The Environment Agency's FRA climate change allowances guidance[42] states that:

- For peak river flow (i.e. fluvial) developments classed as Essential Infrastructure that are allocated in Flood Zones 2 or 3 should use the higher central allowance.
- For sea level rise allowance all developments should assess both the higher central and upper end allowances.
- For peak rainfall intensity (i.e. surface water flood risk and small watercourses) all developments should assess the upper end allowance.

7.2.4. The approach for incorporating these allowances in the FRA is described in the following sections.

TIDAL/TE2100 IN-CHANNEL LEVELS

7.2.5. The Environment Agency has incorporated appropriate climate change allowances within the provided TE2100 in-channel levels[24], which are used within the Environment Agency's River Thames Breach Assessment[22]. As such no further increases for climate change need to be made to these water levels within this assessment.

FLUVIAL/PLUVIAL

7.2.6. The Marsh Dykes Model[23] provided to the Applicant by the Environment Agency is a integrated fluvial, pluvial and sewer model. The model scenario used to inform this FRA for the Proposed Scheme includes the 'Upper end' emissions scenario that comprises a 70% peak fluvial flow uplift (upper end) and a 40% rainfall peak rainfall uplift (upper end). The climate change allowances included in this model therefore exceed those that would be required for the Proposed Scheme.

7.2.7. The Environment Agency's FRA climate change allowances guidance recommends that the Central Allowance is used in the design of any floodplain compensation, following consultation and agreement with the Environment Agency.

8. ASSESSMENT OF FLOOD SOURCES

8.1. POTENTIAL SOURCES OF FLOODING

8.1.1. In accordance with the NPPF[2] and the NPS EN-1[1], which states all sources of flood risk should be taken into account as set out in **Section 4.2** and **Section 4.3**, the following sources of flooding have been considered in this assessment (as detailed in the following sections):

- breach of the River Thames Flood Defences;
- overtopping of the River Thames Flood Defences;
- overtopping and flow constraints associated with the Proposed Jetty;
- flooding from the Marsh Dykes
- surface water;
- groundwater; and
- artificial sources:
  - Crossness Sewage Treatment Works;
  - surcharging of sewers; and
  - reservoirs.

8.1.2. The impacts associated with Site generated surface water runoff is covered in the **Outline Drainage Strategy (Document Reference 7.2)**.

8.2. HISTORICAL FLOODING

8.2.1. The Level 1 SFRA[9] outlines that:

"In the LBB, the only recorded flood incident from the Thames held by the Environment Agency is that associated with the 1953 tidal event. This was an event which affected much of eastern and southeastern England. The extent of this flood even can be seen in Figure A7 in Appendix A, which provides a clear indication of the potential flood risk along the Thames Estuary. Historic flood events have also been recorded on the rivers Cray and Shuttle in 1968 and again on the upper River Cray in 1977."

8.2.2. The Environment Agency's Historical Flood Map (shown in **Figure 8-1** and **Annex E**) shows that the 1953 flood event inundated the whole of the Thamesmead flood cell/Marsh Dykes which includes the Proposed Scheme.

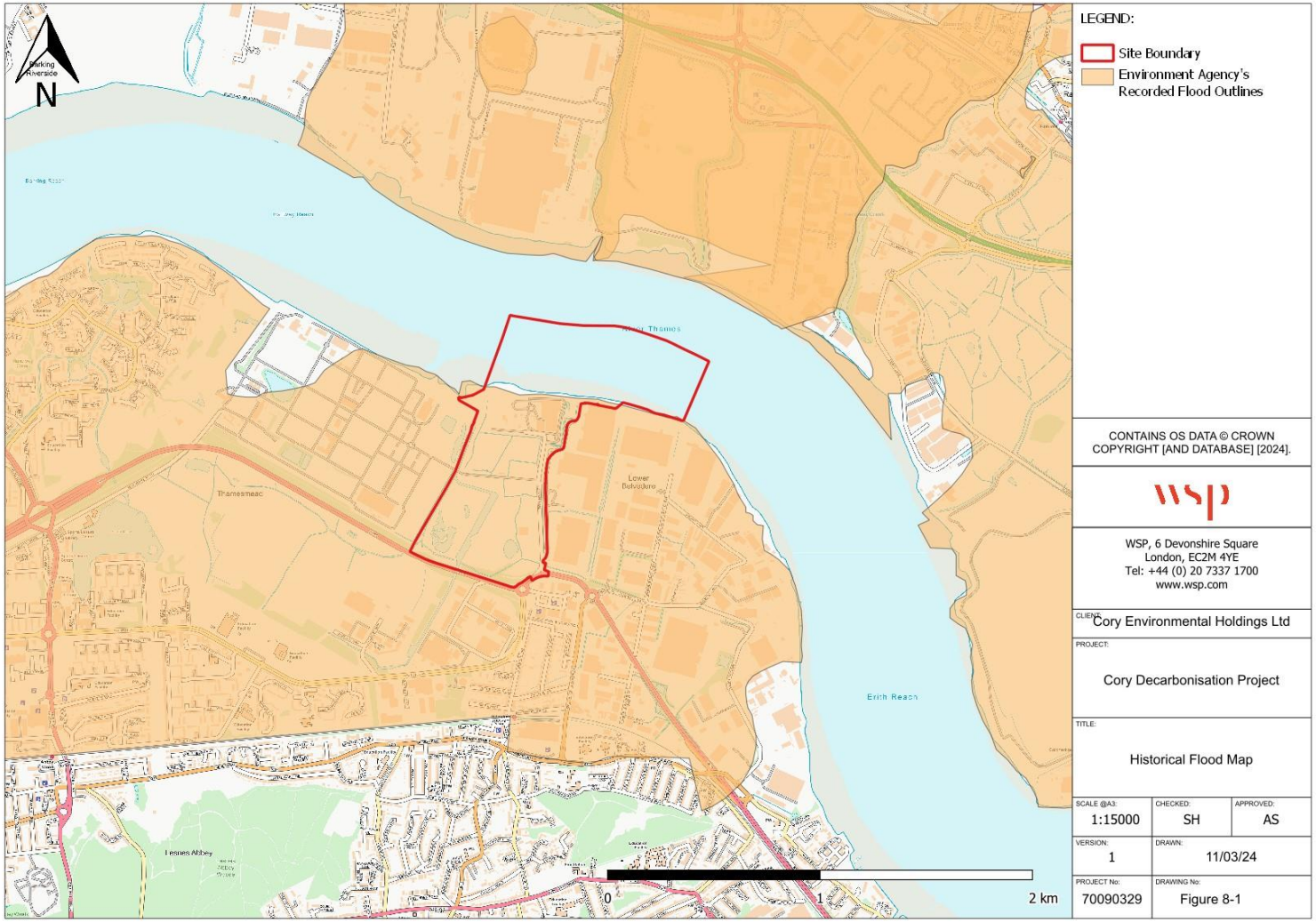

Figure 8-1: Historical Flood Map

8.3. BREACH OF THE RIVER THAMES FLOOD DEFENCES

INTRODUCTION

8.3.1. The Environment Agency's Flood Map for Planning[3] shows that the Proposed Scheme is located in Flood Zone 3, within the undefended tidal flood extent of the 1 in 200 year event (0.5% AEP). The Flood Zones do not take the presence of flood defences into account. As discussed in Section 5.2 flood defences are located along the banks of the River Thames. The Environment Agency has confirmed that the Proposed Scheme and its surroundings are protected up to the present day 1 in 1,000 year event by the River Thames Flood Defences, as shown by the Environment Agency's 'Reduction in Risk of Flooding form Rivers and Sea due to Defences' dataset. The Flood Zones, location of defences and areas that benefit form defences are shown in **Figure 11-3: Flood Zones (Volume 2)**.

8.3.2. The Environment Agency has ensured that measures (raised defences) are in place across the flood cell to prevent flooding during the design event (1 in 200 year event plus climate change) from the River Thames to the Proposed Scheme for the entirety of the design life.

8.3.3. There is however a residual risk associated with a breach of the River Thames Flood Defences. A breach of the existing flood defences is considered unlikely to happen as they are regularly inspected and managed by the Environment Agency. This is considered to be a residual risk, and therefore in accordance with Paragraph 41 of the Flood Risk and Coastal Change PPG[27] is included in this assessment.

8.3.4. The River Thames Flood Defences will be maintained by riparian landowners to keep pace with the impacts of climate change as described in **Section 7.2**. In summary Table 7.1 of the TE2100 Plan (included in **Annex A)** requires the defences at node 3.9 (the most appropriate node in relation to the Proposed Scheme) to be raised to a level of:

- 7.70m AOD for the plan period 2070 – 2120 (into which the design life of the Proposed Scheme falls); and
- 8.2m AOD for the plan period 2120 – 2170 (which is the period immediately after the period into which the design life of the Proposed Scheme falls).

8.3.5. Thus in accordance with the Flood Risk and Coastal Change PPG[27], the main driver for the flood risk mitigation considerations for the Proposed Scheme has been the potential consequences of flooding resulting from breach or failure of that improved infrastructure rather than overtopping. Therefore, this section identifies the potential consequences and associated flood risk mitigation associated with a breach in the River Thames Flood Defences.

FLOOD DEFENCE CONDITION ASSESSMENT

8.3.6. An assessment of the River Thames Flood Defences alongside Riverside 1 and Riverside 2[8] was undertaken in February 2022, to discharge Requirement 20 of the DCO for Riverside 2. This concluded that:

"The residual design life of the wall (subject to ongoing maintenance and inspections to monitor the rate of deterioration) is expected to be between 95 and 130 years following the implementation of remedial works proposed within the report."

8.3.7. The DCO for Riverside 2 requires the implementation of any such approved remedial works and are therefore assumed to have been completed for the purpose of this assessment for the Proposed Scheme.

8.3.8. Furthermore, it is understood that the Environment Agency undertakes inspections of the River Thames Flood Defences twice a year, to ensure that they are of an appropriate condition. It is considered that there is no requirement for this assessment for the Proposed Scheme to include a new assessment of the condition of this section of the flood defences.

8.3.9. However, it is nonetheless proposed that a survey would be undertaken to cover the additional length of the flood defences to the east of that previously assessed (i.e. the length where the Proposed Jetty would cross the defences), with any remedial actions identified undertaken. This is provided for as part of a Requirement of the **Draft DCO (Document Reference 3.1)** submitted for the Proposed Scheme.

ENVIRONMENT AGENCY MODEL ASSESSMENT

8.3.10. Two hydraulic models were provided by the Environment Agency to inform the assessment of flood risk to the Site:

- The Environment Agency's Marsh Dykes Model[23] (an integrated fluvial, surface water and sewer model that also includes flood defence breach at four locations, built in 2020); and
- The Environment Agency's Thames Estuary Breach Assessment[22] (assessed failure of the River Thames Flood Defences every 20m, built in 2020).

8.3.11. During a consultation meeting on 20th September 2023 the Environment Agency confirmed the 2018 Thames Estuary Breach Assessment[22] would be appropriate to inform the assessment of flood risk for new development in this area. Consideration has however been given to the outputs of both models to determine the worst case scenario for the Proposed Scheme and the proposed development levels to manage flood risk from a breach in the River Thames Flood Defences. The results of this assessment are presented below.

Marsh Dykes Model

8.3.12. The Environment Agency's Marsh Dykes Model[23] uses the same TE2100 water level as the Thames Estuary Breach Assessment[22]. However, it has been developed with a better representation of the terrain, flow routes (i.e. watercourses) and pumping stations across the flood cell. The flood depths and extents associated with breaches across the flood cell are smaller and less extensive than those in the Thames Estuary Breach Assessment[22].

8.3.13. The reasons for this are set out in Section 4.3.7 of the Environment Agency's Marsh Dykes Modelling Report[23] which states:

"It expected that the Marsh Dykes Model has more capacity that the Thames Breach model, due to the sewers, lakes and canals being represented in the 1D domain of the Marsh Dykes model. In contrast, the Thames Breach model is 2D-only, with no representation of the capacity provided by the below ground sewer network. Also, lakes and canals in the Thames Breach model are represented within the 2D domain (created using 1m resolution LIDAR), rather than being built into the 1D domain, as in the Marsh Dykes model. LIDAR is partially reflected and absorbed when it reaches a water surface, and therefore the bed of the canals and lakes system is not represented within the 2D domain of the Thames Breach model. As a result, there is considered to be less capacity in the lake and canal system is represented in the Thames Breach model, than in the Marsh Dykes model.

Therefore, smaller flood extents in the Marsh Dykes Model were expected when compared with the 2D-only Thames Breach model. However, the pumping stations located nearest to each defence breach are also predicted to operate to full their capacity during a breach event. Therefore, they remove considerable flood volumes from the catchment and have a significant impact in reducing the predicted flood extent."

8.3.14. The Marsh Dykes Model assessed the impacts of a breach at four locations within the wider flood cell. The extents for all breach scenarios in the vicinity of the Proposed Scheme can be seen in **Figure 8-2** (and **Annex E**) and detailed in **Table 8-1**. This data represents a 1 in 200 year scenario for the year 2115, and therefore presents water levels and flood depths that go beyond the design life of the Proposed Scheme. This confirms that out of the assessed locations, a breach at Great Breach Pumping Station would have the most impact at the Site, followed by one at Green Levels Pumping Station. As these are the locations with the most impact at the Site, these have been included within this assessment.

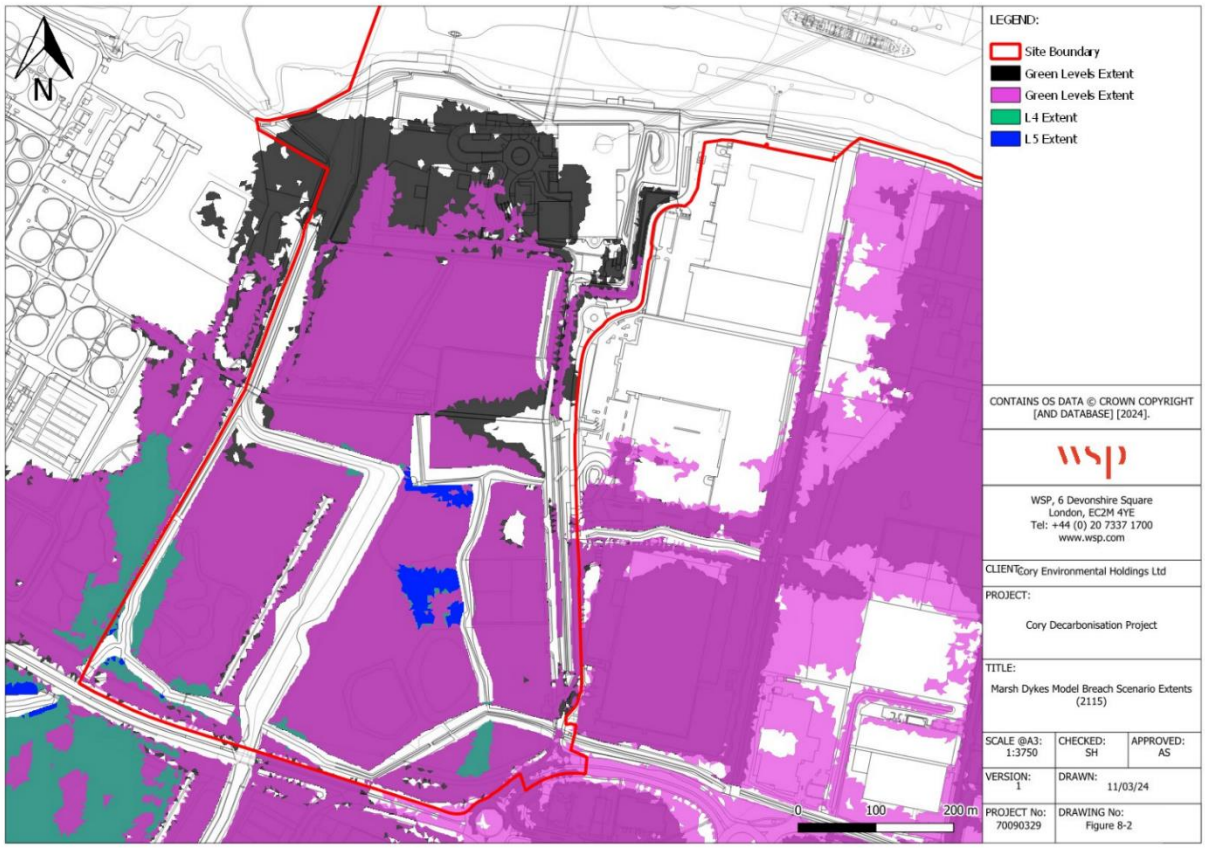

Figure 8-2: Marsh Dykes Model Breach Scenario Extents (2115)

Table 8-1: Marsh Dyke Model Breach Flood Depths (2115)

Breach Location	Water Level (m AOD)		Water Depth (m)	
	Min	Max	Min	Max
Lake 4	0.00	0.00	0.00	0.00
Lake 5	0.00	0.19	0.00	0.05
Green Level Pumping Station	0.00	1.42	0.00	1.22
Great Breach Pumping Station	1.5	1.73	1.38	0.14

Thames Estuary Breach Assessment

8.3.15. The Environment Agency's Thames Estuary Breach Assessment[22] undertaken in 2018, involved the assessment of a failure of the defences every 20m. The resultant flood map and associated depths is the maximum water level/depth across all scenarios, as such it is not possible to determine which breach location resulted in the maximum flood depth at any location in the flood cell. This data represents a 1 in 200 year scenario for the year 2115, and therefore presents water levels and flood depths that go beyond the design life of the Proposed Scheme.

8.3.16. The extents of this breach modelling in the vicinity of the Proposed Scheme scenario are shown in **Figure 8-3** and **Annex E.**

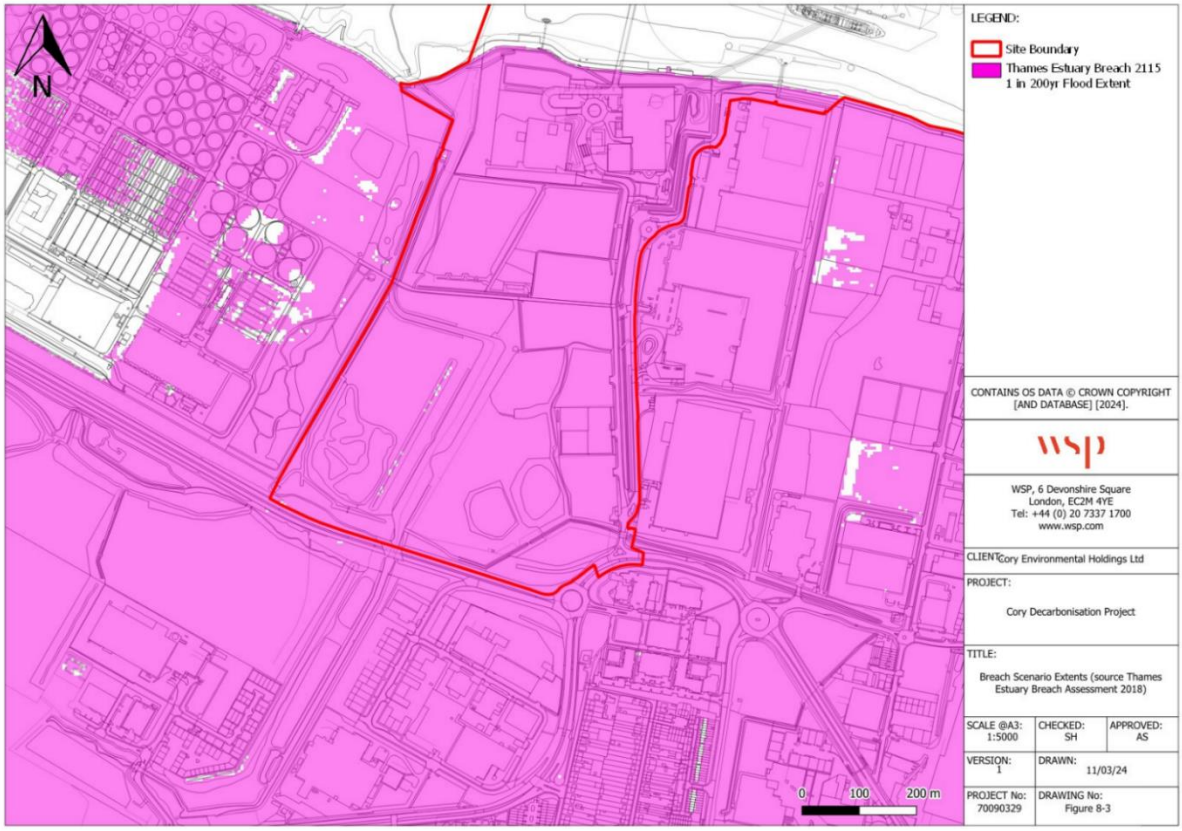

Figure 8-3: Breach Scenario Extents (Source Thames Estuary Breach Assessment 2018)

8.3.17. A GIS assessment has been undertaken to assess the breach flood level and depths for this modelled scenario. The sample points from which the flood levels for the breach scenario have been extracted from are shown in **Figure 8-4** and **Annex E**, with the depths and elevations detailed in **Table 8-2**.

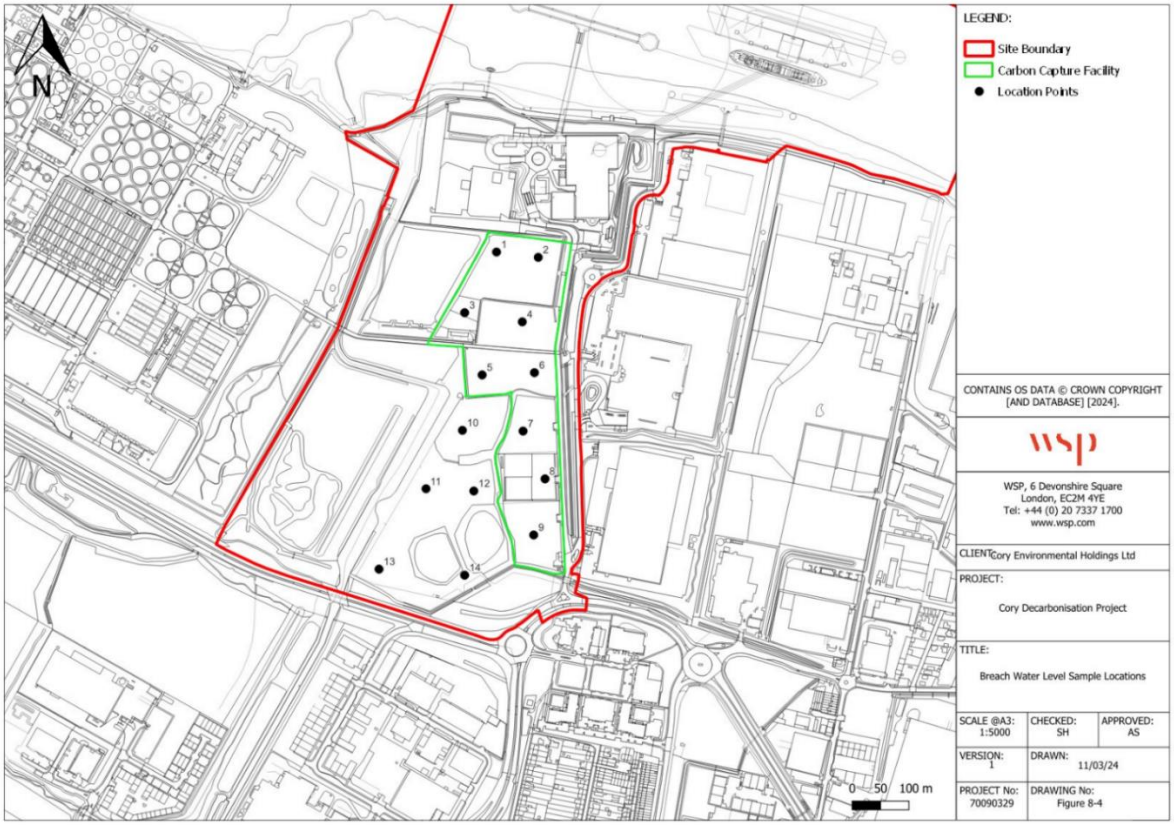

Figure 8-4: Breach Water Level Sample Locations

Table 8-2: 1 in 200 year plus Climate Change Breach Water Levels (2115)

Location Point	Ground Elevation (m AOD)[a]	Thames Estuary Breach Assessment (2018)	
		Water Level (m AOD)	Water Depth (m)
1	0.88	2.49	1.54
2	0.49	2.49	2.02
3	0.44	2.49	2.15
4	1.32	2.49	1.53
5	1.09	2.49	1.73
6	1.47	2.49	1.13
7	0.73	2.49	1.29
8	1.12	2.49	1.36
9	1.29	2.49	1.19
10	1.67	2.49	1.71
11	0.66	2.49	1.73
12	-0.01	2.49	2.33

Location Point	Ground Elevation (m AOD)[a]	Thames Estuary Breach Assessment (2018)	
		Water Level (m AOD)	Water Depth (m)
13	0.66	2.49	2.02
14	0.55	2.49	2.11

Note:
[a] It should be noted that the ground elevations have been derived from a more recent version of LiDAR compared to Thames Esturay Breach Assessment. Therefore, ground elevations may differ slightly to that included in the modelling and so are provided for context only. Water depths were extracted directly from the model.

8.3.18. These water levels are approximately 0.76m above the levels derived from the Marsh Dykes Model in **Table 8-1**.

8.3.19. The maximum breach flood level is 2.49m AOD for the 1 in 200 year plus climate change scenario, (2115) which equates to flood depths of between 1.13m and 2.33m.

Embedded mitigation

8.3.20. The modelling assessment presented above has informed the development levels for the Proposed Scheme. As expected, the Environment Agency's Thames Estuary Breach Assessment[22] provides the worst-case scenario in terms of predicted flood depths following a breach event in the River Thames Flood Defences. This is attributable to the Environment Agency's Thames Estuary Breach Assessment[22] comprising a 2D domain only and not including representation of surface water features or operation of the Great Breach Dyke and Green Level Pumping Stations that have been considered in the Environment Agency's Marsh Dykes Model[23].

8.3.21. Information from Thames Estuary Breach Assessment[22] model has therefore been used to inform the design and flood protection measures.

8.3.22. As stated above, the maximum breach flood level is 2.49m AOD for the 1 in 200 year plus climate change scenario (2115). Given the uncertainty of hydraulic modelling a freeboard[a] allowance is required for the Proposed Scheme to inform the design and flood protection measures.

8.3.23. A freeboard of 600mm has been applied for the critical equipment (**Works Nos.1A, 1B and 1C**) located on the Carbon Capture Facility that must remain dry or operational during a flood event. A minimum freeboard of 300mm has been applied to the remainder of the Carbon Capture Facility.

8.3.24. This equates to minimum levels of:

[a] Freeboard is an allowance that takes account of adverse uncertainty in the prediction of physical processes that affect the design level, which have not been allowed for in the design water level.

- Top of Platform = 2.8m AOD (300mm freeboard);
- Building Finished Floor Level (FFL) = 2.95m AOD (also provides protection from surface water runoff across the platform) (450mm freeboard); and
- Critical Equipment Height = 3.1m AOD (600mm freeboard).

8.3.25. These levels have been informed by the results of the 2115 assessment year and therefore go above and beyond the design life of the Proposed Scheme as discussed in **Section 7.1**. The development levels presented above are considered embedded mitigation for the purposes of this report.

8.3.26. This stepped approach to development levels is adopted to minimise the amount of land raising required. Furthermore, the bunding required for pollution control could provide additional protection for some of the equipment (such as the Above Ground Storage Tanks) to increase freeboard above the current 300mm that has been provided. The height of the bunding would be determined during detailed design in accordance with the **Outline Drainage Strategy (Document Reference 7.2)**.

8.3.27. The Ancillary Infrastructure part of the Carbon Capture Facility is the equipment/infrastructure which is not required to maintain the operation of the Carbon Capture Facility. It could be adversely impacted by flood waters but also relatively easily replaced within the Site and therefore does not require freeboard.

8.3.28. The platform and equipment/building levels referred to above will be maintained for the lifetime of the Proposed Scheme.

8.3.29. The connections and interconnections between both Riverside 1 and Riverside 2 to the Proposed Scheme (Work No. 2) will either be:

- set above the maximum breach flood level (2.49m AOD). Given that Riverside 1 and Riverside 2 have been designed to be above the breach flood level (as defined during their design process and pursuant to their respective consents), setting the connection above the breach level, should be possible; or
- if this is not possible then the connection would be designed to ensure that Riverside 1 and Riverside 2 remain water tight and no new ingress points are created.

8.3.30. The Access Trestle to the Proposed Jetty is elevated above the River Thames Flood Defences and therefore is also above the maximum breach flood level. The Access Trestle is therefore not at risk of flooding in the event of a breach of the River Thames Flood Defences. The impacts to the Proposed Jetty are covered separately in **Section 8.4**.

8.3.31. The flood risk to the Temporary Construction Compounds is addressed through measures in the **Outline CoCP (Document Reference 7.4)**, which includes ensuring that staff are not onsite during times of high risk of a breach of the River Thames Flood Defences.

8.3.32. Should a breach of the River Thames Flood Defences occur there would be no change from the baseline scenario to the Mitigation and Enhancement Area, therefore no specific mitigation measures are required.

8.3.33. The matters above are secured by a Requirement in the **Draft DCO (Document Reference 3.1)** which requires compliance with this FRA.

SCHEME SPECIFIC MODEL ASSESSMENT

8.3.34. As requested by the Environment Agency in their response to the PEIR dated 29th November 2023, further manipulation of the existing Environment Agency's models as presented above (Environment Agency's Thames Estuary Breach Assessment[22] and Environment Agency's Marsh Dykes model[23]) was undertaken to understand the implications of the proposed Scheme on residual flood risk to existing homes, businesses and infrastructure in the flood cell.

8.3.35. The methodology and results of this assessment are presented below.

Methodology

Cory Marsh Dykes Model

8.3.36. The Environment Agency's Marsh Dykes model[23] has been utilised to assess the impact of the Proposed Scheme on flood risk to existing land and property elsewhere for breaches at the two pertinent locations: Great Breach Dyke and Green Level Pumping Stations. This model has been updated to inform this scheme specific assessment and is referred to as the 'Cory Marsh Dykes Model'. The Environment Agency's model was updated to reflect the design of the Proposed Scheme as follows:

- the tide curves were updated to match those within the Cory Thames Estuary Breach Model (as described below);
- the inclusion of the Riverside 1 and Riverside 2 developments in the Proposed Scheme scenario;
- the development platform for the Carbon Capture Facility (land raised above the potential breach level) as discussed above; and
- the inclusion of a surface water drainage strategy (rainfall exclusion polygon across the development platform), as set out in the **Outline Drainage Strategy (Document Reference 7.2)**.

8.3.37. To ensure consistency in the model mesh the baseline scenario (i.e without the Proposed Scheme) was also rerun.

8.3.38. The development platform for the Carbon Capture Facility was represented in the model as a glass wall (i.e. with an infinitely high level) that does not reflect the proposed platform level. This approach was taken to assist the impact assessment of the Proposed Scheme on flood risk elsewhere, instead of impact to the Proposed Scheme itself, noting that the assessment of flood risk to the Proposed Scheme is presented above and informed by the Environment Agency's Thames Estuary Breach Assessment[22] and Environment Agency's Marsh Dykes model[23].

8.3.39. The Proposed Scheme scenarios do not include the Belvedere Power Station Jetty (disused) as this does not have an influence on the results.

Cory Thames Estuary Breach Model

8.3.40. WSP also developed a Site specific model in MIKE by DHI referred to as the 'Cory Thames Estuary Breach Model' to assess the impact of the Proposed Scheme on flood risk to existing land and property elsewhere for breaches at several other locations along the River Thames. The methodology is detailed in **Annex B**.

8.3.41. This modelling assessed the impact of the Proposed Scheme should a breach occur at one of seven locations. The assessment included the Carbon Capture Facility raised platform. The assessment also included Riverside 1 and Riverside 2 in both the baseline and Proposed Scheme scenarios.

8.3.42. The locations of the breaches were identified from the Marsh Dykes Model and in discussions with the Environment Agency. The breach locations cover a distance of approximately 2.25km centred around the Proposed Scheme (**Figure 8-5** and **Annex E**). The locations were selected for the following reasons:

- Breach 1 represents the Great Breach Pumping Station;
- Breach 2 fronts Riverside 2;
- Breach 3 results in a constrained flow path between Riverside 1 and Riverside 2;
- Breaches 4 and 5 are located where the Proposed Jetty comes on land;
- Breach 6 results in a constrained flow path between industrial buildings (i.e. the Iron Mountain Records Storage Facility) to the east of the Site; and
- Breach 7 represents the Green Level Pumping Station.

8.3.43. This model is a worst case residual risk scenario as it does not include the connectivity between the local watercourses that is represented by the Marsh Dykes Models and thus the flood level reduction offered by the network of watercourses across the flood cell or the benefits provided by the Environment Agency's Great Breach and Green Level Pumping Stations during operation.

8.3.44. As per the methodology for the Cory Marsh Dykes Model, the development platform for the Carbon Capture Facility was represented in the model as a glass wall that does not reflect the proposed platform level.

8.3.45. The Proposed Scheme scenarios do not include the Belvedere Power Station Jetty (disused) as this does not have an influence on the results.

Figure 8-5: Cory Thames Estuary Breach Model Breach Locations

Assessment of Proposed Scheme

Cory Marsh Dykes Model

8.3.46. This model shows that the Proposed Scheme does not have an impact on the flood risk across the Thamesmead Flood Cell for both breaches at Great Breach and Green Level Pumping Stations as shown in **Figure 8-6** and **Annex E**. **Figure 8-6a** and **Figure 8-6b** also show the flood difference mapping which include the 0-10mm flood differences. The flood difference map shows that the Carbon Capture Facility has been removed from the floodplain, reflecting the construction of the Proposed Scheme. The flood difference map also shows that Riverside 1 and Riverside 2 are no longer at risk of flooding, reflective of their inclusion in the Cory Marsh Dykes Model but not within the original Environment Agency's Marsh Dykes model[23].

8.3.47. Across large areas of the flood cell there are minor positive and negative fluctuations in flood depths. However, as these are generally adjacent to each other, they reflect the nature of the calculations being undertaken within the model and do not show any overall change. The model therefore demonstrates that should a breach occur at the Great Breach and Green Level Pumping Stations, the Proposed Scheme results in a negligible increase in flood risk to land surrounding the Proposed Scheme.

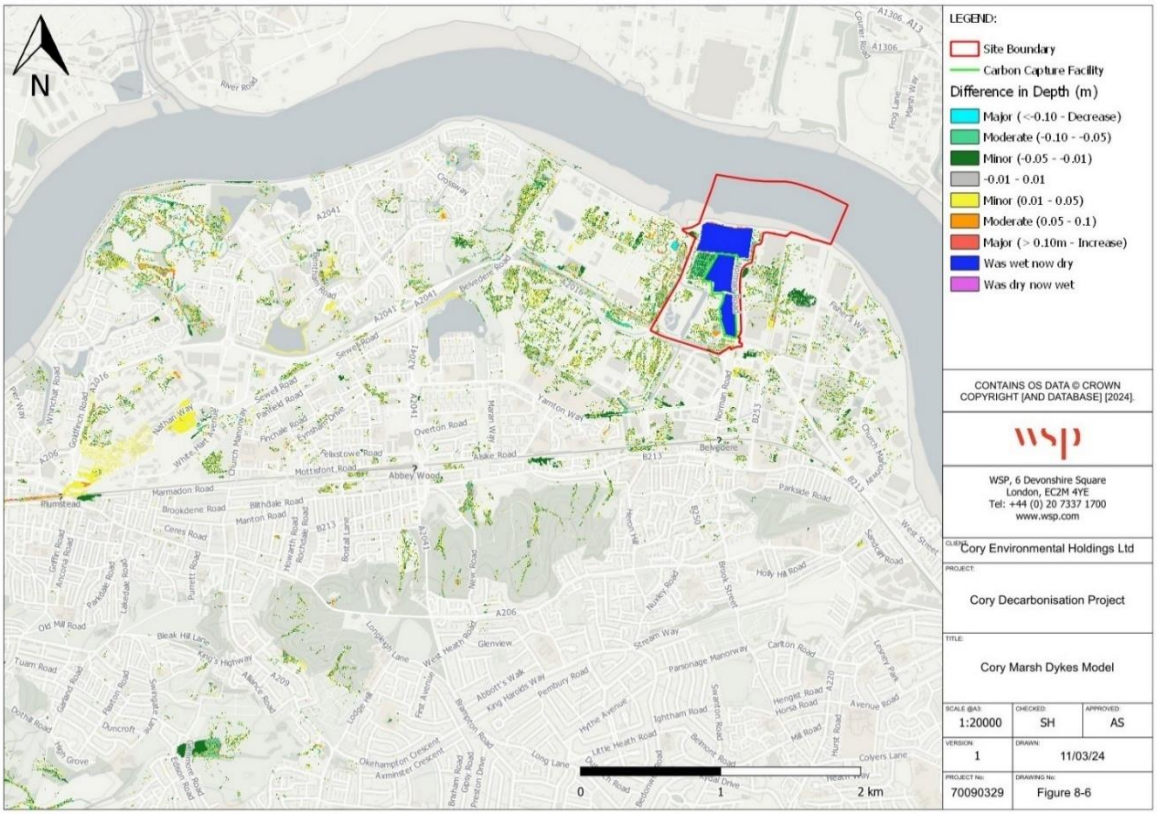

Figure 8-6: Cory Marsh Dykes Model – Breach Analysis

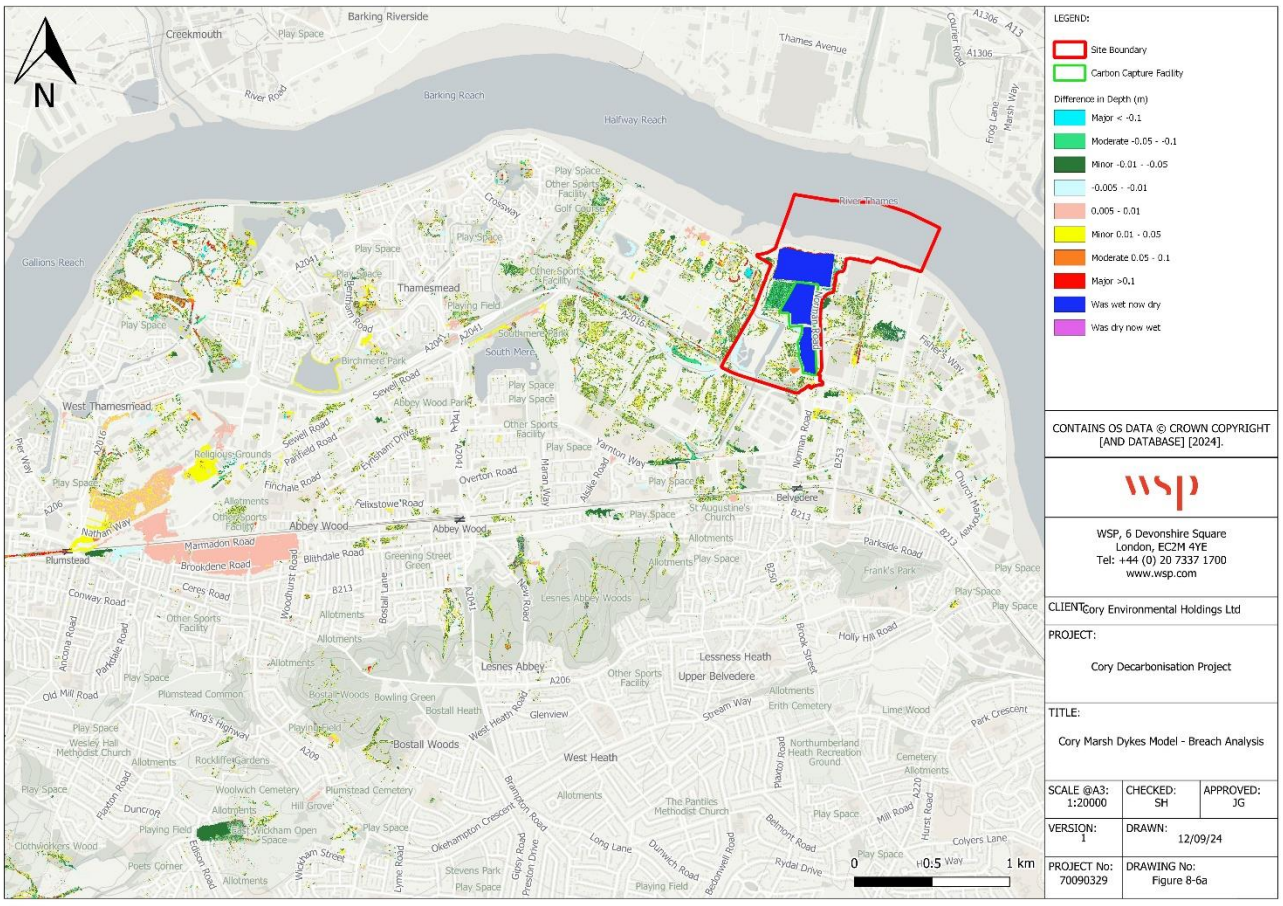

Figure 8-6a: Cory Marsh Dykes Model – Breach Analysis

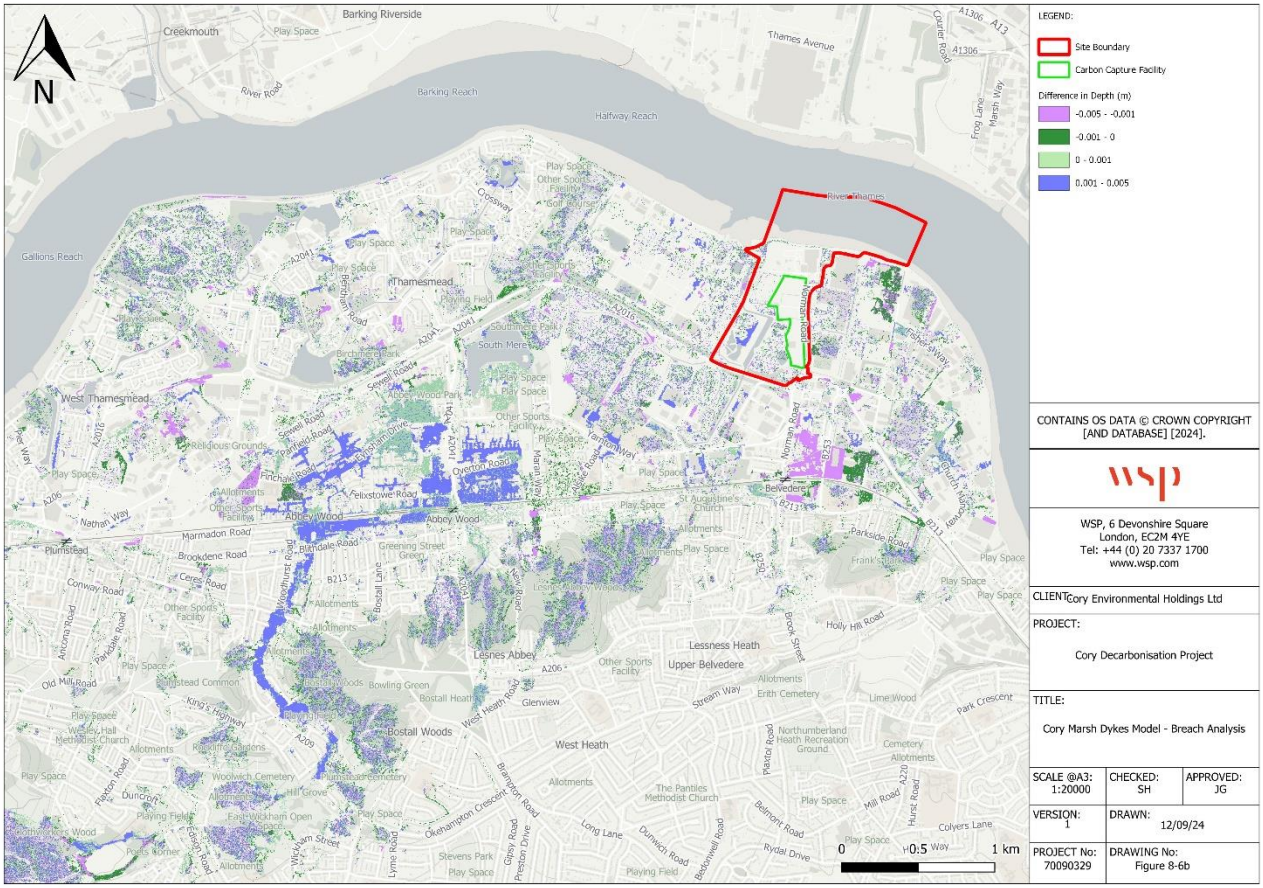

Figure 8-6b: Cory Marsh Dykes Model – Breach Analysis

8.3.48. The Cory Marsh Dykes Model also demonstrates that should a breach occur at Great Breach Pumping Station (i.e. adjacent to the Proposed Scheme) the flood depths result in a negligible flood risk to the Proposed Scheme (i.e. to those areas beyond the development platform of the Carbon Capture Facility) as shown in **Figure 8-7** and **Annex E**.

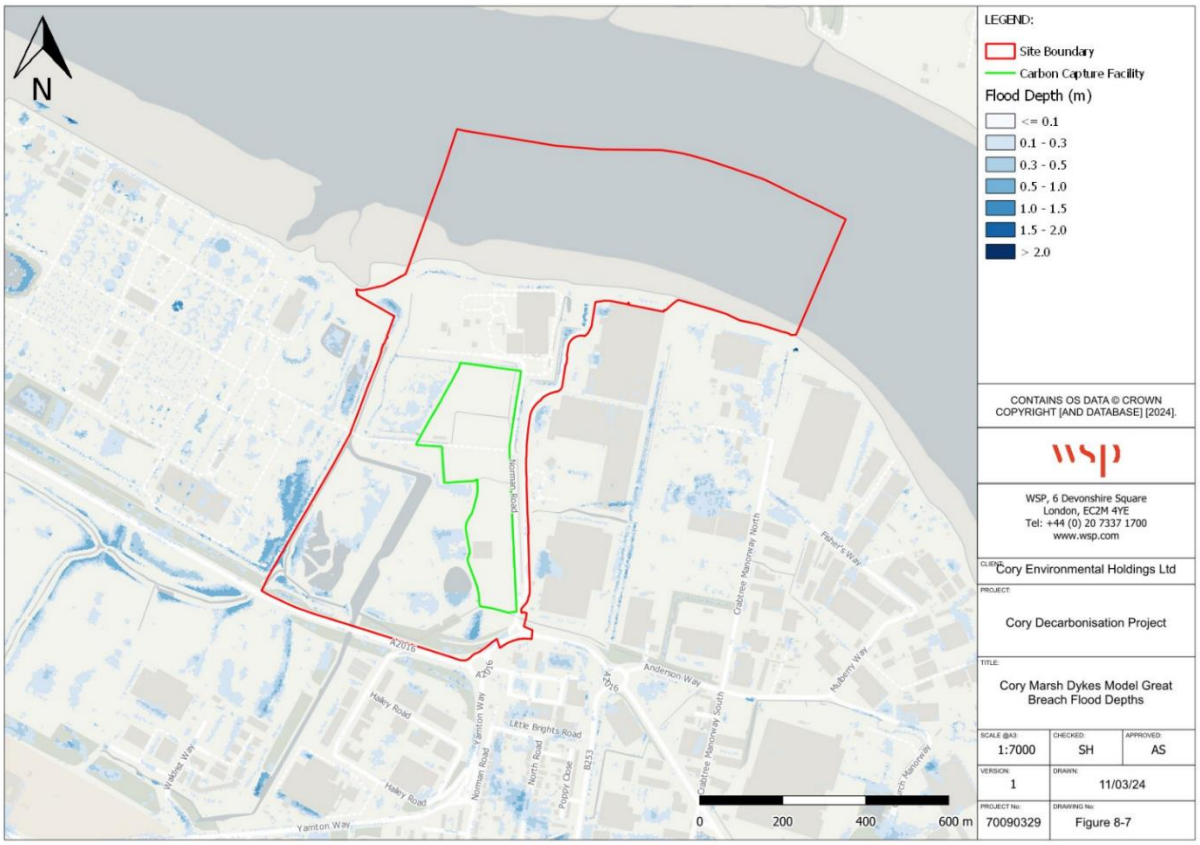

Figure 8-7: Cory Marsh Dykes Model Great Breach Flood Depths

Cory Thames Estuary Breach Model

8.3.49. The flood difference maps (see **Figure 8-8, Figure 8-8a, Figure 8-8b** and **Annex E**) for this model shows that for this scenario the Proposed Scheme results in changes in flood risk in the following areas:

- the Proposed Scheme;
- areas to the west in close proximity to the Proposed Scheme;
- areas to the east in close proximity to the Proposed Scheme;
- areas across the wider flood cell; and
- areas in close proximity to Green Level Pumping Station.

8.3.50. These impacts are further discussed below.

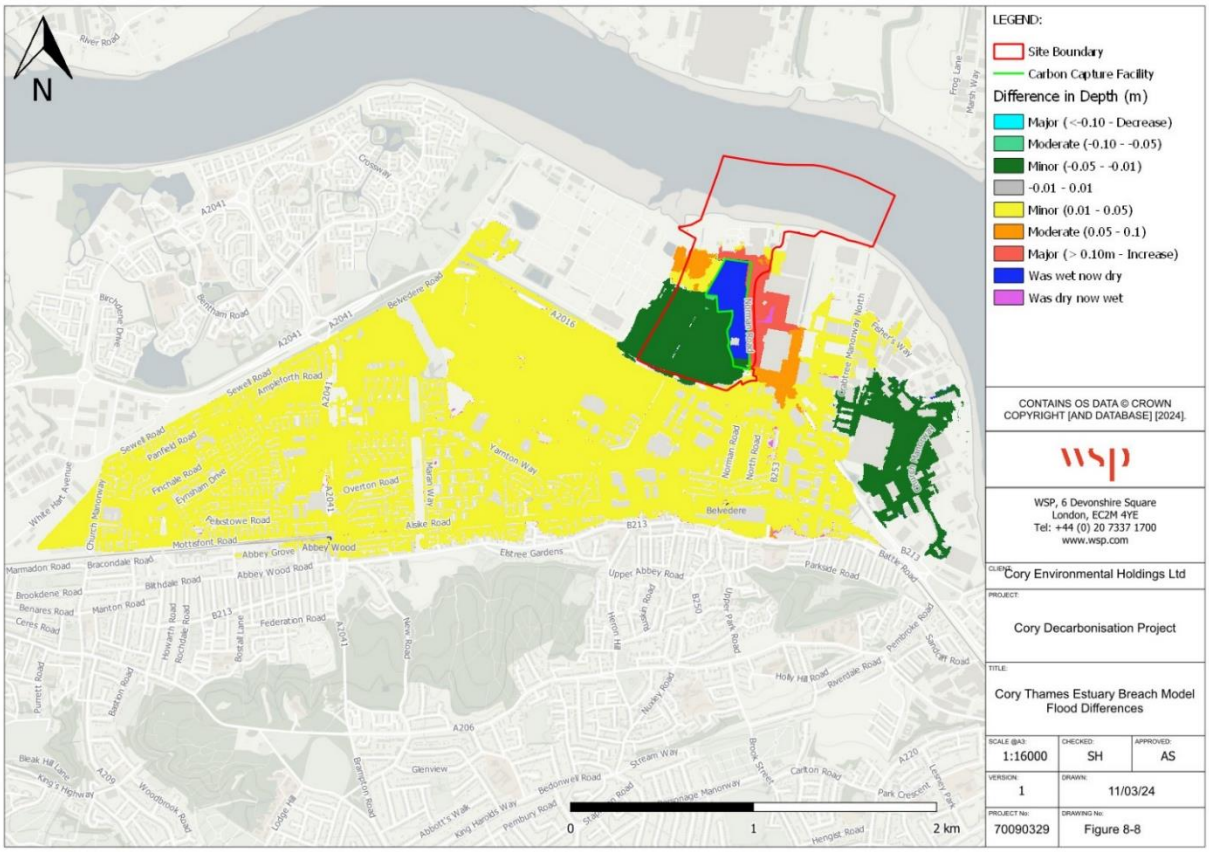

Figure 8-8: Cory Thames Estuary Breach Model Flood Differences

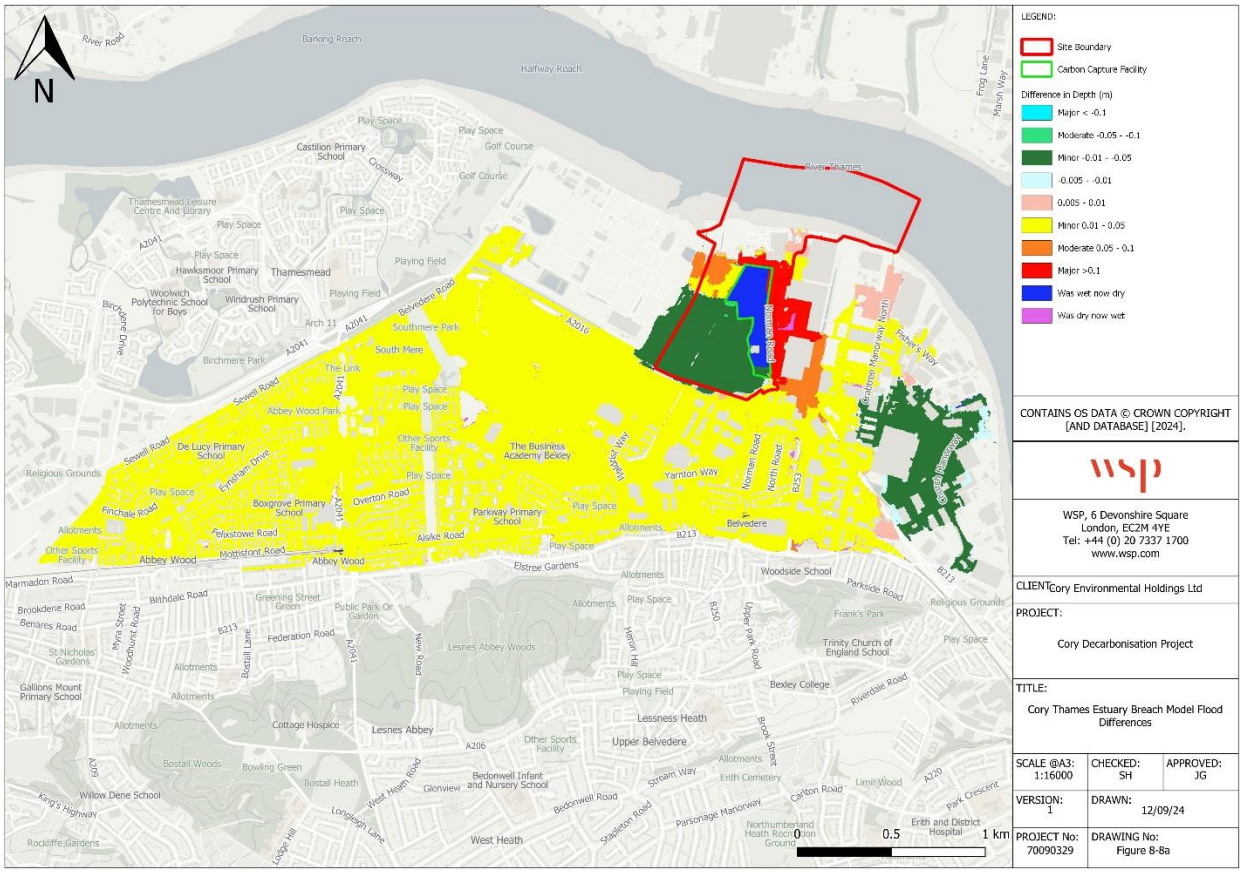

Figure 8-8a: Cory Thames Estuary Breach Model Flood Differences

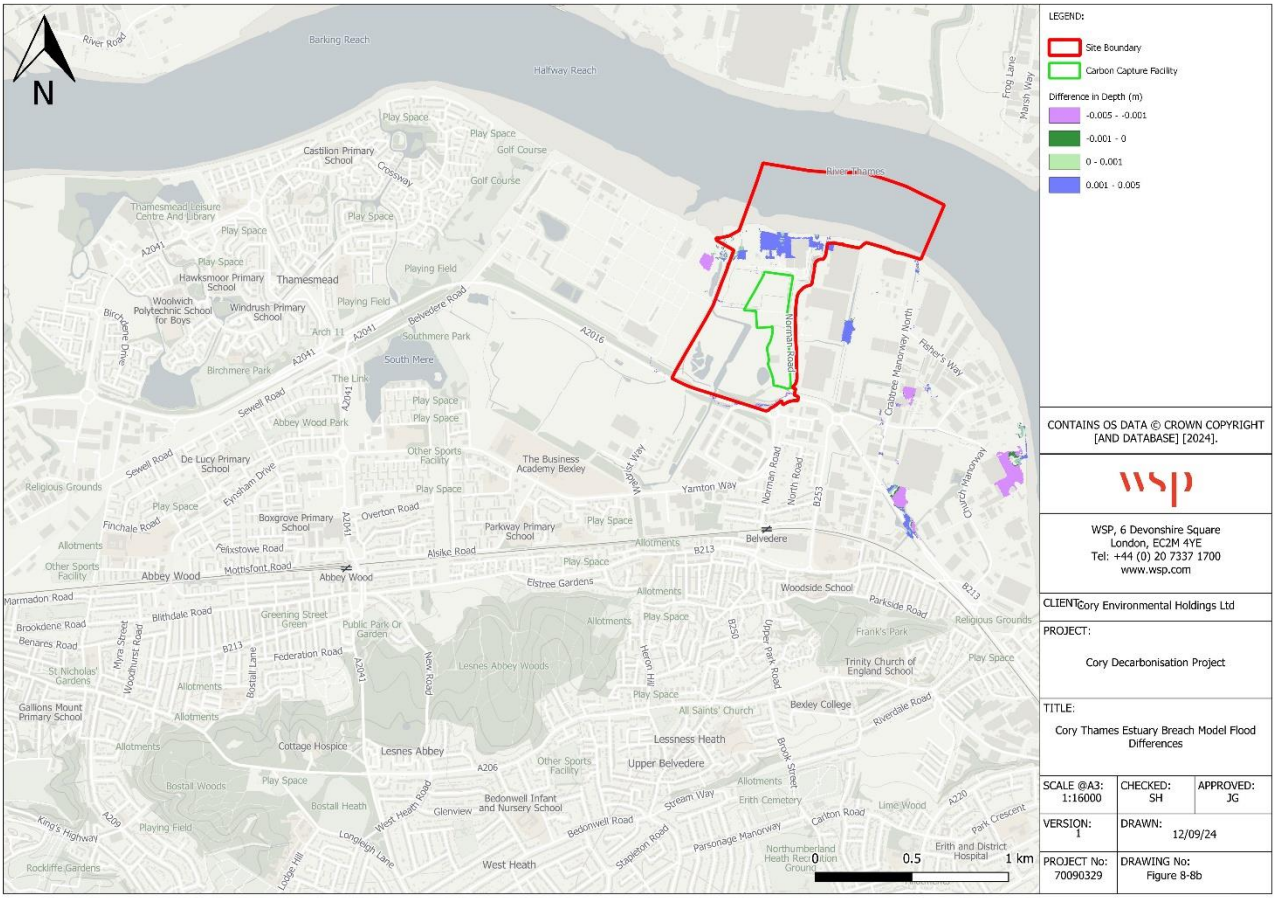

Figure 8-8b: Cory Thames Estuary Breach Model Flood Differences

Change in Breach Location

8.3.51. **Figure 8-9** and **Figure 8-10** and also **Annex E** illustrate the breach locations that result in the maximum flood depth across the flood cell.

8.3.52. The Proposed Scheme scenarios demonstrate that for the vast majority of the flood cell, breach location 6 results in the maximum flood depth for both the baseline and Proposed Scheme scenarios. Breach location 6 is located between Isis Reach and Crabtree Manor Way (Iron Mountain Records Storage Facility and the Lidl Belvedere Regional Distribution Centre). In the Proposed Scheme scenario, this also becomes the critical breach for land between Bronze Age Way and Yarnton Way. The only other notable change is the area around the Carbon Capture Facility where the maximum flood depth changes from breach location 4 to breach location 3.

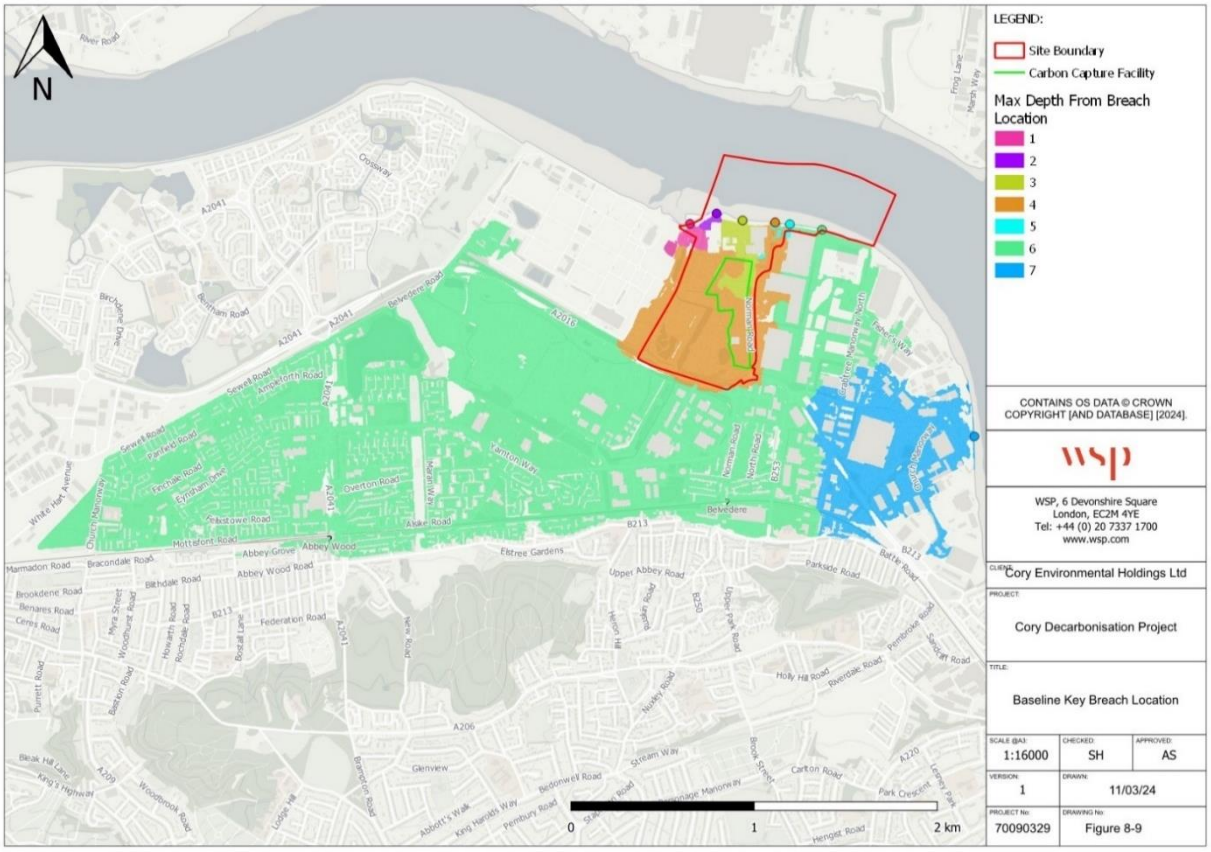

Figure 8-9: Baseline Key Breach Locations

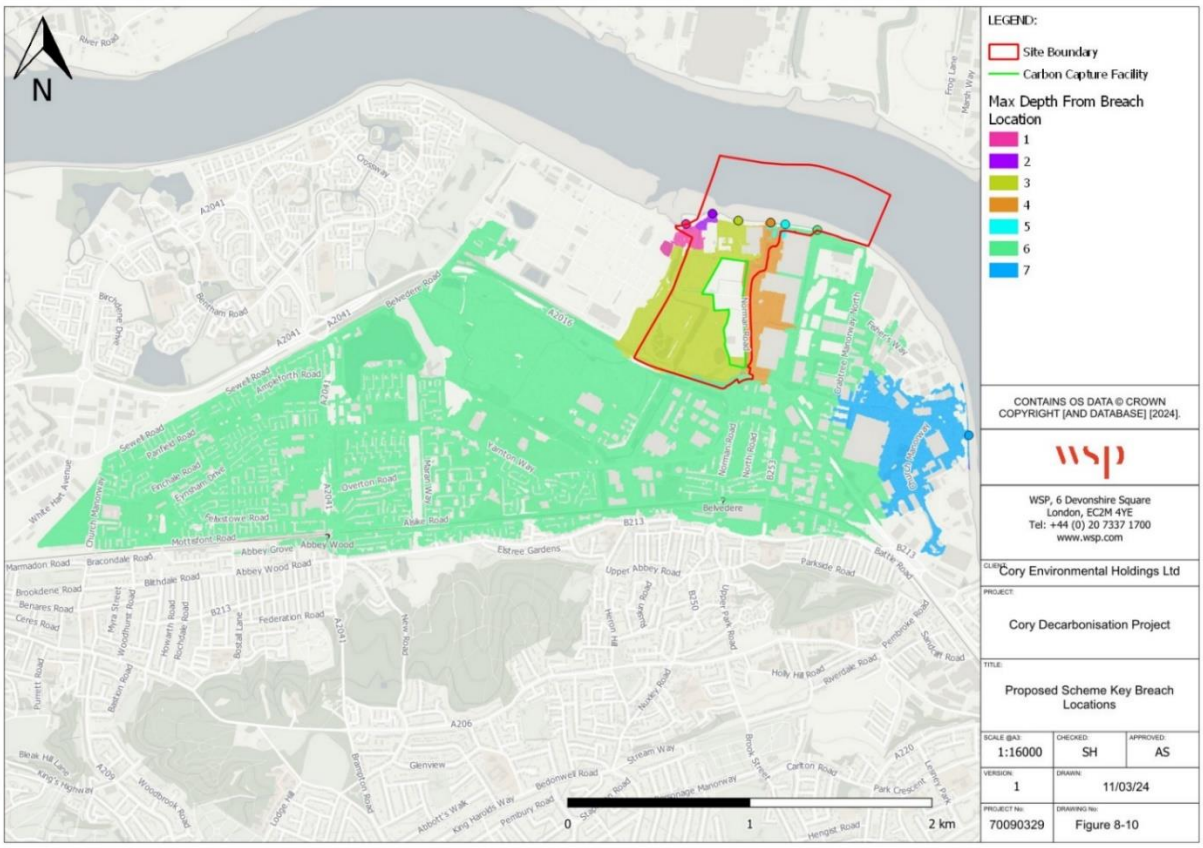

Figure 8-10: Proposed Scheme Key Breach Locations

Carbon Capture Facility

8.3.53. **Figure 8-8** and **Annex E** show the flood difference map between the baseline and Proposed Scheme scenario. This shows that the Carbon Capture Facility has been removed from the floodplain due to the raising of the development platform, however as discussed above the platform has been represented as a glass wall and does not reflect the proposed platform levels.

8.3.54. The modelling indicates that should a breach of the flood defences occur at breach location 3 (between Riverside 1 and Riverside 2), then the flood waters in some locations will reach levels greater than the proposed platform levels as specified in **Paragraph 8.2.15**. This is a result of the flood mitigation measures implemented for both Riverside 1 and Riverside 2, which specified raising the platform levels for these developments above the breach flood level. As a result of these mitigation measures, floodwaters are channelled between these units and then increase in height as they come into contact with the Proposed Scheme platform which acts as a barrier to flows. This is shown in **Figure 8-11** and **Annex E**.

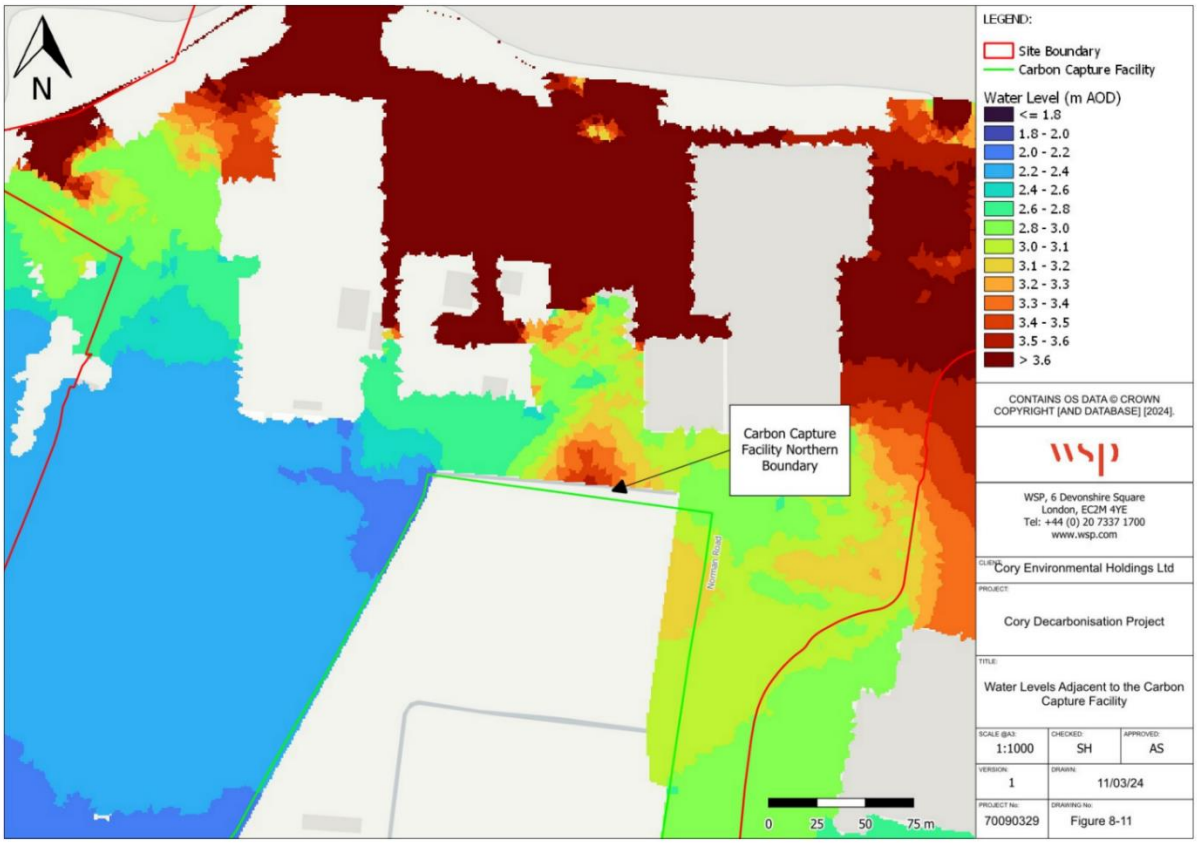

Figure 8-11: Water Levels Adjacent to the Carbon Capture Facility

8.3.55. The peak breach water level within the Site Boundary as modelled in the Proposed Scheme scenario is 3.52m AOD adjacent to the northern boundary of the proposed platform. This would be above the proposed platform level that has a minimum proposed level of 2.8m AOD. Breach water levels of greater than 2.8m AOD are also indicated along the northern and eastern boundaries of the development platform. Therefore, additional mitigation is required to manage the risks associated with a breach at these locations.

8.3.56. It is therefore proposed that a Flood Defence Wall be located along the top of the platform to ensure that the platform is protected to a minimum height of 300mm above the maximum flood level (noting the flood level decreases with distance from Riverside 1 and Riverside 2). This wall could tie into the proposed buildings, with demountable defences across the access roads as required.

Areas to the West of the Carbon Capture Facility, within the Site Boundary and in Close Proximity to the Proposed Scheme

8.3.57. The Proposed Scheme scenario flood difference map (see **Figure 8-8** and **Annex E**) demonstrates that the areas to the immediate west of the Carbon Capture Facility, within and immediately adjacent to the Site Boundary (the Mitigation and Enhancement Area including parts of Crossness Local Nature Reserve) will experience a minor reduction in peak flood levels of up to 50mm. This area includes the Great Breach Pumping Station and grazing land. The change in breach water levels is not expected to change the operation of the pumping station. The Proposed Scheme scenario flood difference map (see **Figure 8-8** and **Annex E**) also

demonstrates a minor to moderate increase in water levels of up to 100mm to the west of the Carbon Capture Facility, within and immediately adjacent to the Site Boundary. This comprises the Mitigation and Enhancement Area and parts of Crossness LNR, with no buildings or other infrastructure within the impacted zone. Given the water compatible nature of this land and the presence of the existing pumping station, the impact is not considered significant, and no mitigation is deemed to be required.

Areas to the East of the Carbon Capture Facility, within the Site and in Close Proximity to the Proposed Scheme

8.3.58. The Proposed Scheme scenario flood difference map (see **Figure 8-8** and **Annex E**) demonstrates an increase in breach water levels in and around the commercial properties in Isis Reach (Iron Mountain Records Storage Facility, Asda ASC Recycling Centre and Asda Belvedere Distribution Centre). However, this increase considers the maximum increase at the most critical breach location for these properties. A review of existing breach water levels at these properties has been undertaken for other breach locations and indicates an overall negligible increase in breach water levels. This is shown in **Table 8-3** that demonstrates a maximum increase in breach water level of 10mm, taking into account predicted breach water levels at other breach locations as assessed in the baseline and Proposed Scheme modelling.

Table 8-3: Differences in Breach Water Levels in the Area Immediately East of the Proposed Scheme

Location	Ground Level (m AOD)	Baseline Maximum Breach Water Level (m AOD)	Proposed Scheme Maximum Breach Water Level (m AOD)	Maximum Difference (m)
Iron Mountain Records Storage Facility	2.75	4.90	4.90	0.00
Asda ASC Recycling Centre	2.78	4.46	4.46	0.00
Asda Belvedere Distribution Centre	1.61	2.53	2.63	0.10

8.3.59. Existing (baseline) breach water levels at the properties along Isis Reach are modelled to have a minimum depth of 0.92m. This is likely to pose internal flood risk to these properties. A slight increase in breach water level as a result of the Proposed Scheme (as presented in **Table 8-3)** is not predicted to pose increased flood risk to these properties, noting that this risk would only occur follow a breach of the River Thames Flood Defences.

Areas Across the Wider Flood Cell

8.3.60. The Proposed Scheme scenario flood difference map shows that across the wider flood cell the Proposed Scheme results in a minor change in flood levels, with a predicted increase of between 10mm and 50mm following a breach of the River Thames Flood Defences.

8.3.61. A GIS based interrogation of the flood levels, elevations and differences has been undertaken at several key locations across the flood cell (see **Figure 8-12** and **Annex E**).

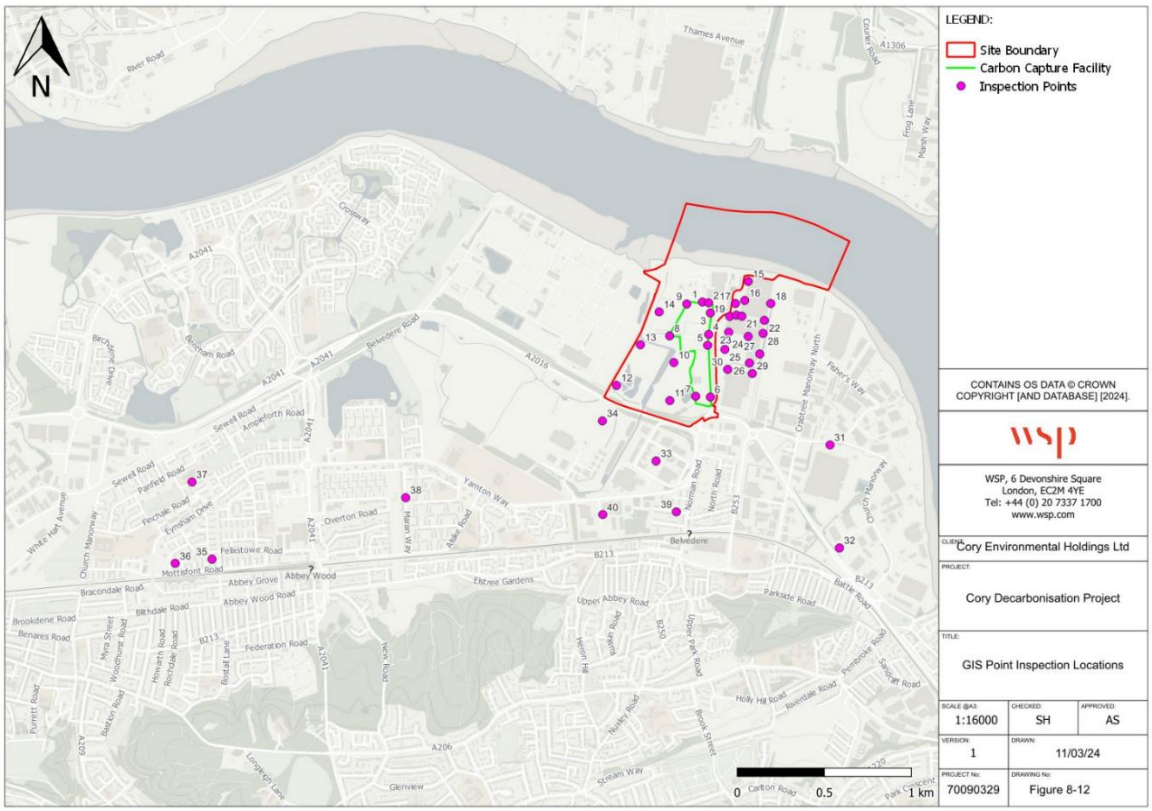

Figure 8-12: GIS Point Inspection Locations

8.3.62. This indicated an increase in water level within the wider flood cell of approximately 14mm. This is 4mm above the 10mm threshold associated with model tolerance (i.e. the level at which uncertainty is applied to cover differences in the calculations and other aspects of hydraulic modelling).

8.3.63. This minor change in flood levels would not result in any adverse impacts to third parties across the flood cell as the flood depths during the design event following a breach of the River Thames Flood Defences are generally greater than 200mm, and the vast majority are greater than 300mm. **Figure 8-13** shows the isolated areas within the wider flood cell area that have an increase in flood depth of 14mm.

8.3.64. Observations made during the Site walkover of property thresholds and likely internal flood levels confirmed that these properties would be internally flooded during this event in the baseline scenario. Therefore, the Proposed Scheme will make no measurable difference to the internal flood depths should a breach occur in the River Thames Flood Defences.

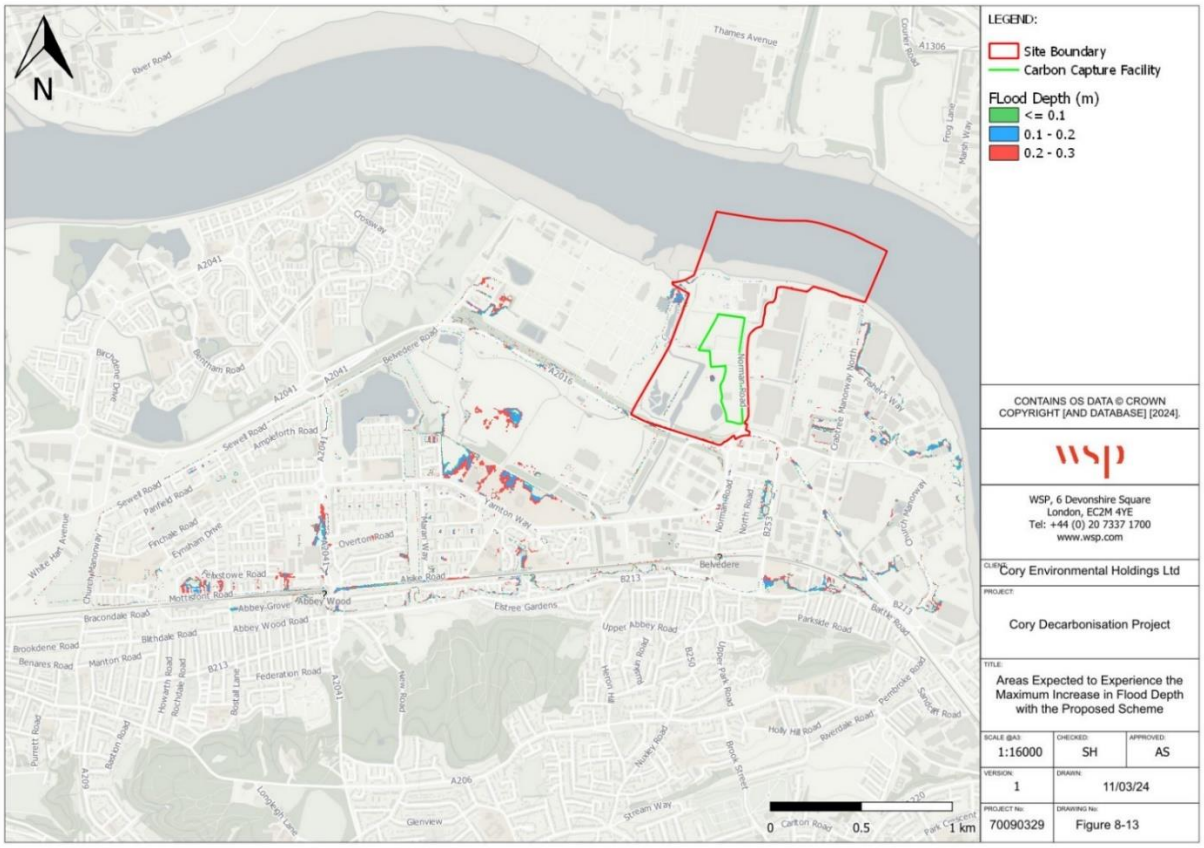

Figure 8-13: Areas Expected to Experience the Maximum Increase in Flood Depth with the Proposed Scheme

Areas in Close Proximity to Green Level Pumping Station

8.3.65. The Proposed Scheme scenario flood difference map demonstrates that in the area closest to Green Level Pumping Station, the Proposed Scheme would result in a reduction in maximum water levels of between 10mm and 50mm following a breach event in the River Thames Flood Defences.

Summary of Breach Water Levels and Flood Depths

8.3.66. **Table 8-4** summarises the modelled breach water levels and flood depths across the Proposed Scheme and wider flood cell at the key point locations shown in **Figure 8-12** following a breach event in the River Thames Flood Defences. This considers the assessment completed using the Cory Thames Tidal Breach Model and Cory Marsh Dykes Model.

Table 8-4: Proposed Scheme Specific Modelled Breach Water Levels and Flood Depths

Location Point	Cory Thames Tidal Breach Model				Cory Marsh Dykes Model							
	Key Breach Location				Great Breach Pumping Stations				Green Level Pumping Stations			
	Breach Water Level (m AOD)		Flood Depth (m)		Breach Water Level (m AOD)		Flood Depth (m)		Breach Water Level (m AOD)		Flood Depth (m)	
	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme
1	2.20	3.52	1.09	2.40	1.03	1.03	0.09	0.04	1.03	1.03	0.01	0.04
2	2.38	3.10	1.68	2.40	1.12	1.02	0.23	0.20	1.02	1.02	0.21	0.20
3	2.29	3.14	1.07	1.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	2.22	2.89	0.77	1.43	1.60	1.62	0.00	0.00	1.62	1.62	0.00	0.00
5	2.12	2.76	0.38	1.02	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	2.09	2.04	1.14	1.09	1.58	1.57	0.00	0.00	1.57	1.57	0.00	0.00
7	2.09	2.07	1.71	1.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	2.12	2.06	1.35	1.29	1.03	0.96	0.00	0.00	0.81	0.81	0.00	0.00
9	2.19	2.19	1.15	1.15	0.93	0.96	0.13	0.24	0.99	0.99	0.00	0.27
10	2.10	2.07	1.35	1.33	0.71	0.71	0.00	0.00	0.71	0.71	0.00	0.00
11	2.09	2.07	1.65	1.62	0.46	0.46	0.11	0.14	0.47	0.47	0.14	0.11
12	2.10	2.08	3.10	3.08	0.28	0.27	0.39	0.38	0.27	0.27	0.39	0.39
13	2.11	2.08	0.87	0.85	1.39	1.42	0.00	0.00	1.46	1.46	0.00	0.00
14	2.17	2.23	1.59	1.65	0.90	0.85	0.12	0.05	0.85	0.85	0.12	0.02
15	4.36	4.37	2.42	2.42	2.24	2.24	0.43	0.43	2.24	2.24	0.43	0.43
16	3.58	3.59	1.91	1.92	2.15	2.15	0.36	0.36	2.15	2.15	0.36	0.36
17	3.42	3.44	0.92	0.93	2.26	2.41	0.00	0.00	2.41	2.41	0.00	0.00
18	4.59	4.59	3.07	3.07	1.52	1.23	0.00	0.00	1.51	1.51	0.00	0.00

Location Point	Cory Thames Tidal Breach Model				Cory Marsh Dykes Model							
	Key Breach Location				Great Breach Pumping Stations				Green Level Pumping Stations			
	Breach Water Level (m AOD)		Flood Depth (m)		Breach Water Level (m AOD)		Flood Depth (m)		Breach Water Level (m AOD)		Flood Depth (m)	
	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme
19	2.59	2.96	0.88	1.26	1.86	1.85	0.03	0.03	1.86	1.86	0.03	0.03
20	3.34	3.37	0.84	0.86	2.17	2.18	0.00	0.00	2.18	2.18	0.00	0.00
21	3.47	3.47	1.10	1.10	2.02	2.02	0.02	0.02	2.02	2.02	0.02	0.02
22	4.32	4.32	2.11	2.11	1.95	2.02	0.00	0.00	2.02	2.02	0.00	0.00
23	2.12	2.68	0.35	0.90	2.04	2.04	0.00	0.00	2.04	2.04	0.00	0.00
24	2.12	2.69	1.29	1.86	1.88	1.88	0.10	0.12	1.88	1.88	0.12	0.10
25	2.13	2.67	0.49	1.03	1.45	1.47	0.07	0.10	1.43	1.43	0.10	0.05
26	2.20	2.44	1.04	1.28	1.26	1.26	0.01	0.01	1.24	1.24	0.01	0.02
27	3.18	3.19	1.77	1.77	1.04	1.06	0.10	0.09	1.03	1.03	0.09	0.03
28	4.34	4.34	2.47	2.47	1.79	1.82	0.01	0.00	1.81	1.81	0.02	0.00
29	2.52	2.60	1.60	1.67	0.94	0.94	0.00	0.00	0.92	0.92	0.00	0.00
30	2.10	2.61	0.79	1.31	1.40	1.39	0.00	0.00	1.40	1.40	0.00	0.00
31	2.31	2.29	1.10	1.08	1.12	1.12	0.00	0.00	1.12	1.12	0.00	0.00
32	2.20	2.18	0.41	0.39	1.65	1.64	0.00	0.00	1.64	1.64	0.00	0.00
33	1.99	2.01	1.45	1.48	0.64	0.64	0.13	0.13	0.64	0.64	0.13	0.13
34	1.83	1.84	0.94	0.95	0.82	0.86	0.00	0.00	0.85	0.85	0.00	0.00
35	1.80	1.81	0.28	0.29	1.46	1.46	0.04	0.04	1.46	1.46	0.04	0.04
36	1.80	1.81	0.18	0.19	1.59	1.59	0.00	0.00	1.59	1.59	0.00	0.00
37	1.80	1.81	1.05	1.07	0.67	0.67	0.09	0.09	0.67	0.67	0.09	0.09

Location Point	Cory Thames Tidal Breach Model				Cory Marsh Dykes Model							
	Key Breach Location				Great Breach Pumping Stations				Green Level Pumping Stations			
	Breach Water Level (m AOD)		Flood Depth (m)		Breach Water Level (m AOD)		Flood Depth (m)		Breach Water Level (m AOD)		Flood Depth (m)	
	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme	Baseline	With Proposed Scheme
38	1.82	1.83	0.91	0.92	0.94	0.94	0.00	0.00	0.94	0.94	0.00	0.00
39	2.03	2.07	1.05	1.09	0.95	0.95	0.03	0.03	0.95	0.95	0.03	0.03
40	1.89	1.91	1.24	1.26	0.45	0.45	0.16	0.16	0.45	0.45	0.16	0.16

ADDITIONAL MITIGATION

8.3.67. The Cory Thames Estuary Breach Model provides the worst case scenario in terms of predicted increase in flood risk to people, property and infrastructure elsewhere as a result of the Proposed Scheme should a breach in the River Thames Flood Defences occur. The model also indicated a localised increase in flood risk to the Proposed Scheme compared to that predicted using the Environment Agency's Thames Estuary Breach model[22], principally due to the inclusion of Riverside 1 and Riverside 2.

8.3.68. As discussed above, predicted flood risk is expected to be worse in the Cory Thames Estuary Breach Model compared to the Cory Marsh Dykes Model as the Cory Thames Estuary Breach Model (that is based on the Environment Agency's Thames Estuary Breach model[22]) only comprises a 2D domain and does not include representation of surface water features or operation of the Great Breach Dyke and Green Level Pumping Stations that have been considered in the Environment Agency's Marsh Dykes Model[23].

8.3.69. Information from Cory Thames Estuary Breach Model has been used to inform recommended additional mitigation as this represents the worst case scenario.

8.3.70. The impacts to people, property and infrastructure elsewhere in the flood cell as a result of the Proposed Scheme should a breach in the River Thames Flood Defences occur are not considered to be significant. No additional mitigation is therefore deemed to be required.

8.3.71. The Cory Thames Estuary Breach Model demonstrated that should a breach in the River Thames Flood Defences occur between Riverside 1 and Riverside 2, then the depth of flood waters adjacent to the Carbon Capture Facility development platform would be greater than the proposed platform levels of 2.8m – 3.1m AOD. This is caused by flood waters being constrained between Riverside 1 and Riverside 2 and channelled directly towards the platform. Additional mitigation is therefore recommended that would go beyond that included as embedded mitigation, whilst also considering the vulnerability of different aspects of the Proposed Scheme and recognition that not all aspects of the Proposed Scheme required the same standard of protection. As such the detailed design will need to provide for a risk-based approach to manage this risk (including safe refuge areas for operational staff) and any associated pollution risks associated with flooding of elements of the Proposed Scheme that could pose pollution risk if inundated with flood waters following a breach event.

8.3.72. The approach to managing this localised increase in flood risk that goes beyond the embedded mitigation of the Proposed Scheme will be set out in the full EPRP(s) with the trigger levels determined as part of the detailed design of the Proposed Scheme. The full EPRP(s) will be developed in accordance with the **Outline EPRP (Document Reference 7.11)**, which is secured through a requirement in the **Draft DCO (Document Reference 3.1)**.

8.3.73. Access to and from the Proposed Scheme could be hindered during a flood event. It is not practicable to raise the height of the surrounding road network. As above, the

risk of unsafe access and egress will be set out in the full EPRP(s) with the trigger levels determined as part of the detailed design of the Proposed Scheme. The full EPRP(s) will be developed in accordance with the **Outline EPRP (Document Reference 7.11)**, which is secured through a requirement in the **Draft DCO (Document Reference 3.1)**.

8.4. OVERTOPPING OF THE RIVER THAMES FLOOD DEFENCES

8.4.1. The standard of protection provided by the River Thames Flood Defences would effectively decrease over time without intervention measures as sea levels rise as a result of the effects of climate change. This could lead to overtopping of the River Thames Flood Defences during the design event (1 in 200 year plus climate change). However, the Environment Agency's TE2100 Plan[37] details that the defences will be managed to keep pace with the impacts of climate change and maintain the standard of protection provided by the defences.

8.4.2. Table 7.1 of the TE2100 Plan (included in **Annex A)** requires the defences at node 3.9 (the most appropriate node in relation to the Proposed Scheme) to be raised to a level of:

- 7.70m AOD for the plan period 2070 – 2120 (into which the design life of the Proposed Scheme falls); and
- 8.2m AOD for the plan period 2120 – 2170 (which is the period immediately after the period into which the design life of the Proposed Scheme falls).

8.4.3. Should overtopping of the River Thames Flood Defences occur during any events that exceed the standard of protection, then the resultant flood waters behind the defences would be expected to be lower than those predicted for the breach event and thus suitably mitigated by the mitigation in place for a breach event.

8.5. OVERTOPPING AND FLOW CONSTRAINTS ASSOCIATED WITH THE PROPOSED JETTY

8.5.1. The design of the Proposed Jetty has been informed by the Environment Agency's TE2100 water levels[24] to set an appropriate base level of the Proposed Jetty above predicted flood levels. The relevant nodes for the TE2100 in-channel water levels are shown in **Figure 8-14** and **Annex E**; node 3.10 is the most representative for the Proposed Scheme.

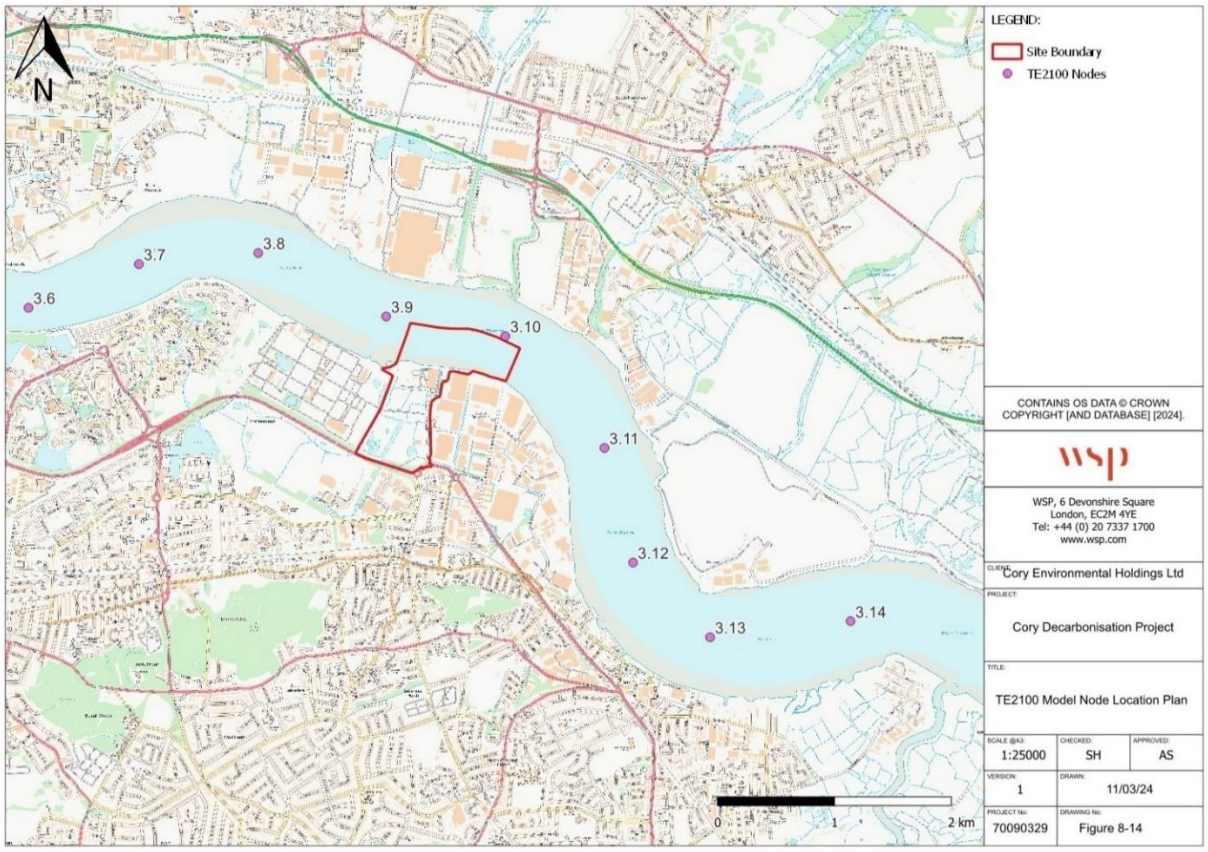

Figure 8-14: TE2100 Model Node Location Plan

8.5.2. The levels presented in the Environment Agency's TE2100 water levels[24] are for still water levels only. An uplift has therefore been applied for wave height and freeboard to establish the design level of the Proposed Jetty. At this location the 50 year and 100 year Significant Wave Height (Hs) is assumed to be 0.3m and 0.5m, respectively. Based on the TE2100 water level, the following extreme water levels (m AOD) including wave height have been estimated as shown in **Table 8-5**.

Table 8-5: Design Extreme In-Channel Water Levels

Levels	2100 (m AOD)
TE2100 Level	6.70
Including 50 year Hs (+0.3m)	7.00
Including 100 year Hs (+0.5m)	7.20

8.5.3. The base of the Proposed Jetty will be set at 7.6m AOD, which is 0.4m above the Environment Agency's TE2100 design water level(including allowance for the 100 year significant wave height (i.e. there is 0.4m freeboard/air gap). Thus, it is deemed to be safe for operation of the Proposed Scheme. The landside elevated process pipe bridge and any flood sensitive equipment would be located at deck level or above.

8.5.4. It is considered that the design of the Proposed Jetty is unlikely to have any significant impact on flood flows for the design event, due to the relatively small nature of the Proposed Jetty compared to the water surface. Therefore, no specific embedded or additional mitigation is required for this aspect.

8.6. FLOODING FROM FLUVIAL ONLY FLOOD RISK

8.6.1. **Figure A** in **Annex E** shows the fluvial extents of Flood Zone 3a and Flood Zone 3b. Fluvial Flood Zone 3 comprises both Flood Zone 3a and Flood Zone 3b. The fluvial only extents of Flood Zone 3a and Flood Zone 3b have been derived from the Environment Agency's Marsh Dykes hydraulic model[23] using just the fluvial flooding mechanisms (rather than the combined surface water and fluvial extents that are also represented in the model). The flood extents shown in **Section 8.7** of this FRA use the combined surface water and fluvial flooding mechanisms from the Marsh Dykes hydraulic model[23], and therefore are different to those presented in **Figure A**. Flood Zone 3b is also shown in the mapping provided in the London Borough of Bexley Level 1 Strategic Flood Risk Assessment (SFRA) (2022)[9] and is based on the Environment Agency's Marsh Dykes hydraulic model[23].

8.6.2. Flood Zone 3a is defined in the PPG for Flood Risk and Coastal Change[27] (paragraph 078) as land having a 1% or greater annual probability of fluvial flooding.

8.6.3. Flood Zone 3b (functional floodplain) is defined in the PPG for Flood Risk and Coastal Change[27] (Paragraph 078) as land where water has to flow or be stored in times of flood, but that the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters.

8.6.4. A review of the fluvial only model outputs indicates that the fluvial only Flood Zone 3b extents are largely the same as the modelled fluvial only Flood Zone 3a extents (i.e. the 1% annual probability extents). The only differences relate to the watercourses located along the eastern boundary of the Carbon Capture Facility. These areas have been removed from the Flood Zone 3b extents as the watercourses are culverted in this area and therefore are not considered to have a functional floodplain.

8.6.5. Review of the fluvial mapped outputs and model cross sections (1D part of the Marsh Dykes hydraulic model[23]) indicates that the mapped flood extents of fluvial only Flood Zone 3b are largely limited to the channel cross sections included within the model and do not indicate flooding that extends beyond the top of the bank of channel.

8.6.6. The assessment of flood risk associated with works in areas that are mapped as Flood Zone 3b has given consideration to the reference to floodplain storage areas as provided in the PPG[27] (Paragraph 049), that states "*The loss of floodplain storage is less likely to be a concern in areas benefitting from appropriate flood risk management infrastructure or where the source of flood risk is solely tidal*". Flooding in the Study Area for the Proposed Scheme is tidally dominated and protected by flood defences. Water level in the Marsh Dykes network is also managed by the Pumping Stations. A detailed description of the Marsh Dykes is provided in **Paragraphs 5.2.6** to **5.2.8** of this FRA.

8.6.7. A review of the information presented above therefore indicates that the fluvial only Flood Zone 3b extents would largely be limited to the watercourse channels, and that any loss of these areas (including that located outside of the watercourse channels albeit this is minimal) and may not strictly be considered as loss of floodplain storage as defined by the PPG[27].

8.6.8. Mitigation to manage any potential increase in fluvial flood risk and compensate for the loss of identified floodplain that emerges out of the channel has been proposed and is summarised below:

- maintaining the alignment and open channel of Norman Road Stream (MR4) in the northeast of the Carbon Capture Facility;
- maintaining the alignment and open channel of the watercourses (OW16 and OW11(b)) that flow adjacent to the western boundary of the Carbon Capture Facility;
- maintaining the alignment and open channel of other watercourses within the Site Boundary that are outside of the footprint of the Carbon Capture Facility;
- maintaining hydraulic connectivity of ditches that will be infilled (OW4, OW15 OW11(a) and OW18, as described in **Paragraph 10.1.2** of this FRA) beneath the footprint of the Carbon Capture Facility; and
- providing compensation of the loss of mapped fluvial flood extent that encroaches to within the footprint of the Carbon Capture Facility; and maintaining a suitable offset to Norman Road Stream (MR4) and the watercourses that flow adjacent to the western boundary of the Carbon Capture Facility (OW16 and OW11(b)).

8.6.9. Compensation for the loss of floodplain will be provided within the detailed design of the Proposed Scheme and approved by the Environment Agency and LBB. An example of how this could be achieved could include thin strips (i.e., easement strips which are 5m minimum from the top of bank) alongside Norman Road Stream (MR4) and the watercourses along the western boundary (OW16 and OW11(b)) of the Carbon Capture Facility, with appropriate gradients and a length and depth that would allow for full compensation to be delivered. This would allow flood waters to be trapped in the lower lying area between the top of bank and the development platform.

8.6.10. This approach, or similar, will enable the loss of flood plain to be sufficiently compensated for within the design of the Carbon Capture Facility, and ensure that there is no overall net loss of fluvial floodplain storage. **Annex C** contains a drawing showing an indicative option for the outline floodplain compensation proposals relevant to Norman Road Stream (MR4).

8.6.11. The watercourses discussed above (i.e. those that are indicated to have potential fluvial ingress into the area of the proposed Carbon Capture Facility) are not proposed to be infilled as part of the Proposed Scheme. The location and proposals for the infilling of watercourses/ditches that cross the area of the proposed Carbon Capture Facility discussed in **Section 10** of this FRA. The watercourses that are proposed to be infilled are minor watercourses that cross the area of the proposed

Carbon Capture Facility and would provide a local drainage function to adjacent land. The loss of these features is therefore not predicted to change or increase fluvial flood risk within the Proposed Scheme or elsewhere as the function of these features will be replaced by the proposed **Outline Drainage Strategy (Document Reference 7.2)**, designed to attenuate flows to the greenfield run-off rate.

8.7. FLOODING FROM COMBINED FLUVIAL AND PLUVIAL FLOOD RISK

ENVIRONMENT AGENCY'S RISK OF FLOODING FROM SURFACE WATER MAP

8.7.1. The Environment Agency's Risk of Flooding from Surface Water Map[4] (see **Figure 8-15** and **Annex E**) shows the flood risk from surface water sources. In the area of the Proposed Scheme the mapping shows limited areas of surface water flooding within the Site Boundary with the extents correlating to localised low lying areas and the Great Breach Lagoon. The mapping suggests there are no overland flow routes that pass through the Site Boundary (with the exception of identified ordinary watercourses and main rivers).

8.7.2. It is understood that LBB has not updated this mapping with any additional local data since its publication by the Environment Agency in 2013. Therefore, the modelling and mapping is based upon the Environment Agency's 2012 composite Digital Terrain Model (DTM) (i.e. LiDAR obtained by the Environment Agency up to April 2012[43]). Depending on the date it was flown this may not cover the as built ground levels for Riverside 1 and will not include works associated with Riverside 2 (under construction).

8.7.3. More detailed modelling of this catchment has been undertaken by the Environment Agency and manipulated by the Applicant to inform this FRA. This is discussed in the sections below.

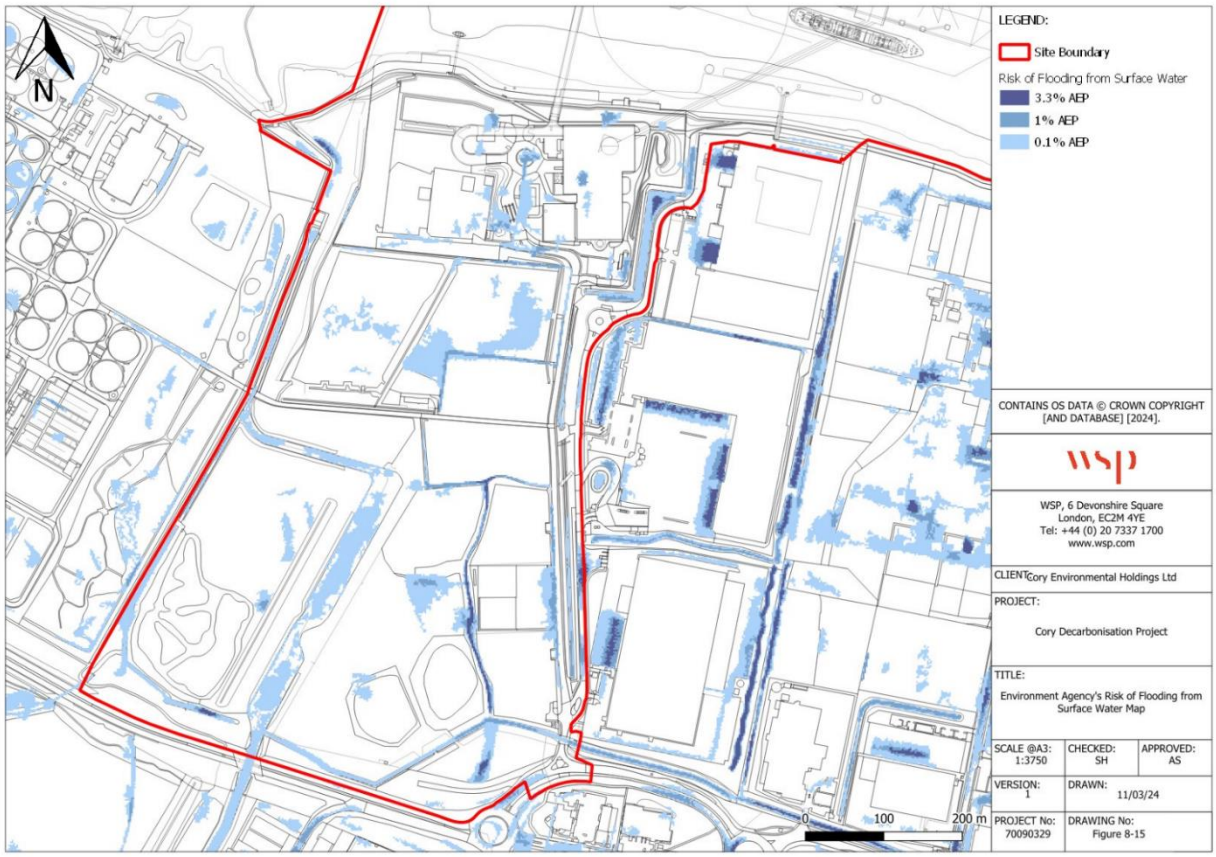

Figure 8-15: Environment Agency's Risk of Flooding from Surface Water Map

MARSH DYKES MODEL

Environment Agency Model

8.7.4. As the Environment Agency's Risk of Flooding from Surface Water Map[4] is based on high level principles to gain an initial understanding of flood risk and was developed at a national strategic scale. The Environment Agency has subsequently undertaken a catchment scale integrated hydraulic modelling of the Marsh Dykes in 2020 (the Environment Agency's Marsh Dykes Model[23]) which provides an integrated assessment of risk of fluvial and pluvial (surface water) flooding to the Site.

8.7.5. The Environment Agency's Marsh Dykes Model[23] does not include the ground levels for Riverside 2 or the impacts of the surface water drainage strategies in place for both Riverside 1 and Riverside 2.

8.7.6. The outputs from the Environment Agency's Marsh Dykes Model[23] (see **Figure 8-16** and **Annex E**) show that flooding occurs in the area proposed for the Carbon Capture Facility during the 1 in 100 plus climate change and 1 in 1000 year events.

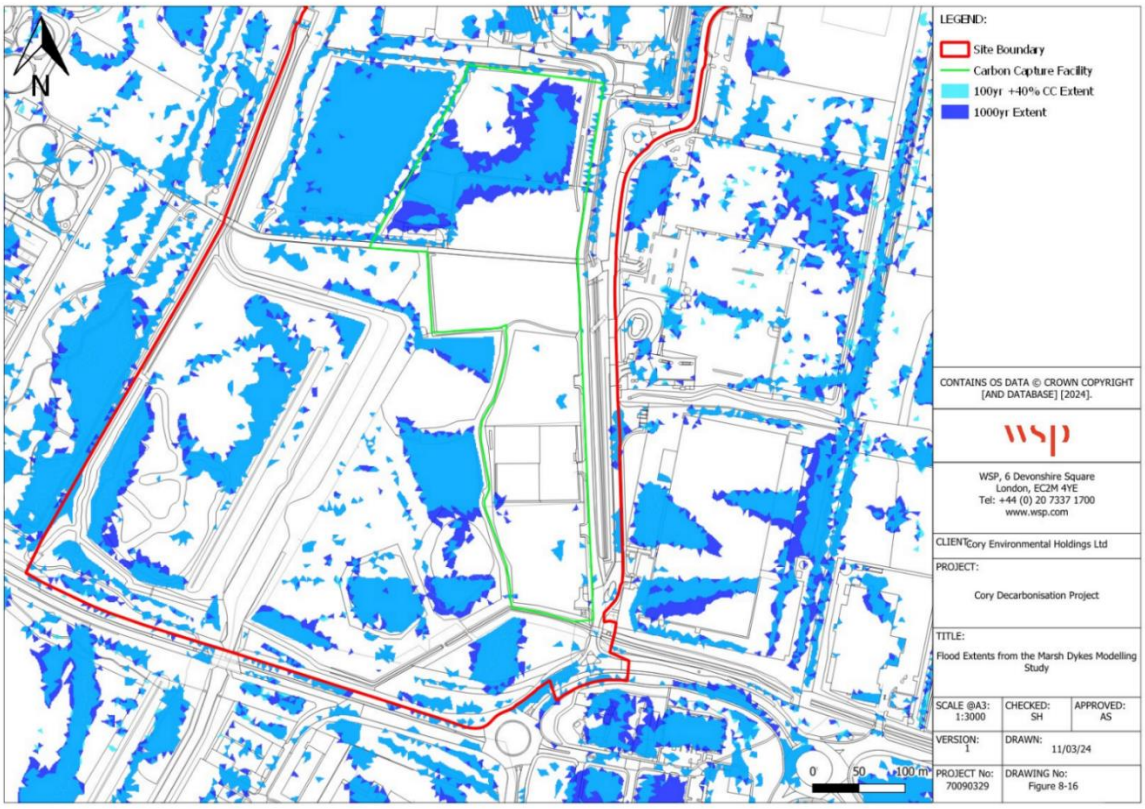

Figure 8-16: Flood Extents from the Environment Agency's Marsh Dykes Model

8.7.7. The flood depths for the 1 in 100 year plus 40% climate change event have been assessed through a GIS point inspection, as shown in **Figure 8-17** and **Table 8-6** (also shown in **Annex E**). This shows that the flood depths in the area proposed for the Carbon Capture Facility have a maximum flood level of 0.80m AOD.

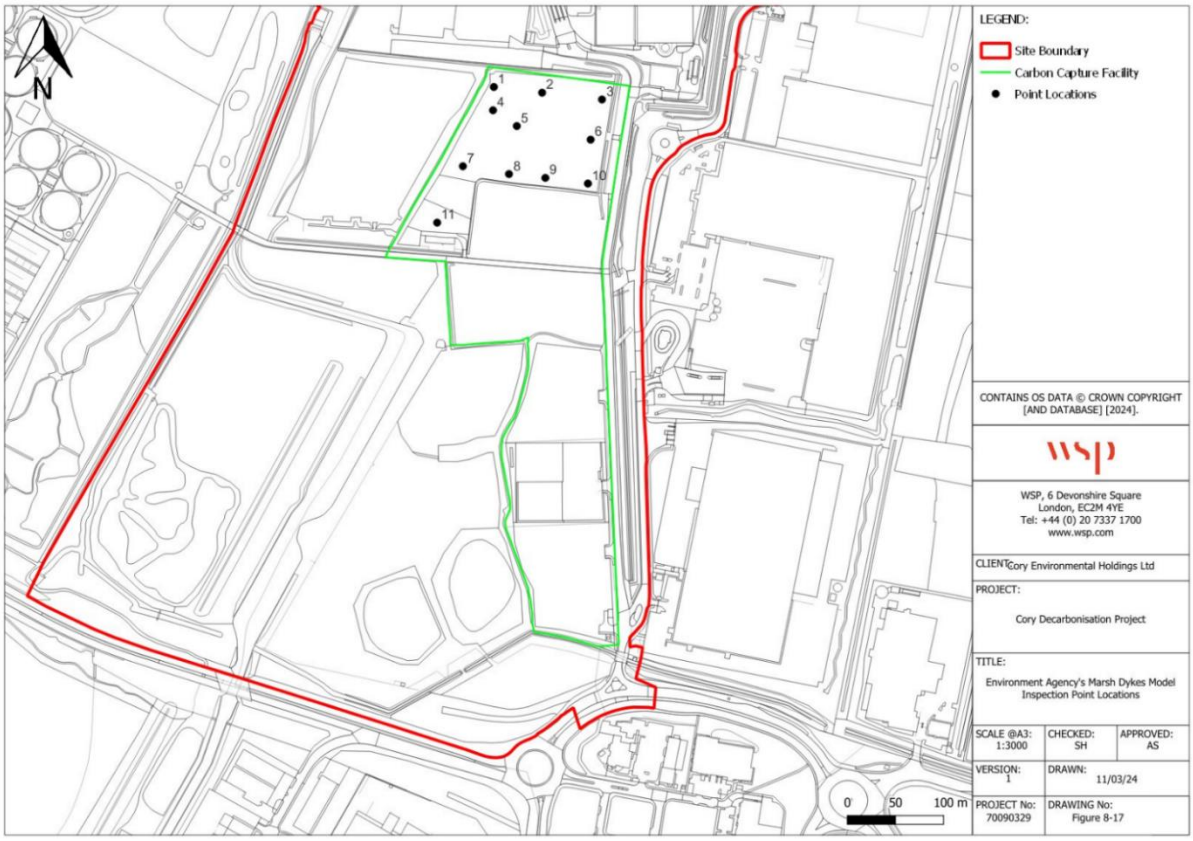

Figure 8-17: Environment Agency's Marsh Dykes Model Inspection Point Locations

Table 8-6: Topographical and Water Levels for the 1 in 100 year plus 40% Climate Change Event

Point	LiDAR Ground Elevation (m AOD)	Water Level (m AOD)	Water Depth (m)
1	0.81	0.00	0.00
2	0.54	0.72	0.07
3	0.61	0.00	0.00
4	0.83	0.00	0.00
5	0.63	0.80	0.05
6	0.45	0.61	0.14
7	0.55	0.61	0.11
8	0.58	0.00	0.00
9	0.41	0.61	0.16
10	0.63	0.00	0.00
11	0.59	0.00	0.00

Point	LiDAR Ground Elevation (m AOD)	Water Level (m AOD)	Water Depth (m)

Note:

The latest LiDAR has been utilised in this review and may differ slightly from that used in the Environment Agency's Marsh Dykes Model[23]. This results in a minor discrepancy when the water depth is added to the ground elevation. However, this is not deemed sufficient to impact the water level, given the size of the floodplain.

8.7.8. The flood levels presented in **Table 8-6** are significantly below the flood levels following a breach of the River Thames Flood Defences. As the proposed Scheme includes embedded mitigation to manage the risk of flooding following a breach in the River Thames Flood Defences (with a minimum platform level of 2.8m AOD) this is considered sufficient to protect the Proposed Scheme from fluvial or pluvial flooding from the Marsh Dykes.

8.7.9. The outputs (especially the flow direction arrows) from the Environment Agency's Marsh Dykes Model[23] (see **Figure 8-18** and **Figure 8-19** and **Annex E**) demonstrate that the flooding shown in the area of the proposed Carbon Capture Facility is largely a result of direct rainfall onsite leading to surface water ponding, as the water is not able to immediately flow into a watercourse due to topographical constraints. As demonstrated by further assessment described below, the surface water ponding as a result of direct rainfall on to the Site will be mitigated via the measures included in the **Outline Drainage Strategy (Document Reference 7.2)** for the Proposed Scheme.

8.7.10. The outputs (especially the flow direction arrows) from the Environment Agency's Marsh Dykes Model[23] also shows that some of the flooding is modelled to flow overland from Riverside 1 and Riverside 2, which in practice would not occur as this water would be captured and attenuated in the respective drainage systems of Riverside 1 and Riverside 2 prior to being discharged into the main river Norman Road Stream. This is because the Environment Agency's model does not include any allowance for site specific surface water drainage infrastructure. Further to this, the site specific topographical survey (included with **Appendix 17-1: Preliminary Risk Assessment (Volume 3)**) demonstrates that the Carbon Capture Facility is separated from Riverside 1 and Riverside 2 by a series of watercourses, which are expected to be able to intercept any exceedance flows from Riverside 1 and Riverside 2 and divert them away from the proposed Carbon Capture Facility.

8.7.11. Site specific model updates have been made to the Environment Agency's Marsh Dykes Model[23] to incorporate the surface water drainage strategies for Riverside 1 and Riverside 2 and assess residual pluvial and fluvial flood risk to the Proposed Scheme. This assessment is presented below.

Figure 8-18: Cory Marsh Dykes Model 1 in 100 Year Plus 40% Climate Change Flood Extents and Flow Directions

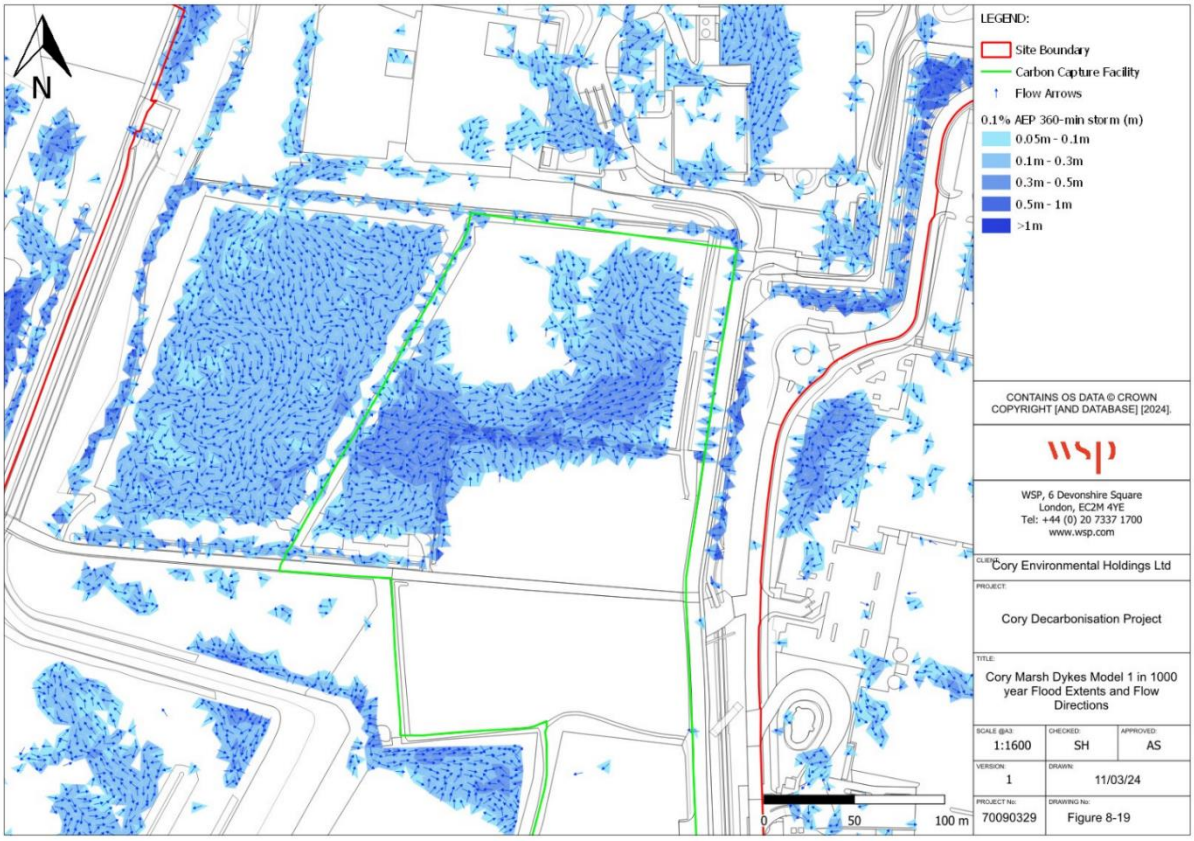

Figure 8-19: Cory Marsh Dykes Model1 in 1,000 year Flood Extents and Flow Directions

Modelling Updates

8.7.12. As discussed above, surface water runoff from both Riverside 1 and Riverside 2 is and will be managed to prevent increased flood risk to adjacent land up to and including the 1 in 100 year plus climate change design event.

8.7.13. The Surface and Foul Water Drainage Strategy approved under Requirement 9 of the Riverside 2 DCO[38] controls the discharge to the greenfield runoff rate, which will provide a betterment in the climate change scenario. The Drainage Strategy states:

"Appropriate restricted surface water discharge rates have been applied to the drainage scheme, to ensure that there is no increase to the equivalent greenfield flow conditions from the site, up to and including the 1 in 100 year storm event (+ 40% climate change allowance). This ensures that the proposed drainage scheme will not only comply with the current planning policy, but shall also achieve considerable overall betterment (up to 80% reduction in offsite flows), when compared to the pre-development drainage arrangements."

8.7.14. Riverside 1 and Riverside 2 discharge at controlled rates (which were previously agreed with the appropriate statutory consultee) into the main river (Norman Road Stream). The Proposed Scheme will also discharge surface water runoff into the main river (Norman Road Stream) and network of ordinary watercourses (as detailed within the **Outline Drainage Strategy (Document Reference 7.2)**).

8.7.15. The Proposed Scheme, including the Carbon Capture Facility, will incorporate, through the **Outline Drainage Strategy (Document Reference 7.2)** a surface water drainage system, designed to attenuate flows to the greenfield runoff rate (in this instance a QMED rate of 3.71 l/s/ha) (QMED is the median annual maxima flood, with a 0.5% AEP and a return period of 1 in 2 years). Surface water will be discharged via multiple outfalls to both to the main river (Norman Road Stream) and to the ordinary watercourses/ditch network within Crossness LNR.

8.7.16. As the Environment Agency's Marsh Dykes Model[23] is a strategic scale model it does not account for the drainage strategies in place at individual sites. Therefore, to inform this FRA for the Proposed Scheme, additional scheme specific hydraulic modelling has been undertaken in accordance with the approach to the Environment Agency's Scoping Comments outlined in **Annex D**. This states that the updates/refinements will be limited to pertinent features within the immediate vicinity of the Carbon Capture Facility. This refined site-specific model is referred to as the Cory Marsh Dykes Model (noting that this is the same model used in the breach assessment albeit in a different manner appropriate to the source of flood risk).

8.7.17. As such the only updates to the Environment Agency's Marsh Dykes Model[23] for the Proposed Scheme specific modelling are including a representation of the three surface water drainage strategies (Riverside 1, Riverside 2 and the Carbon Capture Facility). These have been incorporated within the model through the addition of two polygons (one for Riverside 1 and Riverside 2, and one for the Carbon Capture Facility). These polygons were set to block rainfall from falling directly onto the Site, assuming that any water would be redirected into the drainage system. Although this is a simplified approach that does not take post development permeability into account it is considered suitable to determine the likely source of flooding within the footprint of the Carbon Capture Facility. No changes were made within the model for the new buildings or changes to ground levels which will occur as a result of the construction of Riverside 2, as the surface water runoff will be controlled up to and including the design event (1 in 100 years plus climate change) therefore these updates would not significantly alter the assessment of flood risk to the Proposed Scheme.

Results

8.7.18. The results of the Cory Marsh Dyles Model for the assessment of pluvial flood risk, including representation of the surface water drainage strategies (the porous polygons), are presented in **Figure 8-20** and **Figure 8-21** below and **Annex E**. The modelled flood risk within the Riverside 1, Riverside 2 and Carbon Capture Facility has reduced significantly, demonstrating that this risk was associated with rainfall falling on Riverside 1, Riverside 2 and the Carbon Capture Facility without appropriate consideration of the surface water drainage strategies.

8.7.19. **Annex C** shows the indicative overland flow routes within the Study Area whilst also considering Riverside 1 and Riverside 2. The Cory Marsh Dykes Model show that there are no locations where these flow routes would spill onto the Site, this demonstrates that overland flow does not pose risk to the Site and removing the

rainfall from the updated model is an appropriate methodology (i.e. the source of flood risk is pluvial flooding associated with ponding of rainfall that would be best managed by the surface water drainage strategies).

8.7.20. **Figure 8-20** and **Figure 8-21** demonstrate that the majority of flooding has been removed from the Site when considering the surface water drainage strategies in place for Riverside 1, Riverside 2 and the Carbon Capture Facility (noting that any floodwaters onsite below 10mm have been removed, in accordance with industry wide direct rainfall modelling best practices, as a cut off threshold has to be applied to prevent water showing across the whole of the model domain, thus preventing flooding from being separated from negligible rainfall). The following exceptions are identified with flood waters indicated to enter the area of the Carbon Capture Facility from these sources:

- a small area of ingress from Norman Road Stream (MR4) in the northeast area of the Carbon Capture Facility;
- four areas of minor ingress from the watercourse which flows alongside the western boundary of the northern section of the Carbon Capture Facility (OW6 and OW11(b)); and
- areas of limited ingress from the Norman Road highway drain in the southeast (OW17).

These localised flood risks could be classified as fluvial flood risk that would be lost following construction of the Carbon Capture Facility development platform. These would therefore require the provision of compensation in accordance with planning policy. Mitigation for these areas is as discussed in **Section 8.6** above.

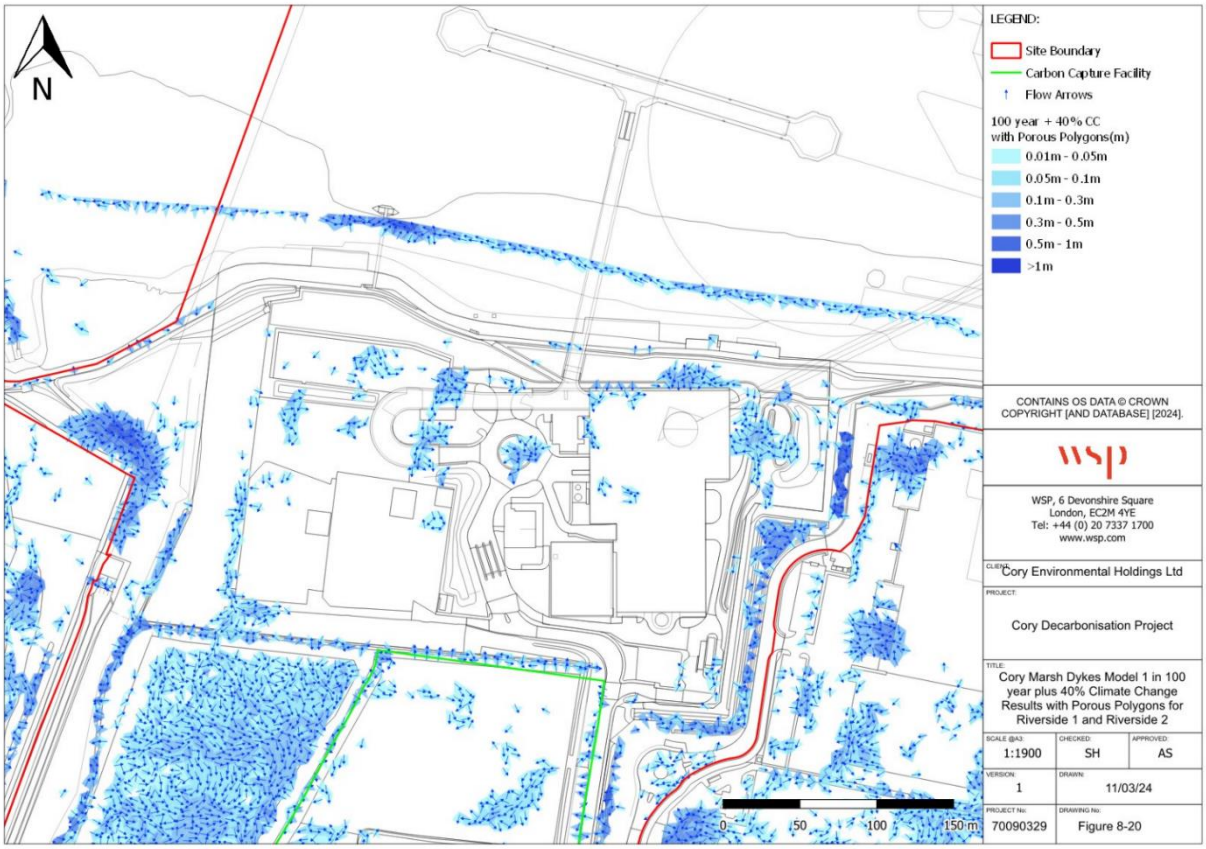

Figure 8-20: Cory Marsh Dykes Model 1 in 100 year plus 40% Climate Change Results with Porous Polygons for Riverside 1 and Riverside 2

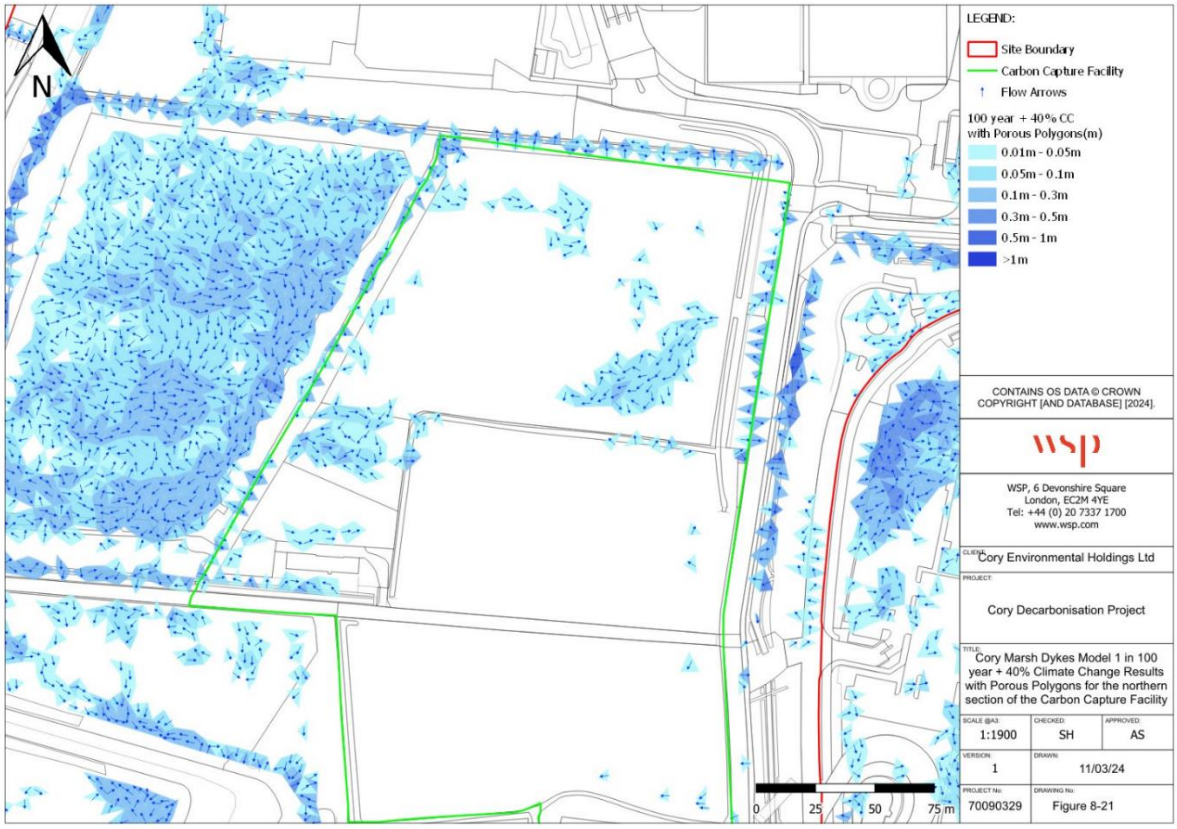

Figure 8-21: Cory Marsh Dykes Model 1 in 100 year plus 40% Climate Change Results with Porous Polygons for the northern section of the Carbon Capture Facility

Summary

8.7.21. The inclusion of the representation of the drainage strategies for Riverside 1 and Riverside 2 along with proposed drainage strategy for the Proposed Scheme, demonstrates that there is limited risk of fluvial/pluvial flooding on the Carbon Capture Facility. The modelling indicated localised residual flood risk that could be classified as fluvial flooding. Loss of areas at fluvial flood risk will be compensated for as discussed in **Section 8.6**. Review of the Proposed Scheme indicates that this can be appropriately mitigated through the inclusion of mitigation within the detailed design of the Proposed Scheme and described above.

8.8. GROUNDWATER

8.8.1. The LBB Level 1 SFRA[9] provides historical records of groundwater flooding from groundwater sources (detailed in **Appendix 11-3: Groundwater Impact Assessment (Volume 3)**) and provides low resolution mapping of areas susceptible to groundwater flooding which identifies the Site as Moderate risk.

8.8.2. The Site is covered by Alluvium and the Taplow Gravel Member that are considered low permeability deposits. Variations in groundwater flow and level (locally) are expected due to the presence of drains and watercourses surrounding the Site as well as tidal influence from the River Thames.

8.8.3. The Proposed Scheme includes proposals for a perimeter sheet pile wall to retain engineering backfill used to raise the land to a future ground level for the Carbon Capture Facility development platform. Other physical changes to the shallow subsurface associated with excavation works also have the potential to interrupt shallow groundwater flow paths within the superficial deposits. In addition to the sheet piling this would include any excavations associated with the enabling works including the preparation of laydown areas, construction compound, site preparation, levelling and piling and any excavation (i.e. open-trenching) or below ground structures related to the Carbon Capture Facility (including piling works) and connection to Riverside 1 and Riverside 2.

8.8.4. Based on the underlying geological conditions, there is potential for groundwater flooding to locally be an issue during the construction phase where groundwater levels are relatively close to the ground surface and construction would involve excavation. This will be managed through the measures included in the **Outline CoCP (Document Reference 7.4)**.

8.8.5. The perimeter sheet pile wall that surrounds the Carbon Capture Facility development platform will be founded within the Taplow Gravel Member. Introducing a permanent groundwater flow barrier could result in the interruption of groundwater pathways and result in changes (locally) to groundwater flow direction and levels within the superficial deposits. Due to the limited porosity and permeability of the superficial deposits (Alluvium and Taplow Gravel Member) introduction of groundwater flow barriers could lead to significant water table rise up and, in the worst case, causing groundwater flooding if no groundwater sinks are available (i.e. groundwater drainage). Green Level Pumping Station is located to the east of the Proposed Scheme (outside the Site Boundary) and pumps to the River Thames. Both pumping stations control water level (locally) to mitigate flood risk in the area.

8.8.6. Given the findings of the previous Ground Investigation (GI), the variable lithology of the superficial deposits provides dedicated flow paths within the more permeable layers, although this may be restricted both horizontally and vertically. **Table 3** within **Appendix 11-3: Groundwater Impact Assessment (Volume 3)** provides a summary of the potential groundwater head (m) that may be acting on the sheet pile wall based on groundwater level monitoring data provided from the previous GI (2017 and 2021). On average, an 8.69m head is expected based on the evolving design for the Proposed Scheme.

8.8.7. Where potential groundwater flows could emerge because of the installation and presence of the perimeter sheet pile wall onsite, a risk of groundwater flooding remains. The LBB Level 1 SFRA identifies the area is susceptible to groundwater flooding and the Site considered moderate risk. Therefore, a residual flood risk due to the potential groundwater flows emerging as part of the scheme development during operation remains. **Appendix 11-3: Groundwater Impact Assessment (Volume 3)** identifies uncertainty around the impacts and risk of groundwater flooding from the proposed perimeter sheet pile wall. Additional groundwater level monitoring for the Site, that is representative of the impacts locally as a result of dewatering activities

associated with the construction of Riverside 2 (especially to north of the Site), supported by detailed GI (described in **Chapter 17: Ground Conditions and Soils (Volume 1)**), will identify measures that should be considered during the detailed design of the Proposed Scheme where required.

8.9. ARTIFICIAL SOURCES

CROSSNESS SEWAGE TREATMENT WORKS

8.9.1. There is a risk of flooding from artificial sources (i.e. Crossness Sewage Treatment Works which is owned and managed by Thames Water). However, it is considered that this is a residual risk and that any associated flood level would be less than the breach flood level from the River Thames. Consequently, no further assessment or mitigation is required within this assessment.

SURCHARGING OF SEWERS

8.9.2. The Carbon Capture Facility will be on a development platform to raise it above the breach flood level. The foul/surface water sewers to support the Proposed Scheme will be new and designed in accordance with current best practices as detailed in the **Outline Drainage Strategy (Document Reference 7.2)** (including management of risk of surged outfalls). The drainage system serving Riverside 1 and Riverside 2 will be managed to prevent increased flood risk to adjacent land up to and including the 1 in 100 year plus climate change design event.

8.9.3. The risk of surcharging of sewers leading to flood risk to the Proposed Scheme is therefore considered to be negligible.

RESERVOIRS

8.9.4. The Environment Agency's Risk of Flooding from Reservoirs Map[4] shows that there is no risk of flooding to the Proposed Scheme as a result of reservoir flooding in either assessed scenario (when river levels are normal or when there is also flooding from rivers). No further assessment or mitigation is required within this assessment.

9. FLOOD RISK MITIGATION

9.1.1. This section summarises the flood risk during the construction and operation phases of the Proposed Scheme and how appropriate management approaches have been developed to ensure that the Proposed Scheme and third parties are not exposed to an unacceptable level of flood risk, as set out in the foregoing sections.

9.1.2. There is a requirement in the **Draft DCO (Document Reference 3.1)** that ensures that the Proposed Scheme is carried out and operated in accordance with this assessment.

9.2. CONSTRUCTION PHASE MITIGATION

9.2.1. No works would be carried out within the Site Boundary when there is a risk of breach of the River Thames Flood Defences. Furthermore, should an event larger than the design event (1 in 200 years plus climate change) be forecast then no works would be carried out within the Site Boundary.

9.2.2. A Method Statement would be developed by the Contractor(s) detailing the procedures for securing the Site and plant equipment for a flood event (breach of the River Thames Defences), in particular with reference to safe working practices, harmful substances and fuels, and ensuring there is an ability safely shut down and evacuate the Site during an exceedance event.

9.2.3. The Contractor(s) would sign up to the Environment Agency flood warning service to receive up to date flood information and warnings.

9.2.4. A temporary drainage strategy will be developed, pursuant to a surface water management plan, to ensure surface water flood risk is managed during the construction phase and will provide the necessary storage and transfer of ponding water.

9.2.5. The above measures are included in the **Outline CoCP (Document Reference 7.4)**. The Contractor(s) will bring forward a full CoCP(s) which must be in substantial accordance with the **Outline CoCP (Document Reference 7.4)**, pursuant to a DCO requirement.

9.3. OPERATION PHASE MITIGATION

9.3.1. The embedded and additional mitigation described in **Section 8.3** is in relation to a breach of the River Thames Flood Defences. This includes (but is not limited to) raising the proposed platform for the Carbon Capture Facility above the design event (1 in 200 years plus climate change) with an appropriate freeboard allowance that is informed by the vulnerability of the development/users of different aspects of the Proposed Scheme.

9.3.2. The embedded mitigation to manage fluvial and pluvial flood risk from the Marsh Dykes is described in **Section 8.6**. The risk to the Carbon Capture Facility will be mitigated by the raised development platform as discussed above. The risk to people, property and infrastructure elsewhere will be mitigated by the provision of an appropriate surface water drainage system (discussed below) and localised fluvial flood compensation areas.

9.3.3. The Proposed Scheme also includes an **Outline Drainage Strategy (Document Reference 7.2)**. The surface water drainage system will manage surface water runoff generated by the Proposed Scheme and will be designed to attenuate flows to the greenfield runoff rate. The surface water drainage system will also replace the function of minor watercourses/ditches that are located within the development footprint of the Carbon Capture Facility development platform and that will be infilled as part of the Proposed Scheme. The Applicant will bring forward a full Drainage Strategy which must be in substantial accordance with the **Outline Drainage Strategy (Document Reference 7.2)**, pursuant to DCO requirement.

9.3.4. No-development zones will be applied to the watercourse network, as amended by the Drainage Strategy, in accordance with **Sections 10** and **Section 11**.

9.3.5. The interaction with the River Thames Flood Defence is dealt with in **Section 11** of this document.

9.3.6. Mitigation measures in relation to groundwater flood risk have not yet been identified as discussed in **Section 8.7**. Additional groundwater level monitoring for the Site, that is representative of the impacts locally as a result of dewatering activities associated with the construction of Riverside 2, supported by detailed GI (described in **Chapter 17: Ground Conditions and Soils (Volume 1)**), will identify measures that should be considered during the detailed design of the Proposed Scheme where required.

9.3.7. The approach to managing flood risk that goes beyond the embedded mitigation of the Proposed Scheme will be set out in the full EPRP(s) with the trigger levels determined as part of the detailed design of the Proposed Scheme. The Applicant will bring forward a full EPRP(s) which must be in substantial accordance with the **Outline EPRP (Document Reference 7.11)**, pursuant to requirement of the **Draft DCO (Document Reference 3.1)**.

10. INTERACTIONS WITH ORDINARY WATERCOURSES/SECTIONS OF THE MARSH DYKES

10.1. INFILLING OF WATERCOURSES

10.1.1. The Proposed Scheme will require all of/section(s) of drainage channels (OW4, OW15, OW11(a) and OW18) where they intersect with the Carbon Capture Facility to be infilled and stopped up. The potentially affected drainage channel sections are shown in **Figure 10-1** and are located within the footprint of the Carbon Capture Facility development platform. These watercourses and their associated functions will be replaced by the surface water drainage system across the Carbon Capture Facility, which will provide attenuation and controlled discharge into the watercourses which flow across the Mitigation and Enhancement Area as set out in the **Outline Drainage Strategy (Document Reference 7.2)**.

10.1.2. The proposed changes, which are subject to detailed design (which will give appropriate consideration to the potential risk of slope failure and associated blockage ditches), are:

- OW4 – this section of channel is not connected to Norman Road Stream (the section of main river to the east, which receives surface water discharge from Riverside 1 and 2). It provides field drainage for the development area and connects into OW4 which receives field drainage from the east and flows in a southerly direction. This section of field drain will be infilled and replaced by the surface water drainage system.
- OW18 – this section provides field drainage to part of the development area and outfalls to Norman Road Stream (the section of main river to the east). This section of field drain will be infilled and replaced by the surface water drainage system.
- OW11(a) – this section provides field drainage to part of the development area, provides connectivity between the highway drainage channel alongside the eastern side of Norman Road and outfalls to the Marsh Dykes. This section of field drain will be infilled and replaced by a new channel to the south of the Carbon Capture Facility.
- OW15 – this ditch provides field drainage to part of the Carbon Capture Facility (the Norman Road Field and Crossness LNR), sections of this field drain will be infilled and replaced by the surface water drainage system. Other sections of this field drain will be deepened and slope gradient altered and a new connection provided from the Norman Road Highway Drainage and a discharge route/connection provided to OW11(b).

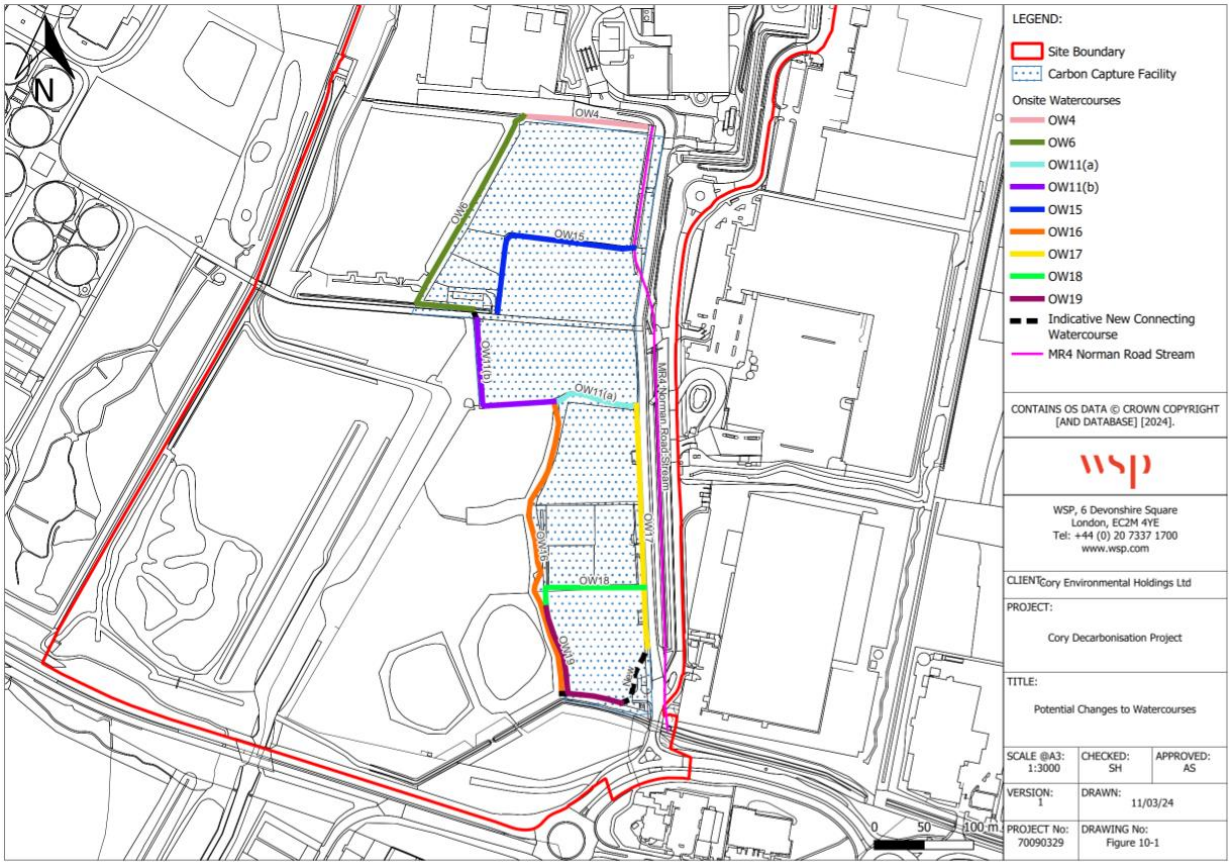

Figure 10-1: Potential Changes to Watercourses

MAINTENANCE NO DEVELOPMENT ZONES

10.1.3. The Proposed Scheme will facilitate the maintenance of the watercourses within the Site through the incorporation of no development zones. The width of these zones will be confirmed during detailed design, as the width for each watercourse is dependent upon the approach to land raising for the Carbon Capture Facility. The proposed no development zones are as detailed below:

- OW6 and OW11b – the intention at this stage is that the maintenance will primarily be undertaken from the western bank of the watercourse, however, should the development platform be raised by sheet piles, then there will be a 5m maintenance strip between the watercourses and the sheet piles; and
- highway drainage – the maintenance for the highway drainage will be undertaken from Norman Road. The Applicant will ensure that its activities do not block access to the ditch from the road.

11. INTERACTIONS WITH ENVIRONMENT AGENCY MANAGED FLOOD DEFENCES/MAIN RIVERS

11.1.1. The construction of the Proposed Scheme has the potential to interact with the Environment Agency managed flood defences and main rivers through the following:

- The **Works Plans (Document Reference 2.3)** show that there is potential for interactions with main rivers and the River Thames Flood Defences that are managed by the Environment Agency. This includes the Carbon Capture Facility – potential impacts to main rivers associated with the new outfalls, impacts and reduction of the maintenance strip and provision of floodplain compensation, crossing of Norman Road Stream by the Carbon Capture Facility development platform, deculverting of a section of Norman Road Stream/Norman Road River and works located in close proximity to the Great Breach Pumping Station.
- Flue Gas Supply Ductwork – potential interaction with the River Thames Flood Defences as discussed in more detail below (**Paragraph 11.3.2**).
- Proposed Jetty – The proposed dredge pocket for capital dredge and operational dredging is considered to be of a sufficient distance from the toe of the River Thames Flood Defences so as not to have any potential adverse structural impact and thus is not considered further. The modifications or removal of the Belvedere Power Station Jetty (disused) and the construction of the Access Trestle for the Proposed Jetty is discussed in more detail below (**Paragraph 11.3.3** to **Paragraph 11.3.6**).
- Temporary Construction Compounds and Access – potential interaction with the River Thames Flood Defences as discussed in more detail below (**Paragraph 11.3.1**).

11.1.2. Further information regarding these works is provided below with relevance to main rivers and the River Thames Flood Defences.

11.1.3. The Mitigation and Enhancement Area includes potential enhancements to the habitats on the River Thames Flood Defences and the main rivers located within this area. More information on the proposals are available in **Appendix 7-1: Biodiversity Net Gain Assessment Report (Volume 3)**.

11.1.4. **Annex C** provides an overview of the Proposed Scheme interactions with Environment Agency assets.

11.2. MAIN RIVER

11.2.1. The construction of the Proposed Scheme is likely to result in the following potential impacts:

- construction of new outfalls into the main river network (Norman Road Stream and Norman Road River);

- impacts to/reduction of the maintenance strip/byelaw protected area of Norman Road Stream and Norman Road River;
- crossing of a culverted section of Norman Road Stream by the Carbon Capture Facility development platform that may subsequently require protection or localised diversion;
- deculverting of a section of Norman Road Stream/Norman Road River, where feasible during detailed design; and
- works in close proximity to Great Breach Pumping Station.

11.2.2. It should be noted from the outset that all of these activities will be controlled pursuant to the protective provisions for the Environment Agency's benefit (i.e. need their approval) in the **Draft DCO (Document 3.1)** or are secured pursuant to being referenced in this FRA, compliance with which is secured through DCO requirement.

NEW OUTFALLS

11.2.3. The design of the new outfalls will be undertaken during the detailed design phase and will be agreed pursuant to the Protective Provisions and will dovetail with the Full Drainage Strategy approved by LBB. Outfall pipes less than 300mm diameter through a headwall are exempt from requiring an Environmental Permit if they are designed in accordance with FRA12 of the Environment Agency's Guidance for Exempt flood Risk Activities: Environmental Permits (REF)[44].

IMPACTS TO/REDUCTION OF THE MAINTENANCE STRIP/BYELAW PROTECTED AREA OF NORMAN ROAD STREAM AND NORMAN ROAD RIVER

11.2.4. To minimise the impacts on the wider environment, the detailed design of the Proposed Scheme will likely need to reduce the existing byelaw buffer strip (i.e. no development zone) alongside Norman Road Stream and Norman Road River, from 9m, due to the need for the development of the Carbon Capture Facility in this area.

11.2.5. When determining the width of the no-development zone in this area at the detailed design stage, appropriate consideration will be given to:

- minimising the potential risk of slope failure and associated blockage of ditches;
- maintenance requirements of both the Applicant and the Environment Agency;
- provision of the floodplain compensation requirements set out in **Section 8.5** of this FRA; and
- ecological requirements, pursuant to approval of the full LaBARDS(s) delivery plan pursuant to the DCO.

11.2.6. The Environment Agency will be able to agree the extent of the no-development zone pursuant to their Protective Provisions. This mechanism will also allow the Agency to ensure that the Applicant's construction methodologies appropriately consider the risk of the channels being infilled or partly infilled by soil failure should ground raising be required within 9m of the main rivers (or ordinary watercourses).

CROSSING OF A CULVERTED SECTION OF NORMAN ROAD STREAM

11.2.7. The proposed development platform for the Carbon Capture Facility may require crossing of a short section (<50m) of the culverted section of Norman Road Stream (immediately downstream of the open section of watercourse).

11.2.8. Norman Road Stream may require diversion or protective measures due to the location of the platform as part of the detailed design. The details of this would be secured pursuant to the Environment Agency's Protective Provisions as part of the **Draft DCO (Document Reference 3.1)**.

WORKS IN CLOSE PROXIMITY TO GREAT BREACH PUMPING STATION

11.2.9. The construction and operation of the proposed scheme will be undertaken within close proximity to the Great Breach Pumping Station.

11.2.10. From discussions with the Environment Agency, it is understood that it has a program in place to upgrade the Great Breach Pumping Station. It is expected that the two construction programmes can be undertaken independently of each other with no adverse impacts, alternatively they can be appropriately phased. The Protective Provisions in the DCO ensure that the Environment Agency will be able to maintain access to the pumping station.

11.3. RIVER THAMES FLOOD DEFENCES

TEMPORARY CONSTRUCTION COMPOUNDS/WORKS AREAS

11.3.1. The **Works Plans (Document Reference 2.3)** show Temporary Construction Compounds/construction works areas that may be required within 16m of the toe of the River Thames Flood Defences. This will be subject to the Environment Agency's approval through the Protective Provisions included in the **Draft DCO (Document Reference 3.1)**.

FLUE GAS SUPPLY DUCTWORK

11.3.2. The Flue Gas Supply Ductwork which is required to route flue gas from both Riverside 1 and Riverside 2 to the Carbon Capture Facility has to be constructed on/in close proximity to the River Thames Flood Defences, as a result of the location of the proposed stack for Riverside 2 (currently under construction). The detailed design of the foundations within and/or within 16m of the toe of the River Thames Flood Defences will be undertaken sensitively to ensure that the structural integrity of the defences is not compromised and will in any event be subject to the Environment Agency's approval through the Protective Provisions.

CONSTRUCTION OF THE PROPOSED JETTY

11.3.3. The Access Trestle, part of the Proposed Jetty, will connect the Loading Platform to land and support Above Ground Pipelines, including LCO_2, running the length of the

Proposed Jetty. It will also provide access for pedestrians (staff only) and emergency/maintenance vehicles. The Access Trestle will run over the England Coast Path (FP3/NCN1) and flood wall, to the rear edge of the Loading Platform.

11.3.4. Where the Access Trestle crosses the River Thames Flood Defences (the crest of the existing defences is 7.2m AOD (+10.38m CD)) it will be in accordance with the below parameters (see the **Engineering Plans: Indicative Equipment Layout (Document Reference 2.5)**):

- Access Trestle Width – no wider than 15m;
- Vertical Clearance – above the 2070 flood defence level (7.70m AOD) of 3.5m (from the top of the River Thames Flood Defence);
- Vertical Clearance – above the 2120 flood defence level (8.2m AOD) of 3m (from the top of the River Thames Flood Defence); and
- Horizontal Exclusion Zone – 7.0m minimum from the toe of the existing River Thames Flood Defences (i.e. no piling for the supporting piers within 7.0m of the toe of the existing flood defences).

11.3.5. This demonstrates that the construction and operation of the Access Trestle will not prevent the River Thames Flood Defences beneath/in close proximity to the Access Trestle from being raised to 7.70m AOD or 8.20m AOD, the level that is required in the TE2100 Plan (see **Annex A**) for the design life of the Proposed Scheme or in the next plan period. The Proposed Scheme does not include the upgrade works of the defences required in the TE2100 plan themselves as:

- it does not extend to the River Thames Flood Defences (there are only limited sections where the Proposed Scheme overlaps with the defences);
- the DCO does not seek powers for the upgrade works;
- the upgrade works are not proportionate to the location at the rear of the Riverside Campus;
- a precedent has been set by other recent schemes in close proximity to the Proposed Scheme which have not increased the height of the defences; and
- it is expected that an economy of scale could be obtained by working in conjunction with neighbouring landowners could be obtained.

11.3.6. The construction of the Access Trestle will likely require piling within 16m of the toe of the defences. The location of this piling is subject to detailed design, however, it will not be within the minimum distance of 7m from the toe of the defences as specified above.

REMOVAL OF BELVEDERE POWER STATION JETTY (DISUSED)

11.3.7. Should the Proposed Scheme include the removal of Belvedere Power Station Jetty (disused) then the River Thames Flood Defences in this area will be reinstated to ensure that they provide the required standard of protection. The details of this would be secured pursuant to the Environment Agency's Protective Provisions, as well as DCO requirement.

RETENTION OF BELVEDERE POWER STATION JETTY (DISUSED)

11.3.8. Should the Proposed Scheme include the retention (and modifications) of the Belvedere Power Station Jetty (disused) then there will be likely be no impact to the River Thames Flood Defences in the immediate vicinity. If any modifications are required, the River Thames Flood Defences would be reinstated to ensure that they provide the required standard of protection.

11.3.9. The remaining parts of the Belvedere Power Station Jetty (disused) will be maintained in accordance with the **Draft DCO (Document Reference 3.1)** and the adjacent flood defences which are transferred into the Applicant's ownership will be maintained in accordance with statutory requirements as set out in the Metropolis Management (Thames River Prevention of Floods) Amendment Act[45].

11.3.10. When the River Thames Flood Defences require raising in accordance with the TE2100 plan, the retention of the Belvedere Power Station Jetty (disused) will not prevent this from occurring, as this is significantly elevated in a similar manner to that for the Proposed Jetty as detailed above.

12. SEQUENTIAL AND EXCEPTION TEST

12.1.1. The Proposed Scheme is classified as Essential Infrastructure under Annex 3 of the NPPF[2]. The location of Essential Infrastructure within Flood Zone 3 requires the Sequential Test and Exception Test to be passed. This section demonstrates how the Proposed Scheme satisfies the requirements.

12.2. SEQUENTIAL TEST

12.2.1. The Sequential Test area has to be limited to the area in the immediate vicinity of Riverside 1 and Riverside 2. This is because of the functional requirement of the Proposed Scheme to connect carbon capture infrastructure to the existing infrastructure of both Riverside 1 and Riverside 2.

12.2.2. The **Terrestrial Site Alternatives Report (Document Reference 7.5)** sets out the other development zones considered in the context of that key requirement. These other sites are also:

- in fluvial/tidal Flood Zone 3 (noting that the North Zone of the other development zones is located within the River Thames, thus at a higher level of flood risk);
- at equal risk of groundwater flooding; and
- at equal risk of surface water flooding (excluding the North Zone of the other development zones which is located in the River Thames, and the East Zone of the other development zones which is not considered to be reasonably available – given the occupation by Iron Mountain).

12.2.3. The **Terrestrial Site Alternatives Report (Document Reference 7.5)** explains why a River Thames site is not feasible. Therefore, it can be concluded that there are no other sites in an area with a lower probability of flooding from any source that would be appropriate for the Proposed Scheme.

12.2.4. As outlined in this FRA, all the potential sites benefit from the protection offered by the River Thames Flood Defences and the Environment Agency's Great Breach Dyke and Great Breach Pumping Stations.

12.2.5. In addition to this, where technical constraints allow, the elements that make up the Proposed Scheme have been sequentially designed to ensure that the more vulnerable aspects are located in areas at less risk of inundation should a breach occur.

12.2.6. The Sequential Test is therefore deemed to be passed.

12.3. EXCEPTION TEST

12.3.1. In accordance with Table 3 of the Flood Risk and Coastal Change PPG[27] Essential Infrastructure can be located in Flood Zone 3, but the Exception Test has to be passed. The Exception Test comprises two parts (Part A and Part B) that are both required to be fulfilled. This is demonstrated below.

- Part A - Demonstration that the development provides wider sustainability benefits to the community that outweigh flood risk:
  - the Proposed Scheme includes carbon capture technology and provides a sustainable approach to the production of energy, which is environmentally more sustainable and aligns with NPS EN-1[1]; and
  - wider benefits of the Proposed Scheme are detailed in the **Planning Statement (Document Reference 5.2)** and the **Project Benefit Report (Document Reference 5.4)**. It is considered that these benefits outweigh the minimal flood risk to/from the Proposed Scheme.
- Part B - A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
  - This assessment demonstrates that the Proposed Scheme will be:
    - **safe for its lifetime** - the Proposed Scheme will be located on a development platform to ensure that it remains operational in the unlikely event of a breach of the River Thames Flood Defences. The development platform is to be set above the breach flood level as identified by the Environment Agency with additional mitigation measures incorporated to manage the additional increase in residual flood risk associated with the construction of Riverside 2, as identified through the Proposed Scheme specific modelling;
    - **accounting for the vulnerability of its users** - The **Outline EPRP (Document Reference 7.11)**, which is secured in the **Draft DCO (Document Reference 3.1)**, includes the emergency procedures to be implemented during a flood event;
    - **will not increase flood risk elsewhere** - the Proposed Scheme, following the embedded mitigation proposed for flooding from the Marsh Dykes as detailed in **Section 9**, will provide floodplain compensation to ensure that there is no overall reduction in the floodplain. The measures are included in the **Outline Drainage Strategy (Document Reference 7.2)**, which is secured in the **Draft DCO (Document Reference 3.1)**, will manage, the surface water runoff. In the residual risk event (i.e. the unlikely event of a breach of the River Thames Flood Defences) the Proposed Scheme is assessed to have minor impact that is not considered to increase risk elsewhere; and
    - **will, where possible, reduce flood risk overall** - opportunities to reduce flood risk overall have not yet been identified, although these will be explored in the detailed design of the floodplain compensation for the Marsh Dykes and opportunities to provide additional storage will, where practicable, be considered in the detailed design.

EXCEPTION TEST SUMMARY

12.3.2. Considering the information provided in the paragraphs above, the Proposed Scheme is considered to fulfil the requirements of the Exception Test.

13. CONCLUSION

13.1.1. The Environment Agency's Flood Map for Planning[3] shows that the area of the Proposed Scheme is located in Flood Zone 3. The Environment Agency has confirmed that the Proposed Scheme and its surroundings are protected up to the present day 1 in 1,000 year event by the flood defences located along the banks of the River Thames. The flood defences will be also maintained by riparian landowners to keep pace with the impacts of climate change and therefore maintain the standard of protection as flood levels rise in the River Thames. There is however residual risk associated with a breach of the River Thames Flood Defences. A breach of the existing flood defences is considered unlikely to happen as they are regularly inspected and managed by the Environment Agency.

13.1.2. The Environment Agency's hydraulic modelling, along with the site specific hydraulic modelling, demonstrates that the Proposed Scheme is at risk of flooding in the unlikely event of a breach of the River Thames Flood Defences. This is considered to be a residual risk. This mapping also indicates that part of the Carbon Capture Facility is at risk of pluvial and fluvial flooding from the Marsh Dykes and rainfall that lands within the Site.

13.1.3. To ensure that the Proposed Scheme is not at risk of flooding from any source and that there are no adverse impacts elsewhere, appropriate mitigation measures have been incorporated in the design, construction and operation of the Proposed Scheme. These are summarised below in **Section 13.2** (Construction Phase) and **Section 13.3** (Operation Phase).

13.1.4. The Proposed Scheme may introduce localised risk of groundwater flooding caused by proposed excavation works that have the potential to interrupt shallow groundwater flow paths within the superficial deposits.

13.1.5. The Proposed Scheme is considered to be at low risk of flooding from overtopping of the River Thames Flood Defences, sewers and reservoirs.

13.1.6. The Proposed Jetty is to be elevated above the River Thames design water levels and thus will be safe and not lead to an increase in flood risk elsewhere.

13.2. CONSTRUCTION PHASE

13.2.1. The most notable potential risk of flooding during construction of the Proposed Scheme is associated with a breach of the existing flood defences, which could potentially impact the Site and staff. Embedded mitigation measures include that stockpiles, hazardous materials and/or site cabins, plant and equipment are not located in the floodplain of the Marsh Dykes and that works are not undertaken in the Site when there is a risk of breach of the existing flood defences (i.e. a significant flood event).

13.2.2. The Contractor(s) would sign up to the Environment Agency flood warning service to receive up to date flood information and warnings.

13.3. OPERATION PHASE

RISK OF FLOODING TO THE PROPOSED SCHEME

13.3.1. The most significant flood risk to the Proposed Scheme is from a breach in the River Thames Flood Defences. Embedded mitigation to manage this risk includes (but is not limited to) raising the proposed platform for the Carbon Capture Facility above the design event (1 in 200 years plus climate change) with an appropriate freeboard allowance that is informed by the vulnerability of the development/users of different aspects of the Proposed Scheme. The sensitive infrastructure will be set 600mm above the design flood levels as identified through the Environment Agency's Thames Estuary Breach Assessment[22]. Additional mitigation measures will be included to ensure that the Proposed Scheme is safe should a breach occur between Riverside 1 and Riverside 2, with localised flooding predicted to exceed the levels identified through the Environment Agency's Thames Estuary Breach Assessment[22] due to flood waters being channelled between Riverside 1 and Riverside 2.

13.3.2. The Environment Agency's Marsh Dykes Model[23] demonstrates that (excluding breach of the flood defences) the flooding across the Carbon Capture Facility is predominantly a result of rainfall within this area becoming trapped in localised depressions and flowing from Riverside 1 and Riverside 2. The Model was re-run to incorporate a representation of the surface water drainage strategies across the three sites (Riverside 1, Riverside 2 and the Proposed Scheme) and demonstrated that this flooding is largely removed. The Proposed Scheme is therefore not considered to be at risk of flooding from surface water runoff / pluvial sources and is not considered to lead to an increase in risk elsewhere.

13.3.3. Fluvial flooding is assessed to largely be limited to watercourse channels. Loss of channels and minor areas of out of bank flooding will be managed by maintaining hydraulic connectivity and capacity, and compensated for via the provision of floodplain compensation that will be developed during the detailed design of the Proposed Scheme. As such, the Proposed Scheme is not considered to be at risk of flooding from fluvial sources and is not considered to lead to an increase in risk elsewhere.

13.3.4. The Proposed Scheme includes an **Outline Drainage Strategy (Document Reference 7.2)**. The surface water drainage system will manage surface water runoff generated by the Proposed Scheme and will be designed to attenuate flows to the greenfield runoff rate. The surface water drainage system will also replace the function of minor watercourses/ditches that are located within the development footprint of the Carbon Capture Facility development platform and that will be infilled as part of the Proposed Scheme.

13.3.5. Mitigation measures in relation to groundwater flood risk have not yet been identified as discussed in **Section 8.7**. Additional groundwater level monitoring for the Site, that is representative of the impacts locally as a result of dewatering activities associated with the construction of Riverside 2, supported by detailed GI (described in **Chapter 17: Ground Conditions and Soils (Volume 1)**), will identify measures that should be considered during the detailed design of the Proposed Scheme where required.

THE SEQUENTIAL TEST AND THE EXCEPTION TEST

13.3.6. This FRA demonstrates that both the Sequential Test and Exception Test are passed as the Proposed Scheme is classified as Essential Infrastructure under the NPPF[2].

13.3.7. The Proposed Scheme passes the Exception Test because it provides sustainability benefits through carbon capture and storage which provides a sustainable approach to the production of energy, which is less harmful to the environment. Additionally, this FRA demonstrates that the Scheme will remain safe throughout its design life and that flood risk will not be increased elsewhere.

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Annex A

TABLE 7.1 AND TABLE 7.2 OF THE TE2100 PLAN

Table 7.1 Defence levels downriver of the Thames Barrier

DEFENCE LEVELS downriver of Barrier		Existing defence levels (2009)		OPTIONS 1.4 & 3.2 Defence levels required in 2040 (for period 2040 to 2070)		OPTION 1.4 Defence levels required in 2070 (for period 2070 to 2120)		OPTION 1.4 Defence levels required in 2120 (for period 2120 to 2170)		OPTION 3.2 Defence levels required in 2070 (for period 2070 to 2170)	
Location	Node	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB
Barrier	a3.1	7.20	7.20	7.20	7.20	8.30	8.30	8.80	8.80	6.20	6.20
	3.2	7.20	7.20	7.20	7.20	8.30	8.30	8.80	8.80	6.20	6.20
	3.3	7.20	7.20	7.20	7.20	8.30	8.30	8.80	8.80	6.20	6.20
	3.4	7.20	7.20	7.20	7.20	8.30	7.70	8.80	8.20	6.20	6.20
Roding	a3.5u	7.20	7.10	7.20	7.20	8.30	7.70	8.80	8.20	6.20	6.20
	a3.5d	7.20	7.10	7.20	7.20	7.70	7.70	8.20	8.20	6.20	6.20
	River Roding	R5.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.6	7.30	7.10	7.20	7.20	7.70	7.70	8.20	8.20	6.10	6.10
	3.7	7.30	7.10	7.20	7.20	7.70	7.70	8.20	8.20	6.10	6.10
	3.8	7.30	7.10	7.20	7.20	7.70	7.70	8.20	8.20	6.10	6.10
Beam	3.9	7.20	7.10	7.10	7.10	7.70	7.70	8.20	8.20	6.10	6.10
	3.10	7.10	7.10	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
	3.11	7.05	7.10	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
	3.12	6.90	7.00	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
	3.13	7.00	7.00	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
	3.14	7.00	6.90	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
Darent	3.15u	7.05	6.90	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
	3.15d	7.05	6.90	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
	River Darent	N/A	R5.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.16	7.15	6.70	7.10	7.10	7.60	7.60	8.10	8.10	6.10	6.10
	3.17	6.85	6.74	7.00	7.00	7.60	7.60	8.00	8.00	8.50	8.50
	3.18	6.90	6.35	7.00	7.00	7.50	7.50	8.00	8.00	8.50	8.50
	3.19	6.85	6.75	7.00	7.00	7.50	7.50	8.00	8.00	8.50	8.50
	3.20	6.85	6.28	7.00	7.00	7.50	7.50	8.00	8.00	8.50	8.00
	3.21	6.90	7.05	7.00	7.00	7.50	7.50	8.00	8.00	8.50	8.00
	3.22	6.85	7.05	7.00	7.00	7.50	7.50	7.90	7.90	8.00	8.00
	3.23	6.85	6.75	7.00	7.00	7.50	7.50	7.90	7.90	8.00	8.00
	3.24	6.50	6.73	6.90	6.90	7.40	7.40	7.90	7.90	8.00	8.00
Tilbury	3.25	6.95	6.87	6.90	6.90	7.40	7.40	7.90	7.90	8.00	8.00
	3.26	6.65	6.75	6.90	6.90	7.40	7.40	7.90	7.90	8.00	8.00
	3.27	7.00	6.35	6.90	6.35	7.40	6.35	7.90	6.35	8.00	6.35
	3.28	7.00	6.57	7.00	6.57	7.00	6.57	7.00	6.57	7.00	6.57
	3.29	6.48	6.12	6.48	6.12	6.48	6.12	6.48	6.12	6.48	6.12
	3.30	6.75	5.91	6.75	5.91	6.75	5.91	6.75	5.91	6.75	5.91
Mucking	3.31	6.90	6.10	6.90	6.10	7.50	6.10	8.10	6.10	8.10	6.10
	3.32	6.50	5.90	6.90	5.90	7.50	5.90	8.10	5.90	8.10	5.90
	3.33	6.60	5.80	6.80	5.80	7.50	5.80	8.10	5.80	8.10	5.80
	Vange Creek	R4.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.34	6.80	5.75	6.70	5.75	7.40	5.75	8.10	5.75	8.10	5.75
Canvey	3.35	6.75	5.82	6.70	5.82	7.40	5.82	8.10	5.82	8.10	5.82
	3.36	6.65	Cliff	6.70		7.40		8.10		8.10	
	EH Creek	R4.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Hadleigh Marsh	R6.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.37	4.75	5.30	6.00	5.30	6.70	5.30	7.40	5.30	7.40	5.30
Southend	3.38	5.70	5.50	6.00	5.50	6.70	5.50	7.40	5.50	7.40	5.50
	Grain east	N/A	5.70	N/A	6.30	N/A	7.00	N/A	7.70	N/A	7.70

Key		Notes
	P5 (1:10,000)	Defence levels are shown at ISIS model nodes. Policy Units are not indicated.
	P4 (1:1,000)	Representative levels are shown using the prefix 'R' for defences
	P4 (1:200)	not represented by ISIS nodes.
	P3	

If staff are requested to provide data to developers in P3 areas downriver of the Barrier, including at Hadleigh Marshes, North Kent Marshes and Isle of Grain, they must contact the TE2100 implementation team as early as possible, to ensure they use the best available data on design levels. The TE2100 Plan assumed that the existing defence crest levels would be maintained in P3 areas downriver of the Barrier but did not calculate the specific design levels required for such sites. These may need to be calculated to support such a data request.

Source: Reference 29 (*Phase 3 Set 2 Estuary Wide Options – Hydraulic Modelling*). Some minor adjustments were subsequently made to simplify the level information.

Table 7.2 Defence levels for Policy Units downriver of the Thames Barrier

Recommendations are given in the right hand column for the allowances for future raising that should be included in new defence designs when defences are replaced.

Policy Unit	Bank	Defence levels (m AOD)				Comment and Recommendations
		Existing (2009 data)	2070 Implement in 2040	2170 See Table 7.1 for implementation dates	2170	
				Option 1.4	Option 3.2	
Greenwich, Royal Docks	R L	7.2	7.2	8.8	6.2	Downriver Thames Barrier. Allow future raising to 8.8m AOD
Barking & Dagenham	L	7.2	7.2	8.2	6.1	Allow future raising to 8.2m AOD
Rainham	L	6.9 – 7.1	7.1	8.1	6.1	Allow future raising to 8.1m AOD
Thamesmead	R	7.0 – 7.1	7.1 – 7.2	8.1 – 8.2	6.1	Allow future raising to 8.2m AOD
Dartford & Erith:						
- U/R new barrier	R	6.7 – 7.0	7.1	8.1	6.1	Allow future raising to 8.1m AOD
- D/R new barrier	R	6.7	7.0	8.0	8.5	Allow future raising to 8.5m AOD
Swanscombe & Northfleet	R	6.3 – 7.1	6.9 – 7.0	7.9 – 8.0	8.0	Allow future raising to 8.0m AOD
Purfleet, Grays & Tilbury:						
- U/R new barrier	L	7.1	7.0 - 7.1	8.0 - 8.1	6.1	Allow future raising to 8.1m AOD
- D/R new barrier to Grays	L	6.8 – 6.9	7.0	8.0	8.5	Allow future raising to 8.5m AOD
- D/R Grays	L	6.5 – 6.9	6.9 – 7.0	7.9	8.0	Allow future raising to 8.0m AOD
East Tilbury	L	6.4 – 6.9	6.4 – 6.9	6.4 – 6.9	6.4 – 6.9	APF will be 5% by 2100. Consider secondary defence for East Tilbury.
Shellhaven & Fobbing	L	6.5	6.8 – 6.9	8.1	8.1	Allow for future raising of existing tidal defences to 8.1m AOD in the southern half of the policy unit (i.e. from Mucking Sluice to Fobbing Barrier) to protect critical infrastructure, including London Gateway Port.
Bowers	L	6.5	6.7	8.1	8.1	Allow future raising to 8.1m AOD for primary defence on Holehaven Creek.
Canvey	L	6.6 – 6.8	6.7	8.1	8.1	Allow future raising to 8.1m AOD
Hadleigh	L	6.0	6.0	6.0	6.0	
Southend	L	4.7 – 5.7	6.0	7.4	7.4	Allow future raising to 7.4m AOD
North Kent west	R	6.1 - 6.5	6.1 - 6.5	6.1 - 6.5	6.1 - 6.5	
North Kent east	R	5.8 – 6.1	5.8 – 6.1	5.8 – 6.1	5.8 – 6.1	
Grain west	R	5.5	5.5	5.5	5.5	No defence raising proposed for Allhallows and Grain Marshes. Protection needed for access routes to Grain east.
Grain east	R	5.7	6.0 – 6.3	7.4 – 7.7	7.4 – 7.7	Industrial areas. Allow future raising to 7.4m or 7.7m AOD depending on location.

Notes:
Green shading: Policy P3 - No change in levels
Orange shading: Increase in defence levels
D/R: Downriver U/R: Upriver

If staff are requested to provide data to developers in P3 areas downriver of the Barrier, including at Hadleigh Marshes, North Kent Marshes and Isle of Grain, they must contact the TE2100 implementation team as early as possible, to ensure they use the best available data on design levels. The TE2100 Plan assumed that the existing defence crest levels would be maintained in P3 areas downriver of the Barrier but did not calculate the specific design levels required for such sites. These may need to be calculated to support such a data request.

Annex B –

BREACH MODELLING METHODOLOGY

INTRODUCTION

This Annex details the methodology of the modelling undertaken to assess the potential impact of a breach of the River Thames Flood Defences.

The Environment Agency (in its response to the Statutory Section 42 Consultation dated 29th November 2023) requested that baseline and Proposed Scheme breach modelling was undertaken to understand the implications on residual flood risk to existing homes, businesses and infrastructure. A 2D hydrodynamic model has been developed using the MIKE by DHI Flexible Mesh modelling software and provides further information on the flood depth, extent, and hazard under current baseline conditions and after the Proposed Scheme is constructed in the event of a flood defence breach.

The following scenarios have been modelled for each of the breach locations:

- **Existing baseline scenario** – this includes current topography, all current buildings (as identified on OS mapping) and roads, as well as the under-construction Riverside 2 facility;
- **Proposed scenario** – this takes the existing scenario and adds the Carbon Capture Facility (i.e. a raised platform, new buildings, and new roads).

Table B-1 describes the units and conventions used in the modelling, where possible expressed using SI notation.

Table B-1: Units and Conventions

Variable	Unit
Position	Relative to British National Grid (Easting & Northing)
Water level (surface elevation)	Metres Above Ordnance Datum (mAOD)
Water depth	Metres (m)

MODEL CONFIGURATION

MODEL DOMAIN

The landward extent of the model domain (**Figure B-1: Model Domain and Bathymetry (Existing Scenario)**) covers an area c.5.6km x 2.3km south of the Proposed Scheme. The boundary of the model domain was determined by iterative testing and analysis of the topography to ensure that is large enough to ensure that it does not influence the predicted flows.

The extent of the River Thames included in the model domain is an area c.320m away from the banks to propagate the applied water level boundary condition.

TOPOGRAPHY AND BATHYMETRY

Multiple sources of topographic and bathymetric data have been used within the model including:

- Digital Terrain Model (DTM) LiDAR data of the overland section of the model domain (1m resolution, 2020 data) sourced from DEFRA (tiles TQ47nw/ne, TQ48sw/se, TQ57nw and TQ58sw). Sensitivity testing against more recently released 2022 data has shown no significant differences to ground levels around the site compared to the 2020 dataset used;
- local bathymetric data of the Thames around the site sourced from the Port of London Authority 'PLA' chart 327; and
- bathymetric data upstream of the site sourced from C-MAP Admiralty Chart Data owned and licensed to WSP.

All data sets were corrected to a common datum (m ODN), 3.28m below chart datum (UKHO Admiralty TotalTide Erith Station) and converted to the British National Grid horizontal projection system. Where data overlapped, checks were undertaken to ensure each provided consistent results.

MESH

The landward extent of the mesh has a resolution of approximately 5m, and the river extent ranges from 10m at the banks to 100m further into the channel.

The Environment Agency's 'Asset Information and Maintenance Programme[46] records the crest height of the flood defence along this reach of the Thames as at least 7m ODN, 0.44m higher than the extreme water level considered (1 in 200 year event at the end of the 50 year design life; 6.56m ODN). This means that no inundation is expected to occur as a result of the defence being overtopped. Furthermore, the TE2100 Plan[37] details the height to which the defences will be raised to ensure continuity of protection. Therefore, this modelling only focuses on the impacts of individual breaches through the adoption of a 'glass wall'. This assumption has been utilised so that the only section of the wall included in the model mesh is where the breach occurs.

As per option 4 in the guidance titled 'Buildings: modelling flood risk to property' (2D)[47], buildings in the model domain have been excluded from the model mesh (i.e. assumed to be raised/impermeable). Mapping from OS OpenMap Local[12] was used to generate the building polygons. Buildings forming the under-construction Riverside 2 development have been added to the mesh. Where gaps between buildings are less than 5m wide (the resolution of the model mesh), the polygons were merged to prevent prohibitively small mesh elements.

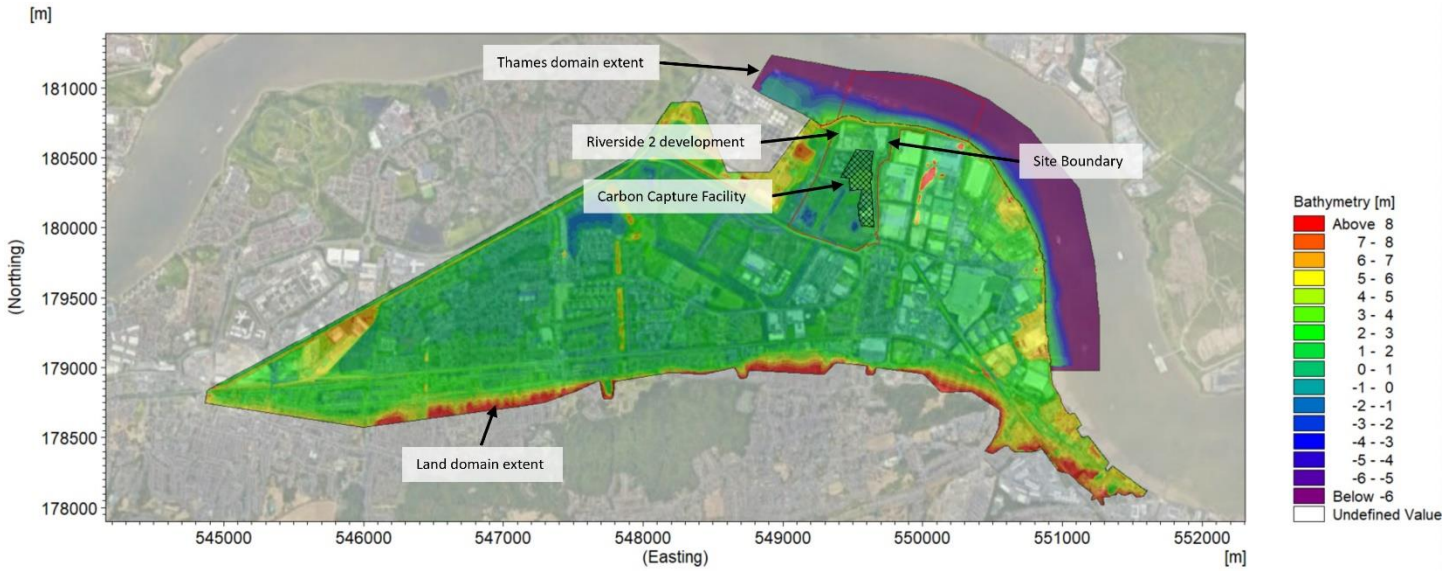


Figure B-1: Model Domain and Bathymetry (Existing Scenario)

BOUNDARY CONDITIONS

The Environment Agency provided water levels for the River Thames for the future scenario from the TE2100 2008 dataset. However, the Environment Agency's assessment year is beyond the design year of the Proposed Scheme.

Thus, design water levels for the design year have been derived from the TE2100 2008 data (using the data for Dartford as a proxy given that this is the nearest node with sufficient available data) through linear interpolation/extrapolation. As the Dartford node is not immediately adjacent to the site, the hydrodynamic model (detailed in **Appendix 11-4: Coastal Modelling Studies (Volume 3)**) was used to determine the realistic worst case difference in peak water levels between Dartford and the Proposed Site. This required an 80mm uplift to the linear interpolation/extrapolation derived levels to determine the final extreme water levels of 6.56m AOD for a 1 in 200 year event in the design year (2081).

A single water level boundary condition has been applied to the model (**Figure B-2: Water Level Boundary Condition Around Time of Breach**), in addition to the zero normal velocity land boundary. This is applied in the river channel, approximately 320m away from the breach locations (at the domain boundary as shown in **Figure B-1: Model Domain and Bathymetry (Existing Scenario)**. No other sources or infiltration have been considered.

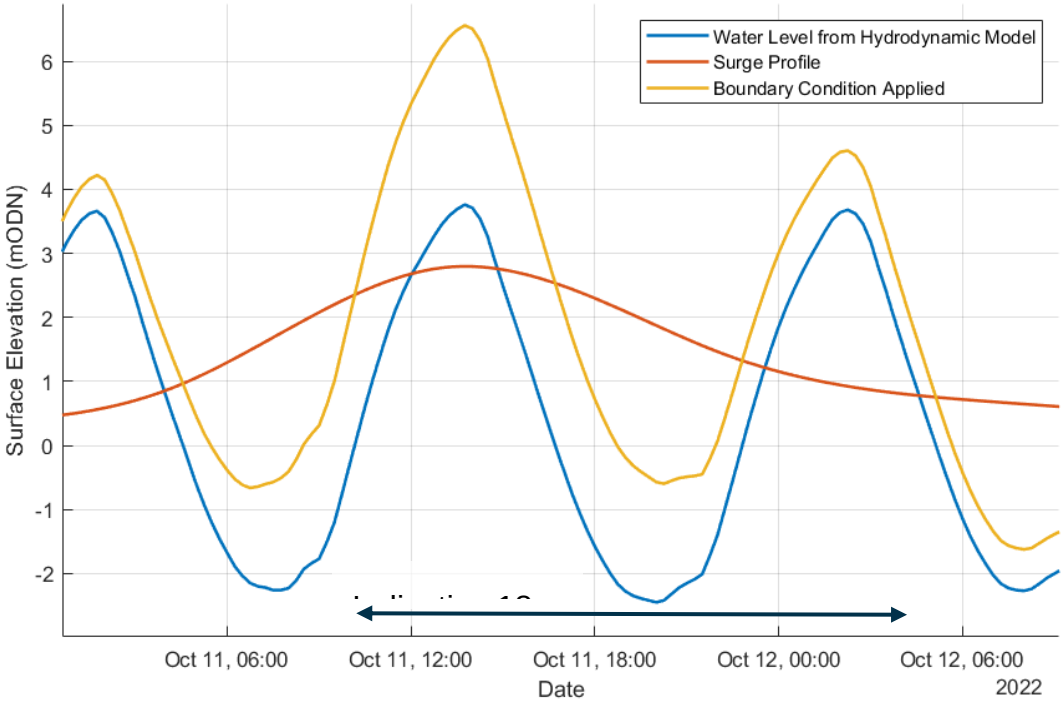


Figure B-2: Water Level Boundary Condition Around Time of Breach

Data for Dartford (approximately 6km downstream from the site) from the TE2100 2008 Environment Agency dataset[24] was combined with the Coastal Flood Boundary surge profile (Sheerness) and tidal profiles extracted from the hydrodynamic model to create a series of tides representative of a 1 in 200 year extreme event in 2081 (the end of the design life, as detailed in the FRA). The peak water level is 6.56m ODN.

Within the model run covering a total of 7 tidal cycles, the breach occurs over an 18hr window. The exact timing of the breach varies between locations depending on the breach level adopted (starting with a water level at 75% of the total defence height).

BED ROUGHNESS

Bed roughness is represented using a variable Mannings M value over the model domain (**Figure B-3: Model Domain And Roughness (Existing Scenario) Breaches**). Different surface types (with shapes defined by OS OpenMap Local data) were assigned roughness values (**Table B-2**) based on HR Wallingford's Conveyance Estimation System. The section of the domain in the river is set to match the hydrodynamic model.

Table B-2: Roughness Values Applied to Model Domain

Surface	Manning M ($m^{1/3}/s$)
Road	50
Woodland	4

Surface	Manning M ($m^{1/3}/s$)
Surface water	28
Railway track	28
Foreshore	55
General surface	25
Riverbed	65

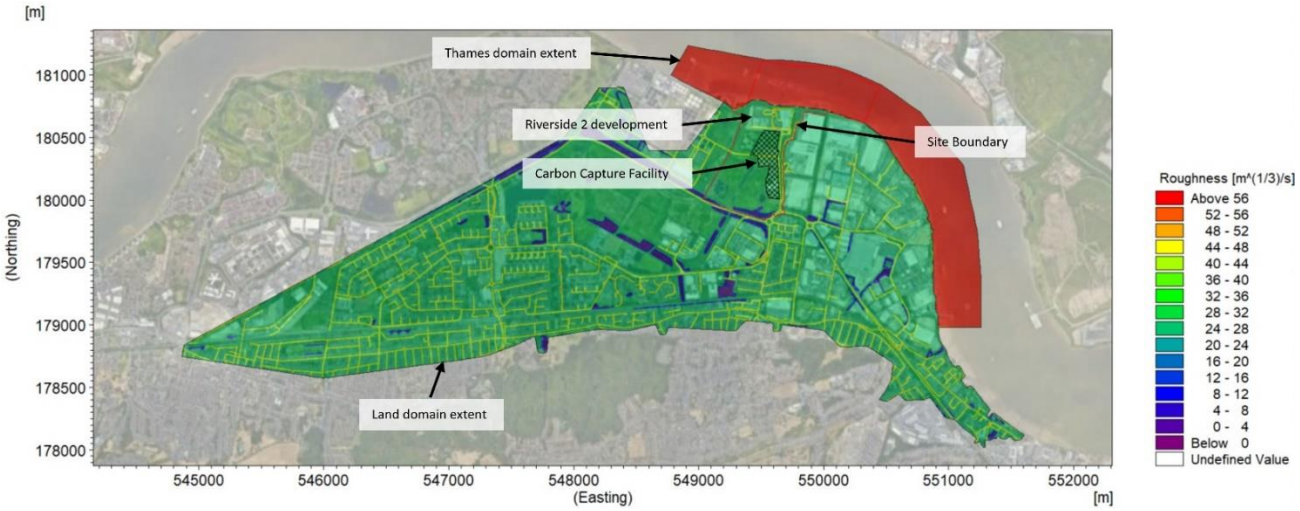


Figure B-3: Model Domain And Roughness (Existing Scenario) Breaches

Seven breach locations have been separately modelled, covering a distance of c.2.25km centred around the raised platform area of the Carbon Capture Facility (**Figure B-4: Breach Locations**). Breaches 1 and 7 are in locations used in existing Environment Agency models. Breaches 2-6 cover the site frontage in locations chosen for the following reasons:

- Breach 2 fronts the Riverside 2 development;
- Breach 3 has a clear flow path between Riverside 1 and 2;
- Breaches 4 and 5 are located where the Proposed Jetty and Access Trestle comes on land; and
- Breach 6 has a clear flow path between industrial buildings to the east of the Site.

Each of the breaches has been modelled as 20m wide and open for 18hrs, as per the Environment Agency's "*Breach of defences*" guidance for hard defences (this defence is recorded as a wall in the Environment Agency's asset management database) on an urban tidal river.

Figure B-4: Breach Locations

For each breach the underlying ground model was lowered as per the Environment Agency's "*Breach of defences*" guidance. The landward toe level was determined as the lowest point within a semicircle centred on the breach crest with a radius equal to the breach width. **Figure B-5: Elevation Cross-Sections at Breach Locations** shows the existing and breach cross-sections at the seven breach locations.

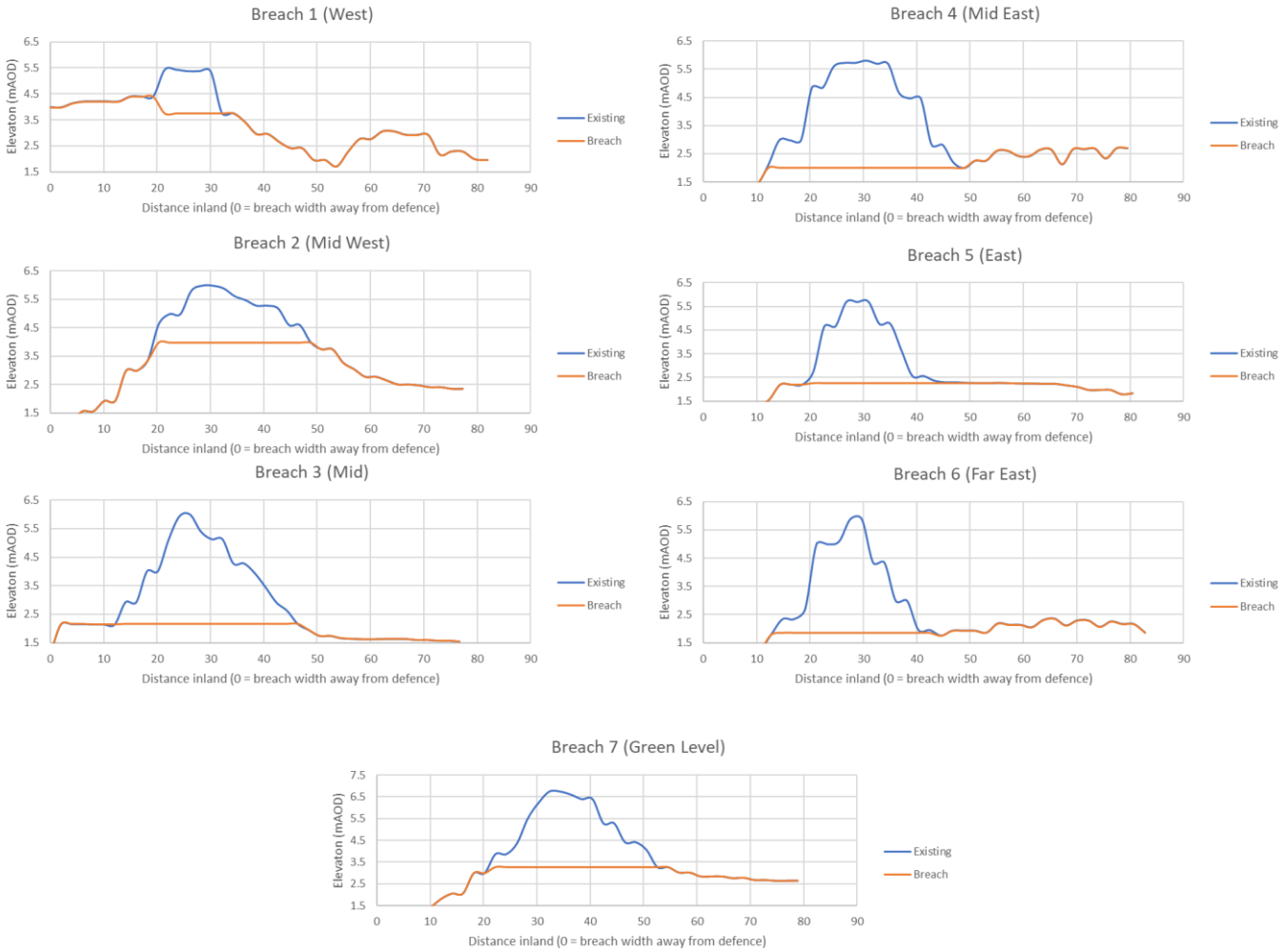


Figure B-5: Elevation Cross-Sections at Breach Locations

PROPOSED SCENARIO

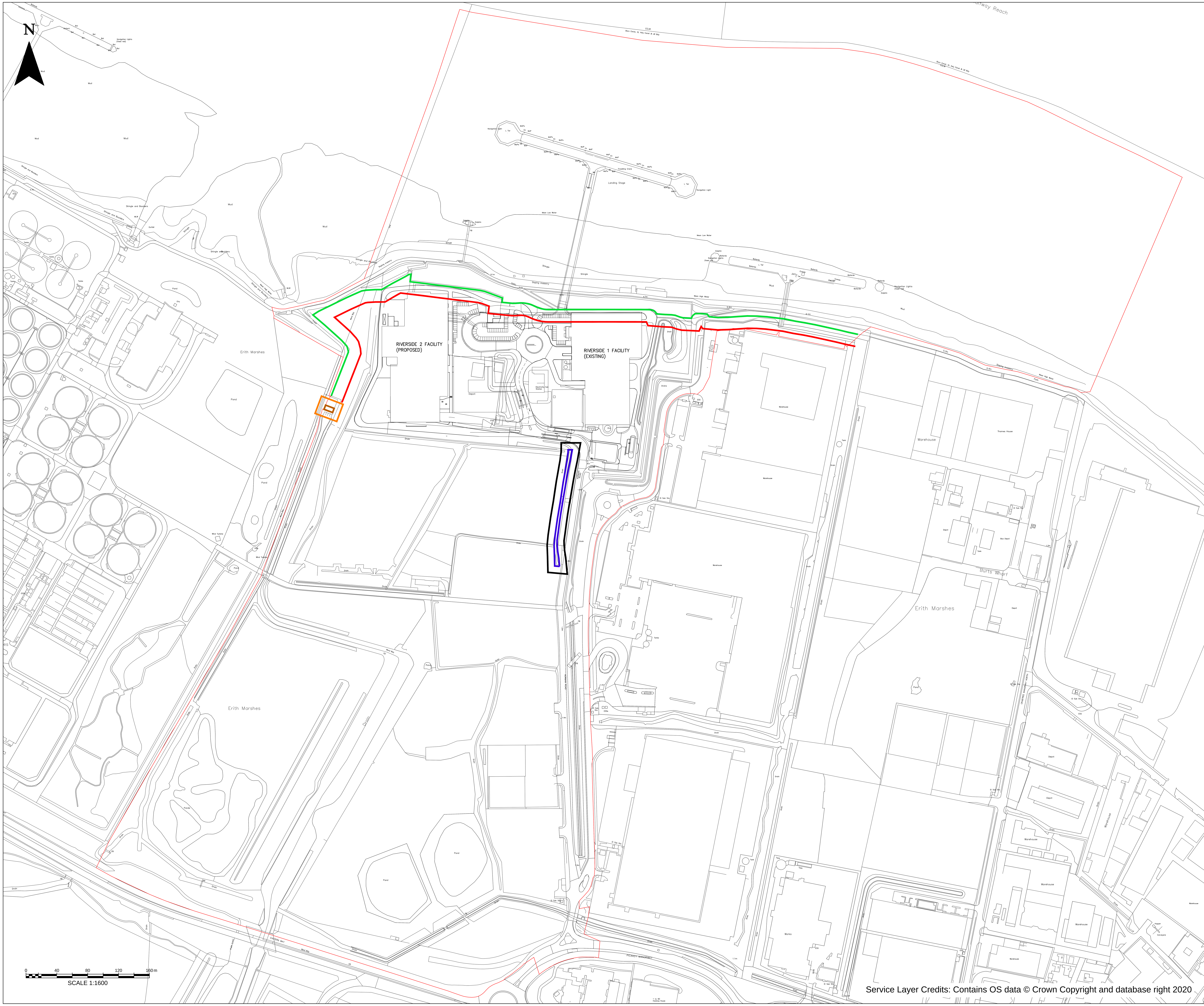
To model the proposed scenario, a raised platform (shown hatched in **Figure B-4: Breach Locations**) was included in the model. As with the buildings, it was excluded from the model mesh (i.e. assumed to be raised high enough to always remain dry). The recommended levels for the platform are detailed in **Section 8.2** of this assessment.

The raised platform along with proposed buildings and roads were added to the model. Any existing buildings within the raised platform area were removed.

Annex C

FLOOD RISK ASSESSMENT DRAWINGS

[Please see the separate PDF for full A3 versions of **Annex C**]



Key:

- RIVER THAMES FLOOD DEFENCE
- FLOOD DEFENCE 16m OFFSET
- MAIN RIVER
- MAIN RIVER 9m OFFSET
- GREAT BREACH PUMPING STATION
- GREAT BREACH PUMPING STATION 9m OFFSET

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	SH	JG	JW	14/03/2024
FINAL				

DESCRIPTION

wsp

PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

ENVIRONMENT AGENCY ASSETS

DRAWING STATUS

FINAL

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
SH	JG	JW	AS

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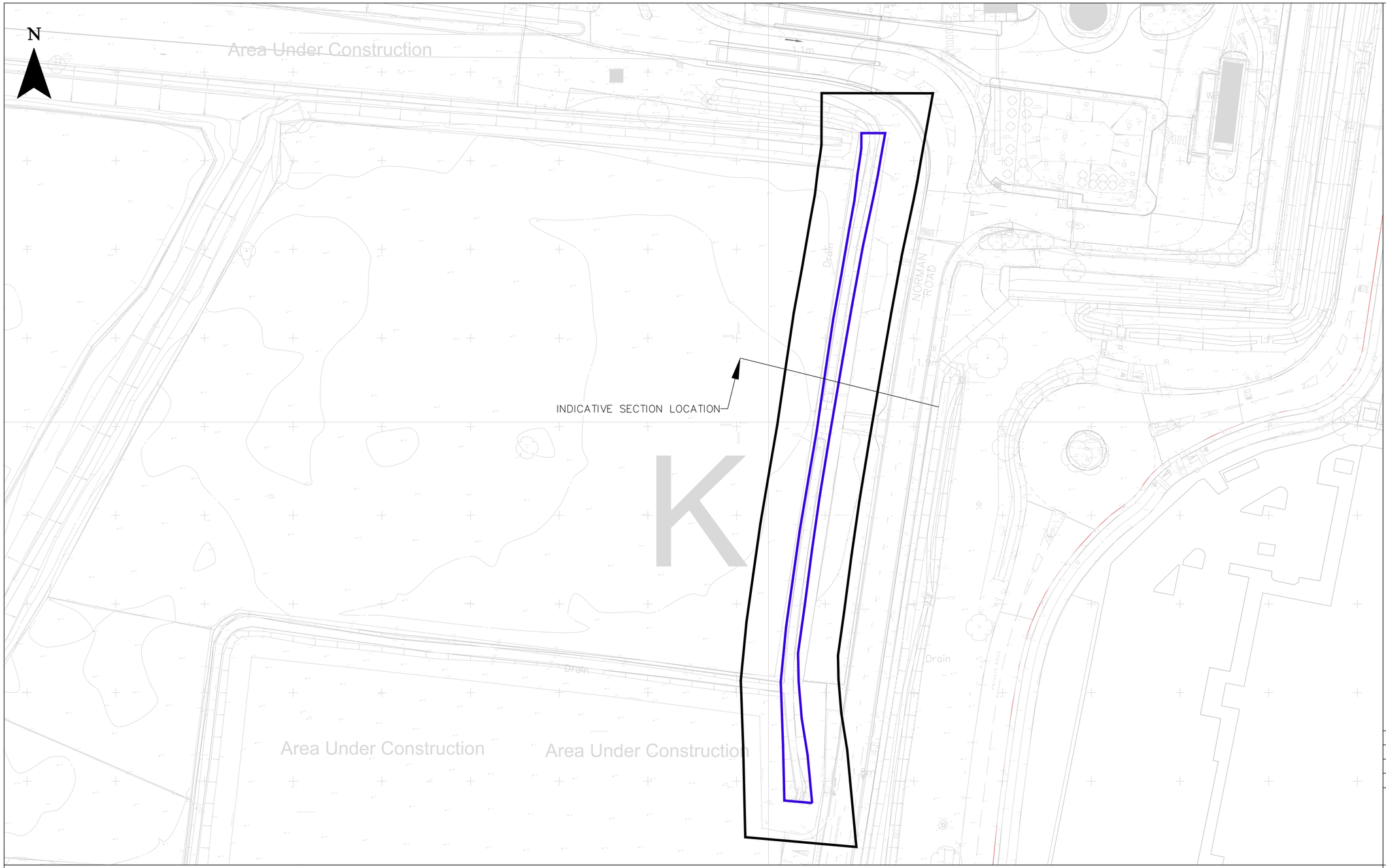
1:1600	14/03/2024	P01

DRAWING NUMBER:

70090329-FRA-A3-001



Key:

MAIN RIVER

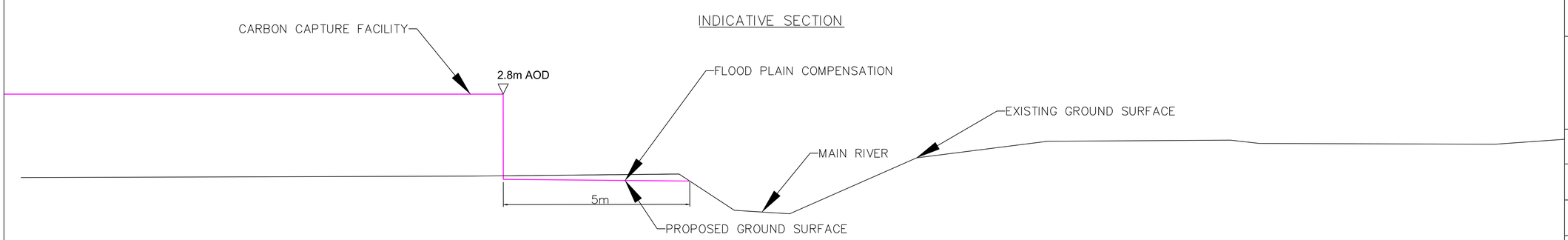
MAIN RIVER 9m OFFSET

NOTES:

1. THIS DRAWING IS FOR INFORMATION ONLY AND SHALL NOT BE USED FOR ANY OTHER PURPOSE
2. ENGINEERING SECTIONS/ELEVATIONS AND PLANS ARE INDICATIVE ONLY AND WILL BE SUBJECT TO DETAILED DESIGN DEVELOPMENT
3. DETAILS AND LOCATION OF EXISTING INFRASTRUCTURE SHOWN INDICATIVELY
4. ALL LEVELS ARE IN METERS TO ORDINANCE DATUM (OD) UNLESS STATED OTHERWISE
5. THIS DRAWING IS NOT TO SCALE
6. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FLOOD RISK ASSESSMENT

P01	SH	JG	JW	11/03/2024
FINAL				
REVISION	DRAWN	CHECKED	APPROVED	DATE
DESCRIPTION				

INDICATIVE SECTION



PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

OUTLINE FLOOD COMPENSATION / NORMAN ROAD STREAM PROPOSAL

DRAWING STATUS: FINAL

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SH	JG	JW	AS

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NOT TO SCALE	11/03/2024	P01

DRAWING NUMBER:

70090329-FRA-A3-002

N

0 40 80 120 160m

SCALE 1:1600

Service Layer Credits: Contains OS data © Crown Copyright and database right 2020

NOTES:

1. **DO NOT SCALE FROM THIS DRAWING.**
2. **THIS DRAWING IS FOR INFORMATION ONLY AND SHALL NOT BE USED FOR ANY OTHER PURPOSE**
3. **LOCATION OF PROPOSED INFRASTRUCTURE SHOWN INDICATIVELY**
4. **ENGINEERING ELEVATIONS AND PLANS ARE INDICATIVE ONLY AND WILL BE SUBJECT TO DETAILED DESIGN DEVELOPMENT**
5. **ALL LEVELS ARE IN METERS TO ORDINANCE DATUM (OD) UNLESS STATED OTHERWISE**
6. **FINISHED SITE LEVELS HAVE BEEN PRODUCED BY COMBINING LEVELS FROM TOPOGRAPHICAL SURVEY FROM MALTBY SURVEYS LTD DEC 2023 AND PROPOSED FINISHED SITE LEVELS 11004105 BY HITACHI ZOSEN INOVA**

LEGEND

- INDICATIVE OVERLAND FLOW ROUTE (Based on surveyed and proposed site levels)
- WATERCOURSE / WATERBODY / DRAINAGE DITCH
- RIVERSIDE 1 AND RIVERSIDE 2

REVISION	DRAWN	CHECKED	APPROVED	DATE
P01	SH	JG	JW	11/03/2024

FINAL

DESCRIPTION

PROJECT TITLE:

CORY DECARBONISATION PROJECT

DRAWING TITLE:

INDICATIVE
OVERLAND FLOW ROUTES

DRAWING STATUS

FINAL

DRAWN:	CHECKED:	APPROVED:	AUTHORISED:
GH	SH	JG	JW

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1:500	11/03/2024	P01

DRAWING NUMBER:

70090329-FRA-A3-003

Annex D

ENVIRONMENT AGENCY'S MARSH DYKES MODEL COMMENTS

The Environment Agency provided comments to inform the use of the Marsh Dykes Model as part of its Scoping Response (dated 16th May 2023). The aspects which relate to the modelling aspects adopted within this assessment are addressed below.

Item 1 - "*The Marsh Dykes modelling study 2020, assumed that the gravity outfall was working at Great Breach although that outfall is now blocked by sediment build up at and beyond the tidal flap valve."*

It is understood that the outfall was blocked at the time of the modelling, as stated on page 41 of the Marsh Dykes Technical Modelling Report[23]. However, this may not have been included in the model, as the Environment Agency had aspirations to dredge the outfall, although it is understood that this is unlikely to occur. As the outputs from the Environment Agency's flood modelling demonstrates that the Proposed Scheme is only impacted by localised surface water ponding, for the design event and the 1 in 1,000 year event no further action is required to inform this assessment. Furthermore, the Environment Agency has subsequently informed the Applicant that it has a programme in place to upgrade the Great Breach Pumping Station by 2036. As the Environment Agency's programme had only just commenced at the time of writing, it has not been able to confirm the scope of the works. However, it is the Applicant's view that these works can be expected to accommodate the impacts of the lack of operation of the gravity outfall and to keep pace with the impacts of climate change.

Item 2 - "The need for flood modelling of the ditch network should be reviewed considering any changes to the network of surface water features or the floodplain."

A review of the publicly available aerial photographs has established that, whilst there have been alterations to the built form surrounding the Proposed Scheme, no substantial changes to the watercourse network are visible. Furthermore, Riverside 2 will not result in any changes to the adjacent watercourse network.

It is recognised that some minor ditch modifications/realignments may have occurred; however, these are unlikely significantly to affect flow conveyance or flood mechanisms. Consequently, there is no requirement to consider this aspect further. An excerpt of the Marsh Dykes Modelling Report is provided in **Figure D-1: Marsh Dykes Model Report - Excerpt** below, this indicates that the most significant changes in the catchment, the Crossrail embankment, is already included within the Marsh Dykes Model. **Section 8.5** of the main FRA finds that there is no requirement for additional modelling as the inundation shown in the model results is a result of rainfall ponding in localised depressions.

2.5.5 Level modification

Buildings have been explicitly represented in the Marsh Dykes model. The footprint of each building has been informed by Master Map. These polygons have been imported into the model as 'porous polygons'. The porous polygons have been assigned a threshold height of 0.15m and a porosity of zero (i.e. non-porous), overlain with a roughness zone with a Manning's *n* value of 0.3. As such surface flows are able to pass through a building, where flooding reaches the property threshold depth, but would preferentially flow between buildings. This approach was reviewed and agreed by the Environment Agency.

In order to determine the suitability of representing buildings in this way, a series of sensitivity tests were carried out. Details and results of this sensitivity testing are provided in Section 4.1.5.

All the roads have been included explicitly in the 2D domain. Kerb lines of the roads in the catchment have been included to represent the kerb drop shown in the DTM within the mesh. In addition, roughness zones of the highways have been included to represent a smooth road surface.

The only alteration to DTM levels is the Crossrail embankment, where land has been raised since the LIDAR was flown. The location and scale of DTM edits has been determined by design drawings, supplied by Crossrail.

The Crossrail embankment has been raised by 1.00 - 3.4m above DTM levels. The location of the DTM edits is shown in Figure 2-7.

The embankment elevations were based on drawings available at the time of building the model. Future development of the model should refer to the latest available Crossrail drawings.

Figure 2-7: Representation of the Crossrail embankment in the model

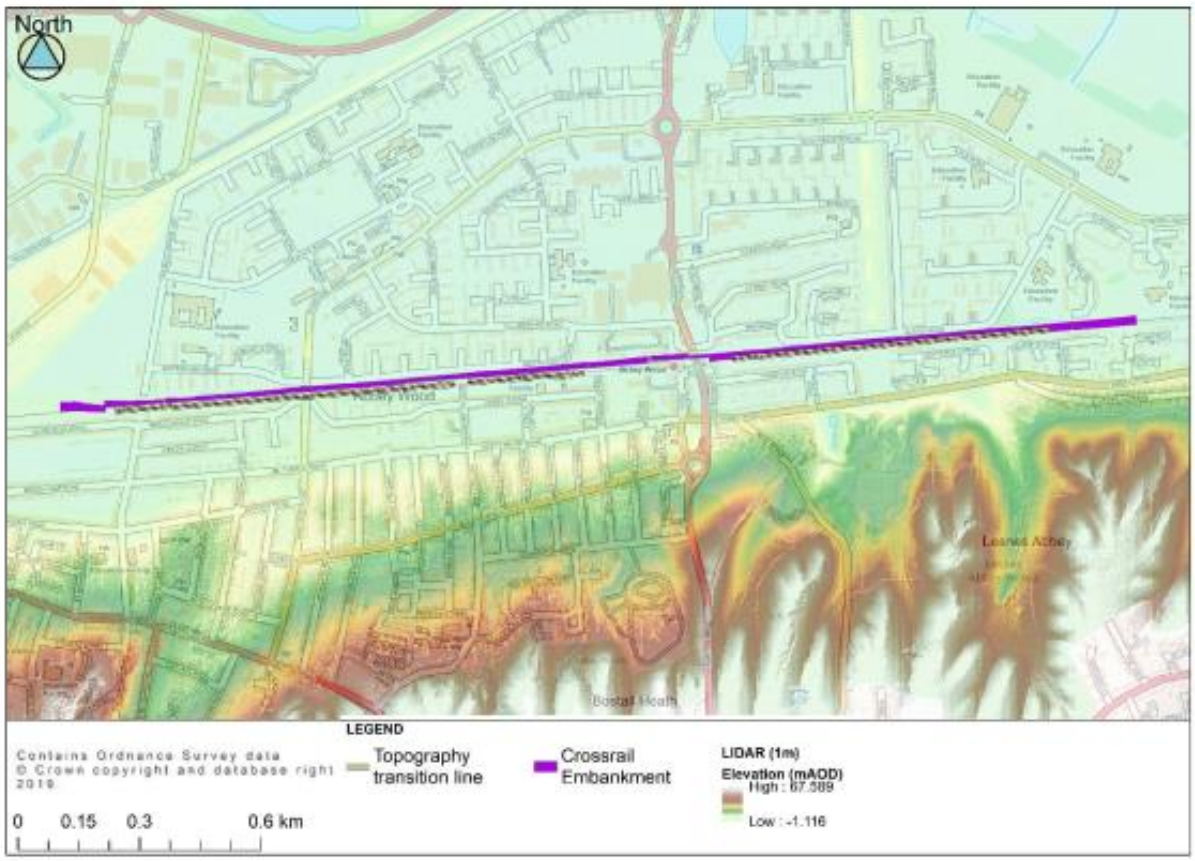
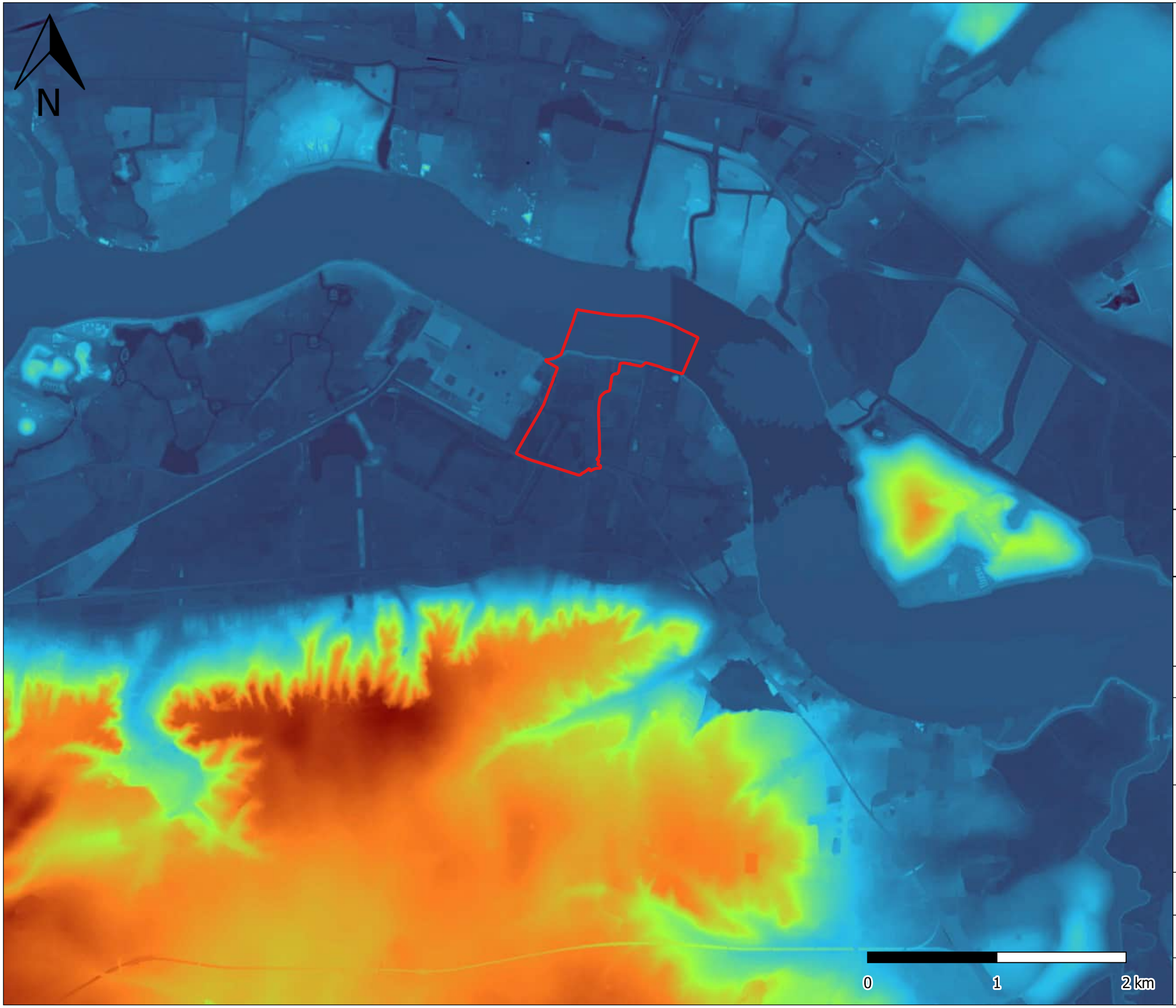


Figure D-1: Marsh Dykes Model Report - Excerpt

Annex E

FLOOD RISK ASSESSMENT FIGURES



LEGEND:

Site Boundary

Elevation (m AOD)

72.599007

-4.766075

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Local Topography

SCALE @A3:	CHECKED:	APPROVED:
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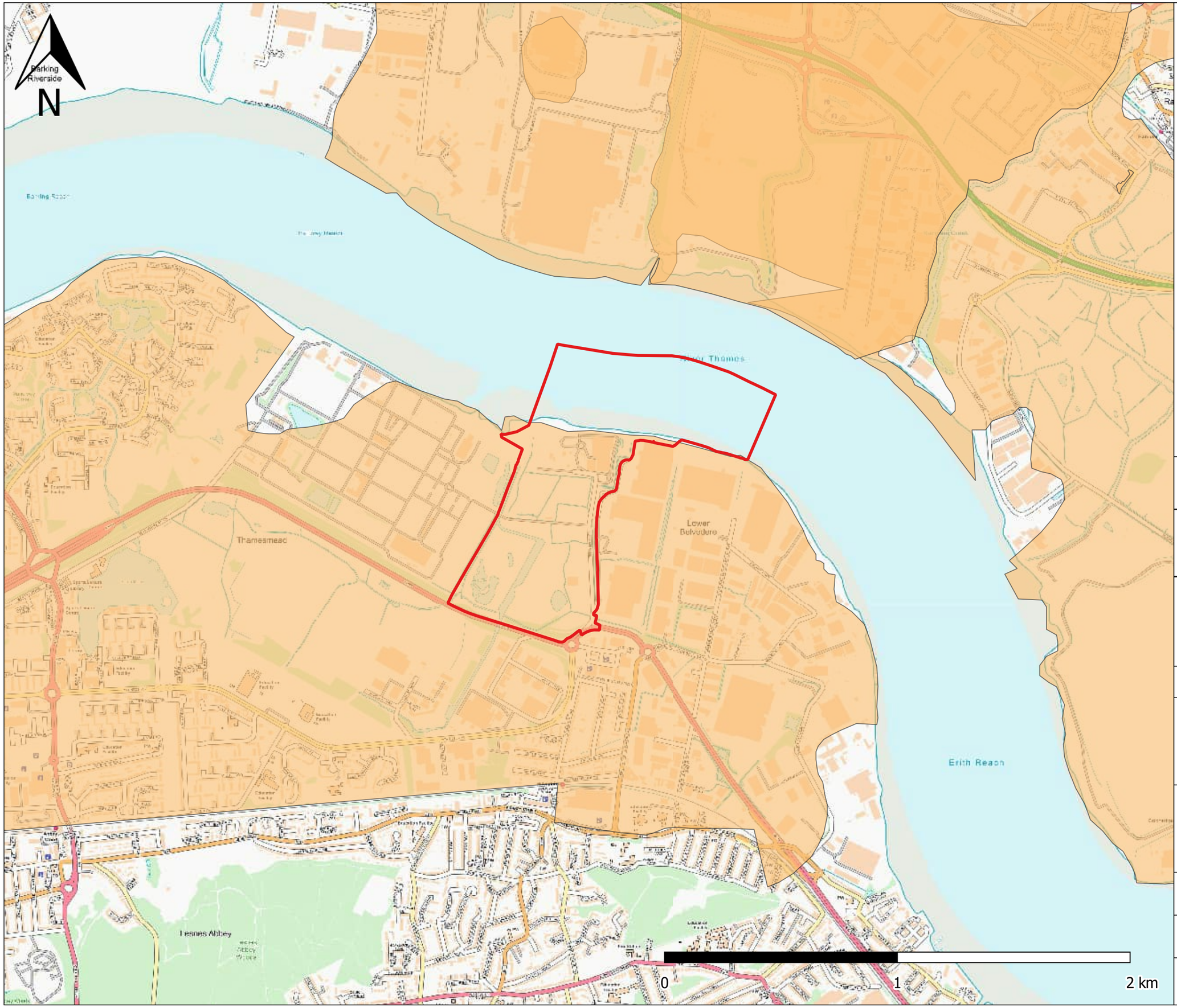
VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 5-1



LEGEND:

Site Boundary

Environment Agency's Recorded Flood Outlines

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Historical Flood Map

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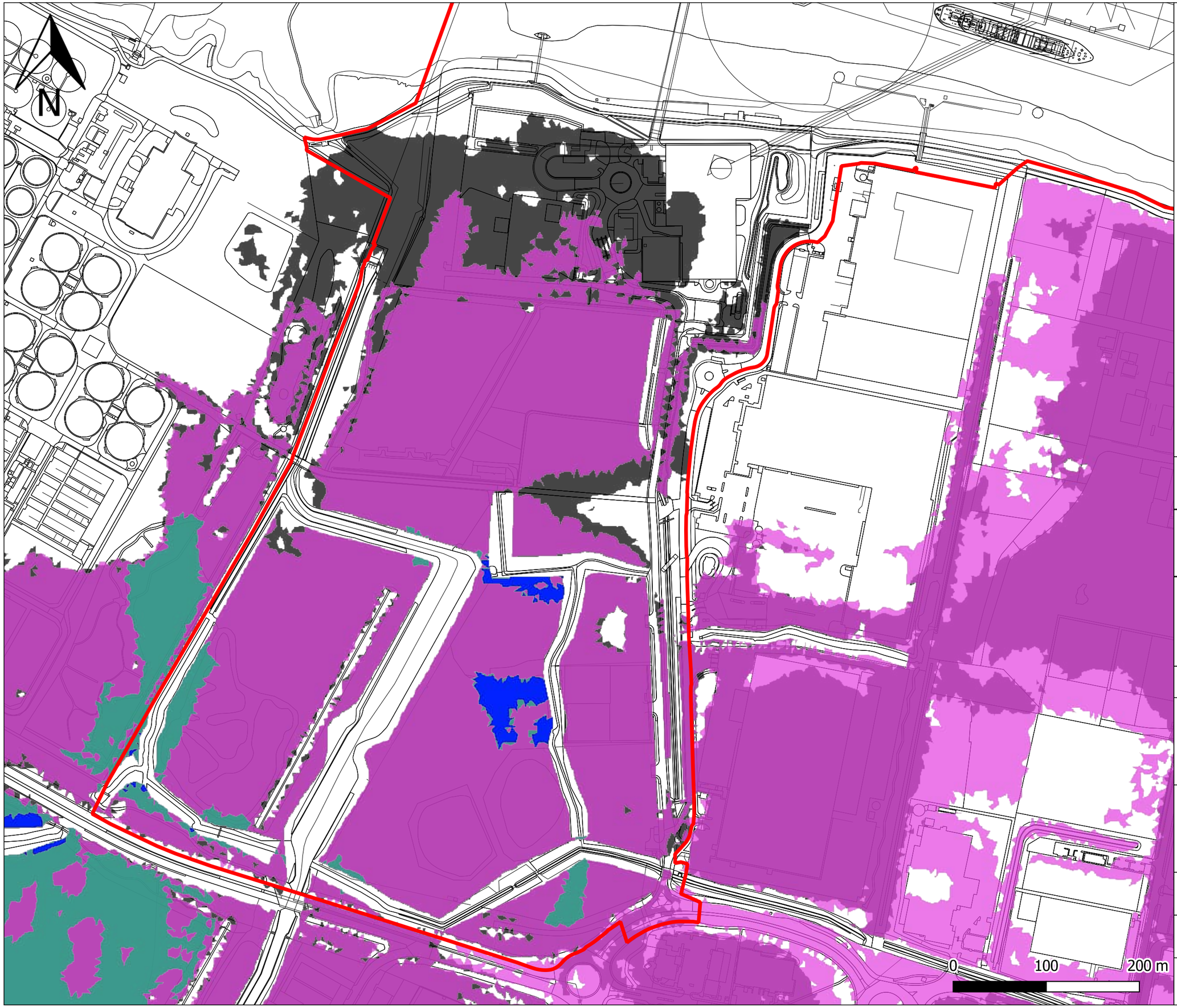
PROJECT No: 70090329	DRAWING No: Figure 8-1	



LEGEND:

- Site Boundary
- Green Levels Extent
- Green Levels Extent
- L4 Extent
- L5 Extent

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT:

Cory Decarbonisation Project

TITLE:

Marsh Dykes Model Breach Scenario Extents (2115)

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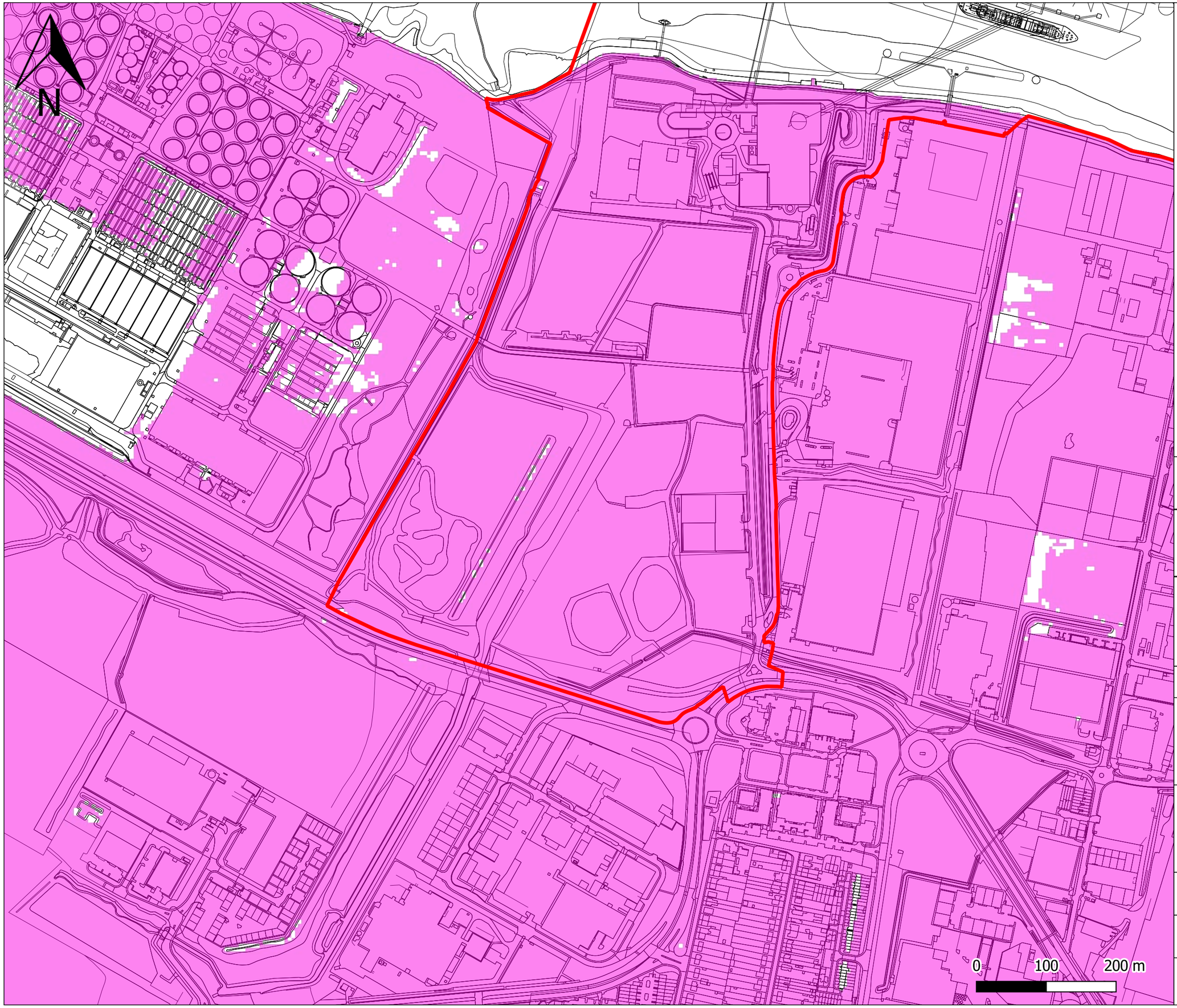
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-2	



LEGEND:

Site Boundary

Thames Estuary Breach 2115
1 in 200yr Flood Extent

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT:

Cory Decarbonisation Project

TITLE:

Breach Scenario Extents (source Thames Estuary Breach Assessment 2018)

SCALE @A3:	CHECKED:	APPROVED:
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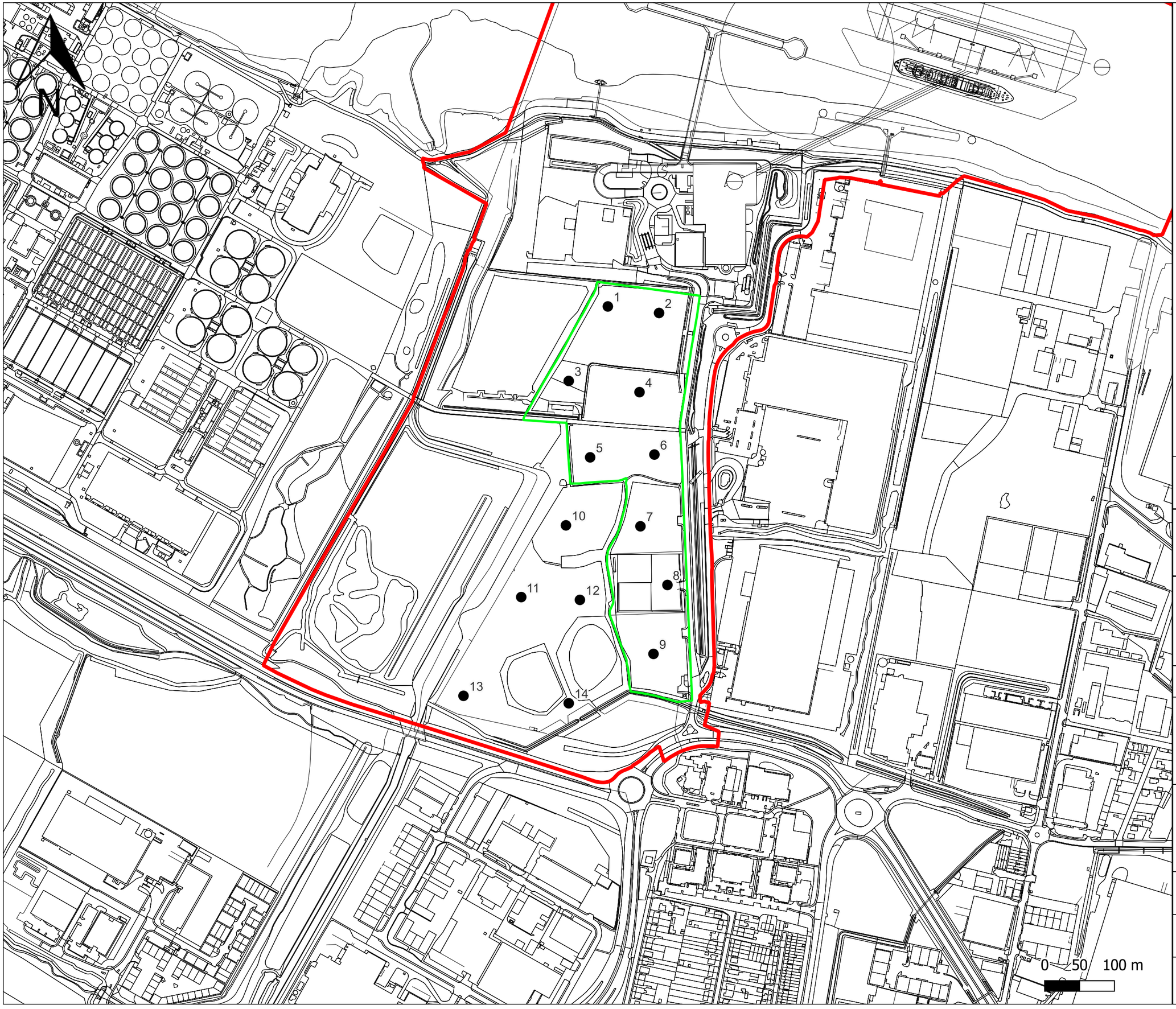
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-3	



LEGEND:

- Site Boundary
- Carbon Capture Facility
- Location Points

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Breach Water Level Sample Locations

SCALE @A3:	CHECKED:	APPROVED:
1:5000	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-4	

LEGEND:

- Site Boundary
- Raised Platform Area
- Breach Locations

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Thames Estuary Breach Model Breach Locations

SCALE @A3:	CHECKED:	APPROVED:
1:9000	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-5	

N

LEGEND:

- Site Boundary
- Carbon Capture Facility

Difference in Depth (m)

- Major (<-0.10 - Decrease)
- Moderate (-0.10 - -0.05)
- Minor (-0.05 - -0.01)
- -0.01 - 0.01
- Minor (0.01 - 0.05)
- Moderate (0.05 - 0.1)
- Major (> 0.10m - Increase)
- Was wet now dry
- Was dry now wet

0 1 2 km

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Marsh Dykes Model

SCALE @A3:	CHECKED:	APPROVED:
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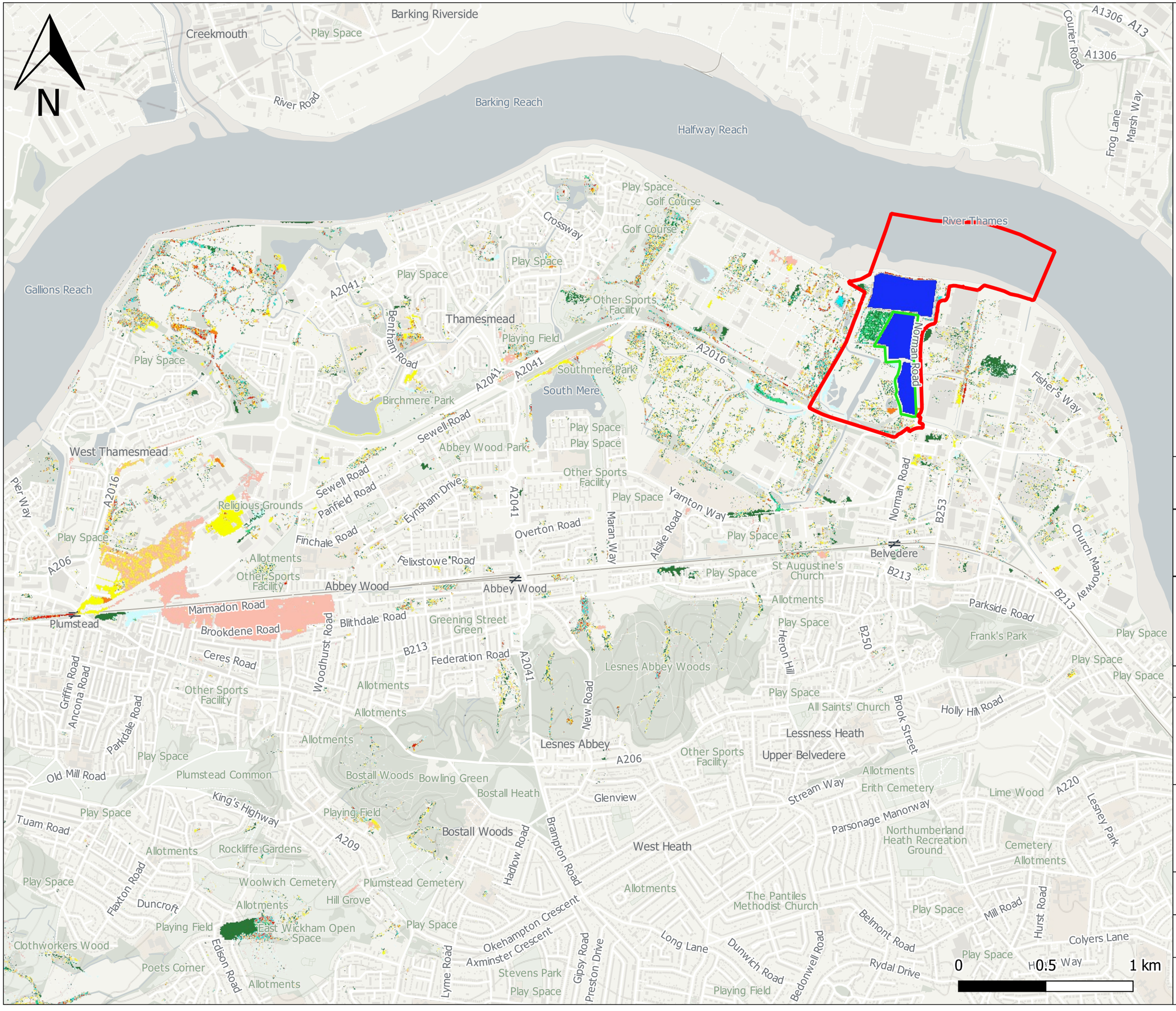
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-6	



LEGEND:

- Site Boundary
- Carbon Capture Facility

Difference in Depth (m)

- Major < -0.1
- Moderate -0.05 - -0.1
- Minor -0.01 - -0.05
- -0.005 - -0.01
- 0.005 - 0.01
- Minor 0.01 - 0.05
- Moderate 0.05 - 0.1
- Major >0.1
- Was wet now dry
- Was dry now wet

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT:

Cory Decarbonisation Project

TITLE:

Cory Marsh Dykes Model - Breach Analysis

SCALE @A3:	CHECKED:	APPROVED:
1:20000	SH	JG
VERSION: 1	DRAWN: 17/09/24	
PROJECT No: 70090329	DRAWING No: Figure 8-6a	

N

LEGEND:

- Site Boundary
- Carbon Capture Facility

Difference in Depth (m)

- -0.005 - -0.001
- -0.001 - 0
- 0 - 0.001
- 0.001 - 0.005

0 0.5 1 km

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Marsh Dykes Model - Breach Analysis

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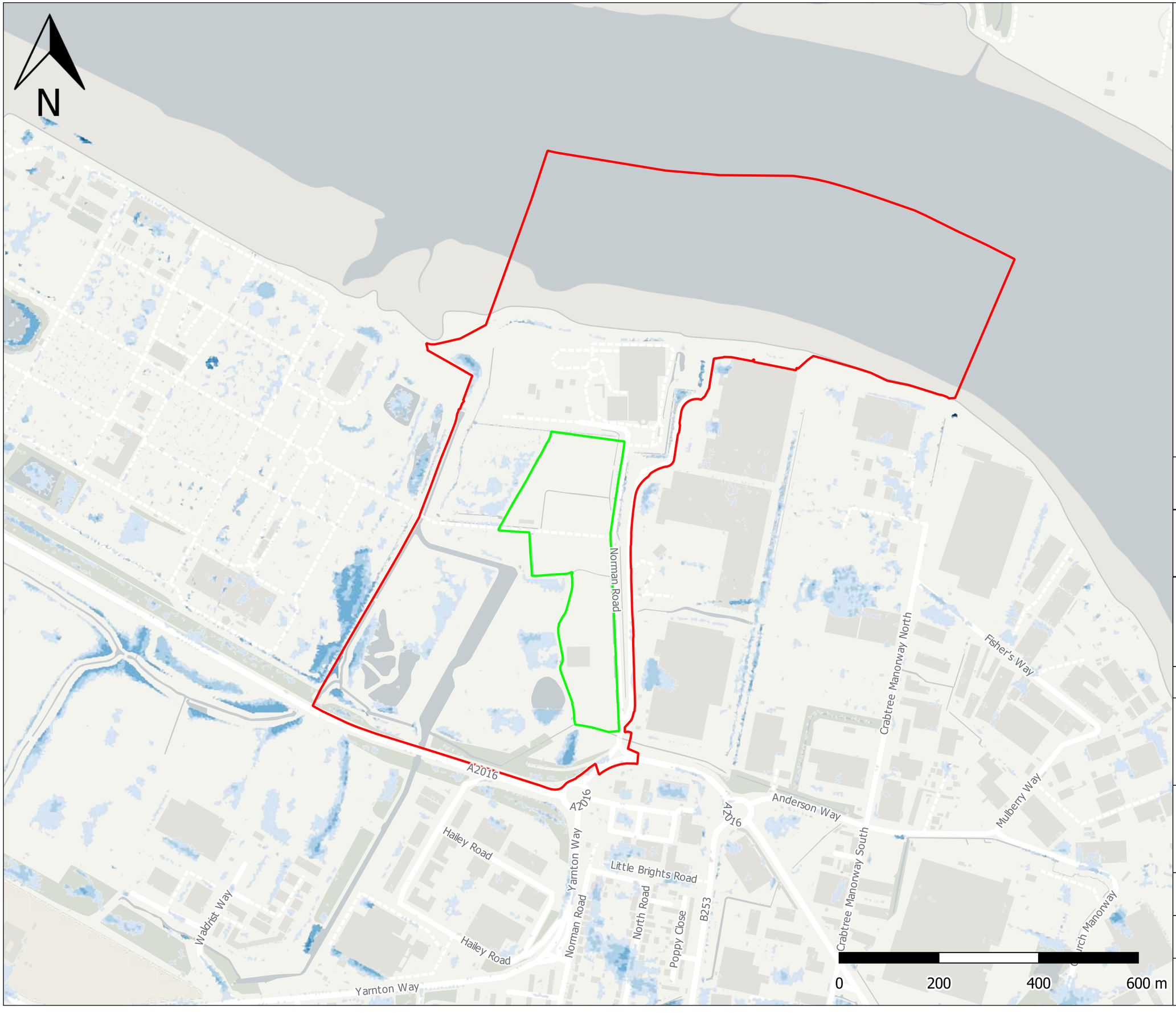


LEGEND:

- Site Boundary
- Carbon Capture Facility

Flood Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Cory Environmental Holdings Ltd

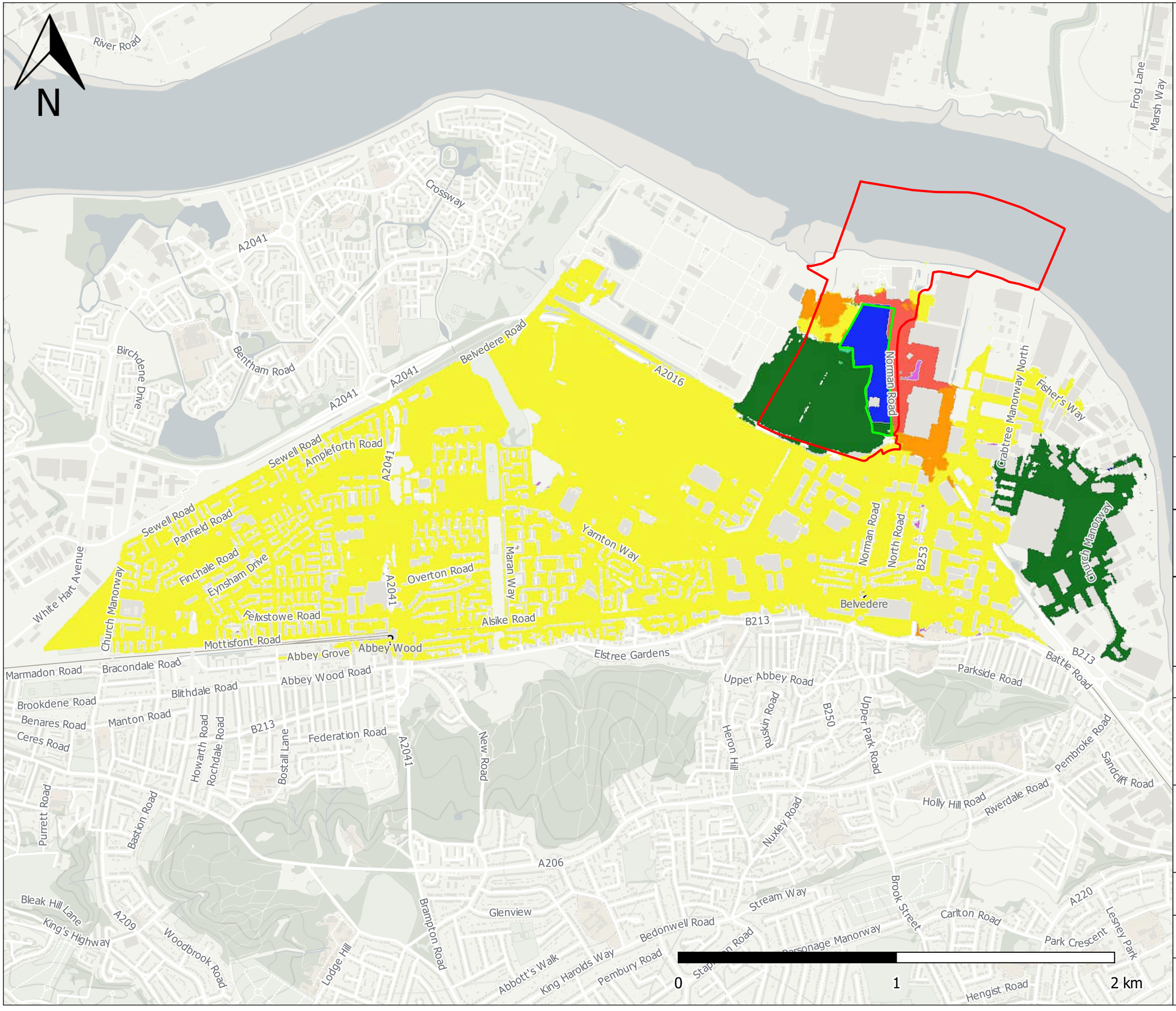
PROJECT: Cory Decarbonisation Project

TITLE: Cory Marsh Dykes Model Great Breach Flood Depths

SCALE @A3:	CHECKED:	APPROVED:
1:7000	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-7



LEGEND:

- Site Boundary
- Carbon Capture Facility

Difference in Depth (m)

- Major (<-0.10 - Decrease)
- Moderate (-0.10 - -0.05)
- Minor (-0.05 - -0.01)
- -0.01 - 0.01
- Minor (0.01 - 0.05)
- Moderate (0.05 - 0.1)
- Major (> 0.10m - Increase)
- Was wet now dry
- Was dry now wet

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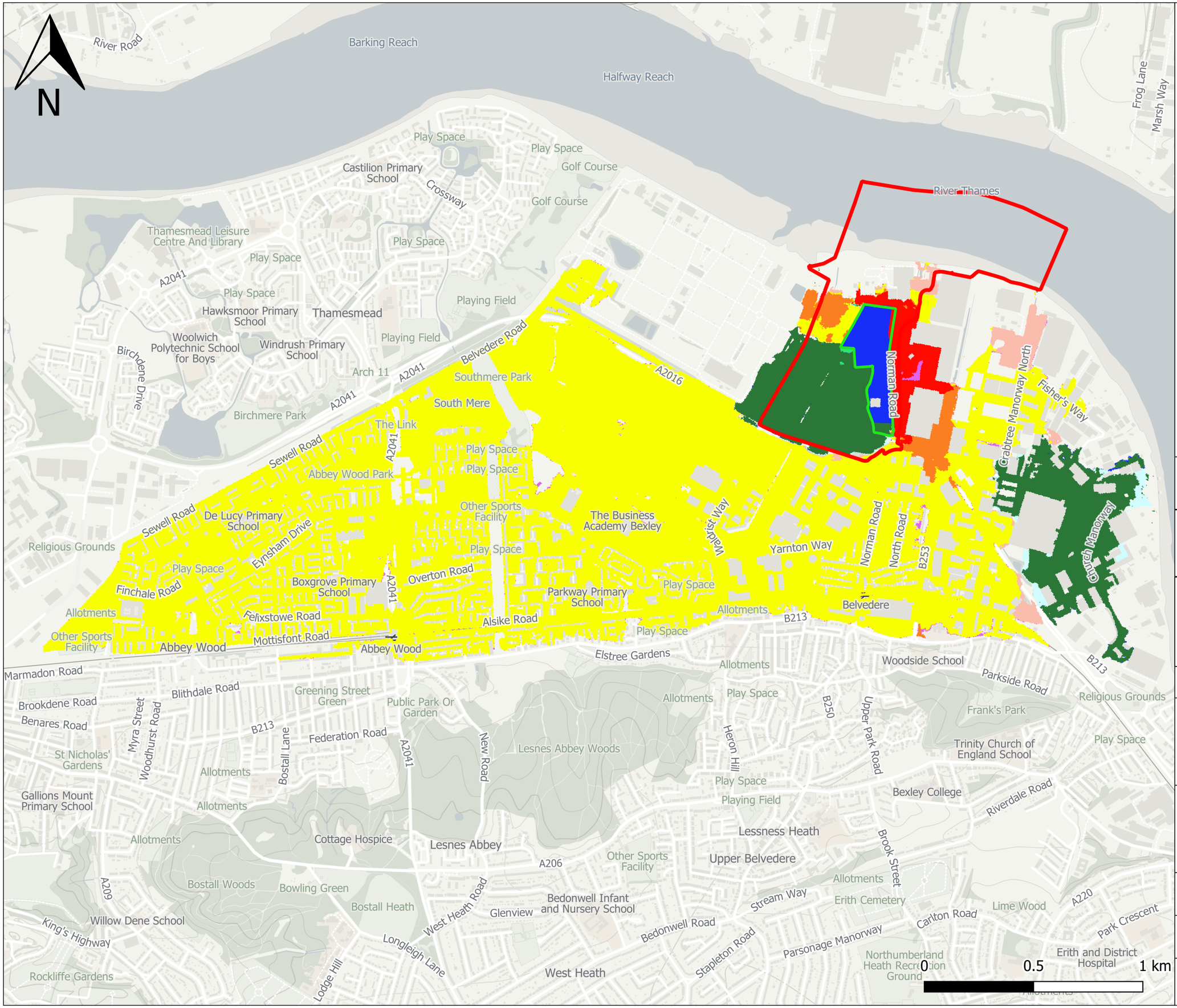
CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Thames Estuary Breach Model Flood Differences

SCALE @A3:	CHECKED:	APPROVED:
1:16000	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-8	



LEGEND:

- Site Boundary
- Carbon Capture Facility

Difference in Depth (m)

- Major < -0.1
- Moderate -0.05 - -0.1
- Minor -0.01 - -0.05
- -0.005 - -0.01
- 0.005 - 0.01
- Minor 0.01 - 0.05
- Moderate 0.05 - 0.1
- Major >0.1
- Was wet now dry
- Was dry now wet

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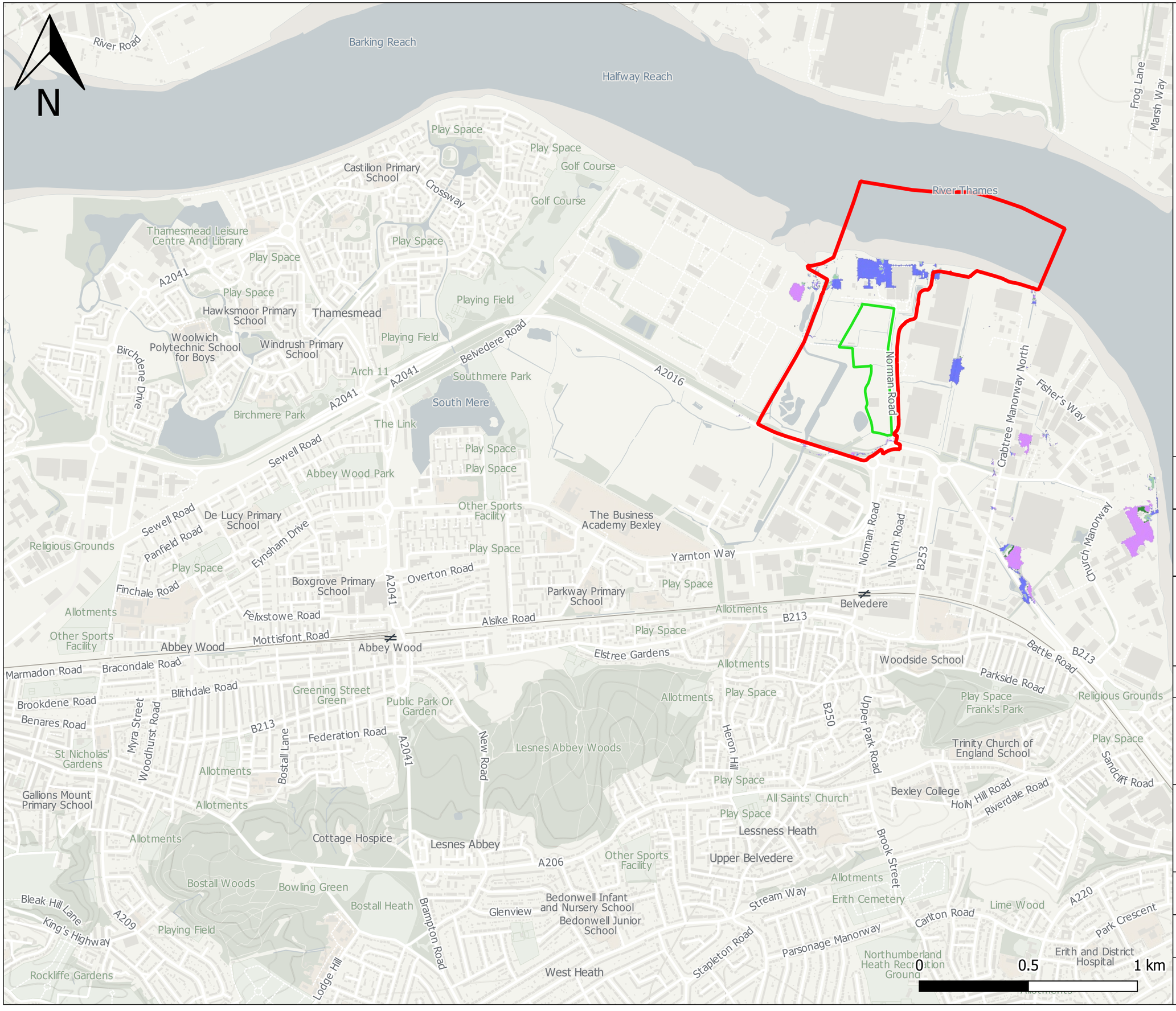
CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Thames Estuary Breach Model Flood Differences

SCALE @A3:	CHECKED:	APPROVED:
1:16000	SH	JG
VERSION: 1	DRAWN: 12/09/24	
PROJECT No: 70090329	DRAWING No: Figure 8-8a	



LEGEND:

- Site Boundary
- Carbon Capture Facility

Difference in Depth (m)

- -0.005 - -0.001
- -0.001 - 0
- 0 - 0.001
- 0.001 - 0.005

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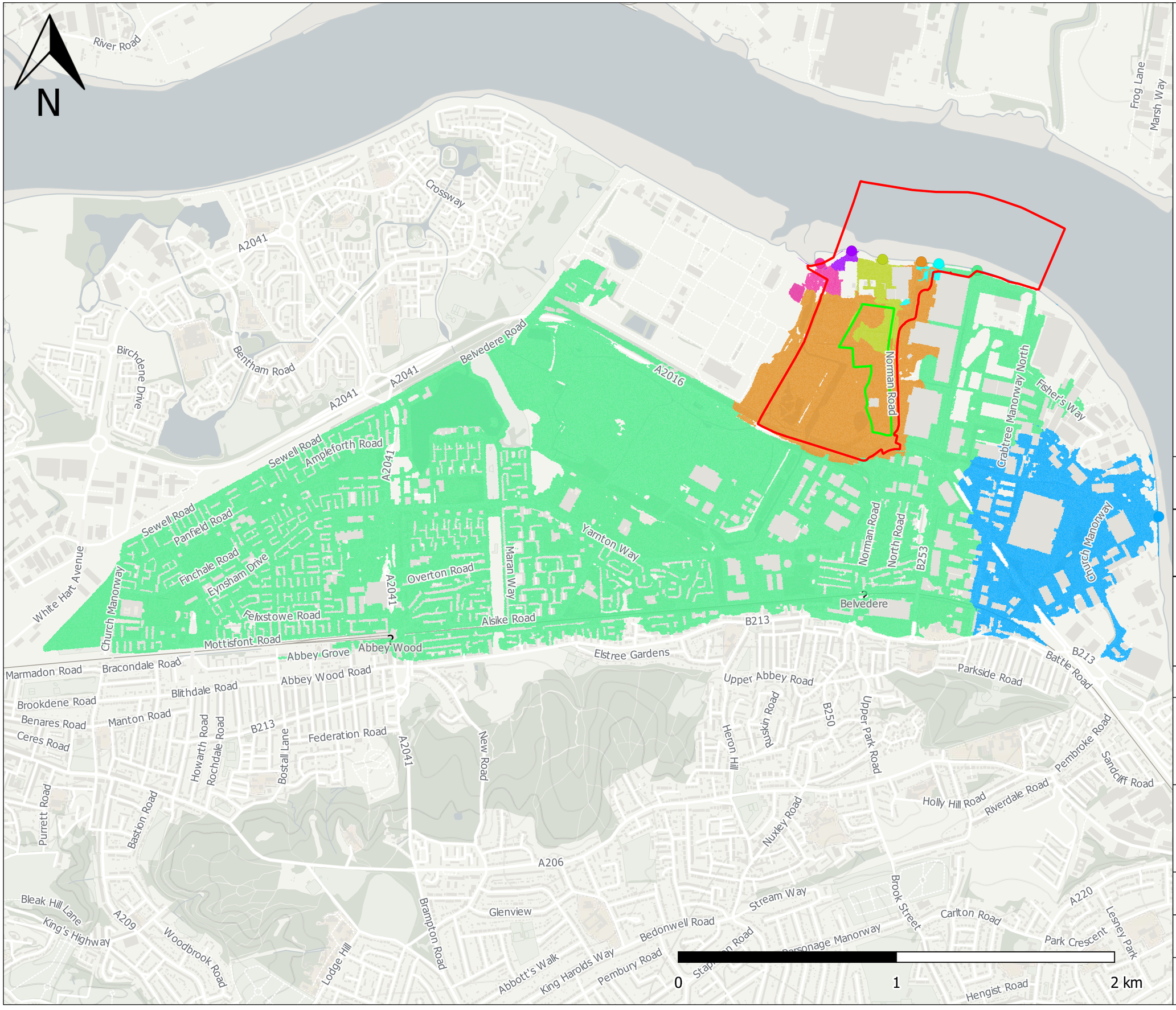
CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Thames Estuary Breach Model Flood Differences

SCALE @A3:	CHECKED:	APPROVED:
1:16000	SH	JG
VERSION: 1	DRAWN: 17/09/24	
PROJECT No: 70090329	DRAWING No: Figure 8-8b	



LEGEND:

- Site Boundary
- Carbon Capture Facility

Max Depth From Breach Location

- 1
- 2
- 3
- 4
- 5
- 6
- 7

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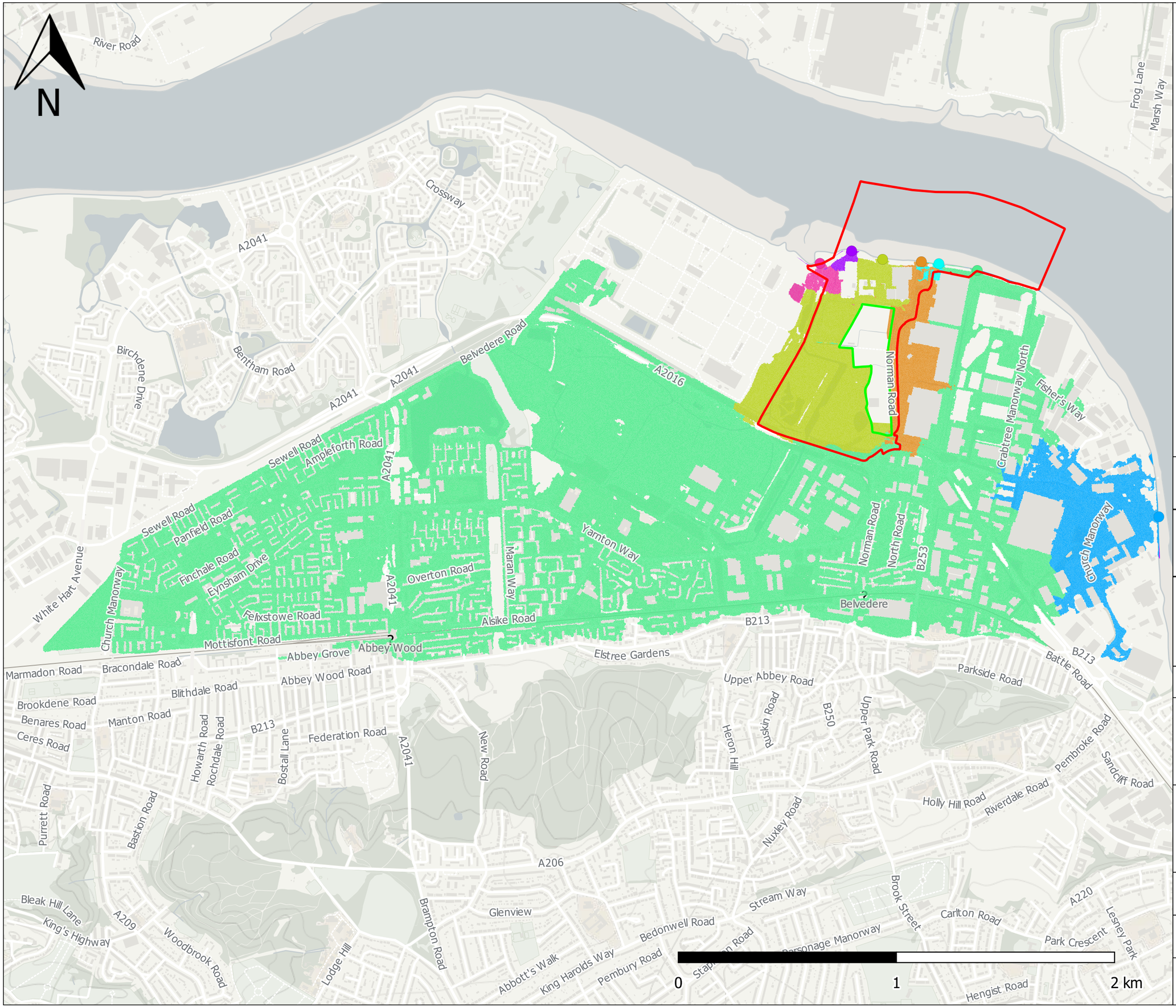
CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Baseline Key Breach Location

SCALE @A3:	CHECKED:	APPROVED:
1:16000	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-9	



LEGEND:

- Site Boundary
- Carbon Capture Facility

Max Depth From Breach Location

- 1
- 2
- 3
- 4
- 5
- 6
- 7

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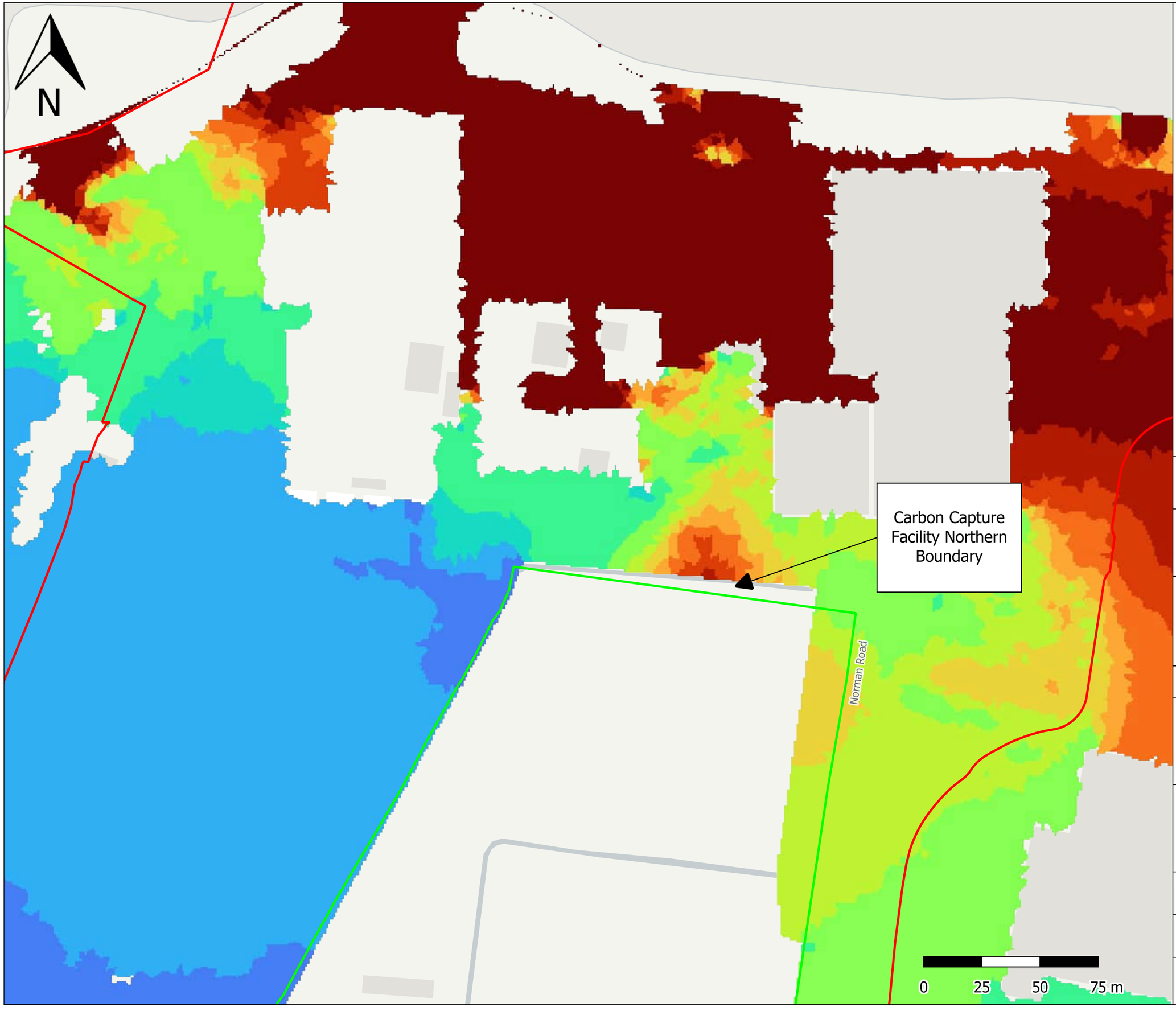
CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Proposed Scheme Key Breach Locations

SCALE @A3:	CHECKED:	APPROVED:
1:16000	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-10	



LEGEND:

Site Boundary

Carbon Capture Facility

Water Level (m AOD)

- <= 1.8
- 1.8 - 2.0
- 2.0 - 2.2
- 2.2 - 2.4
- 2.4 - 2.6
- 2.6 - 2.8
- 2.8 - 3.0
- 3.0 - 3.1
- 3.1 - 3.2
- 3.2 - 3.3
- 3.3 - 3.4
- 3.4 - 3.5
- 3.5 - 3.6
- > 3.6

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CLIENT: Cory Environmental Holdings Ltd

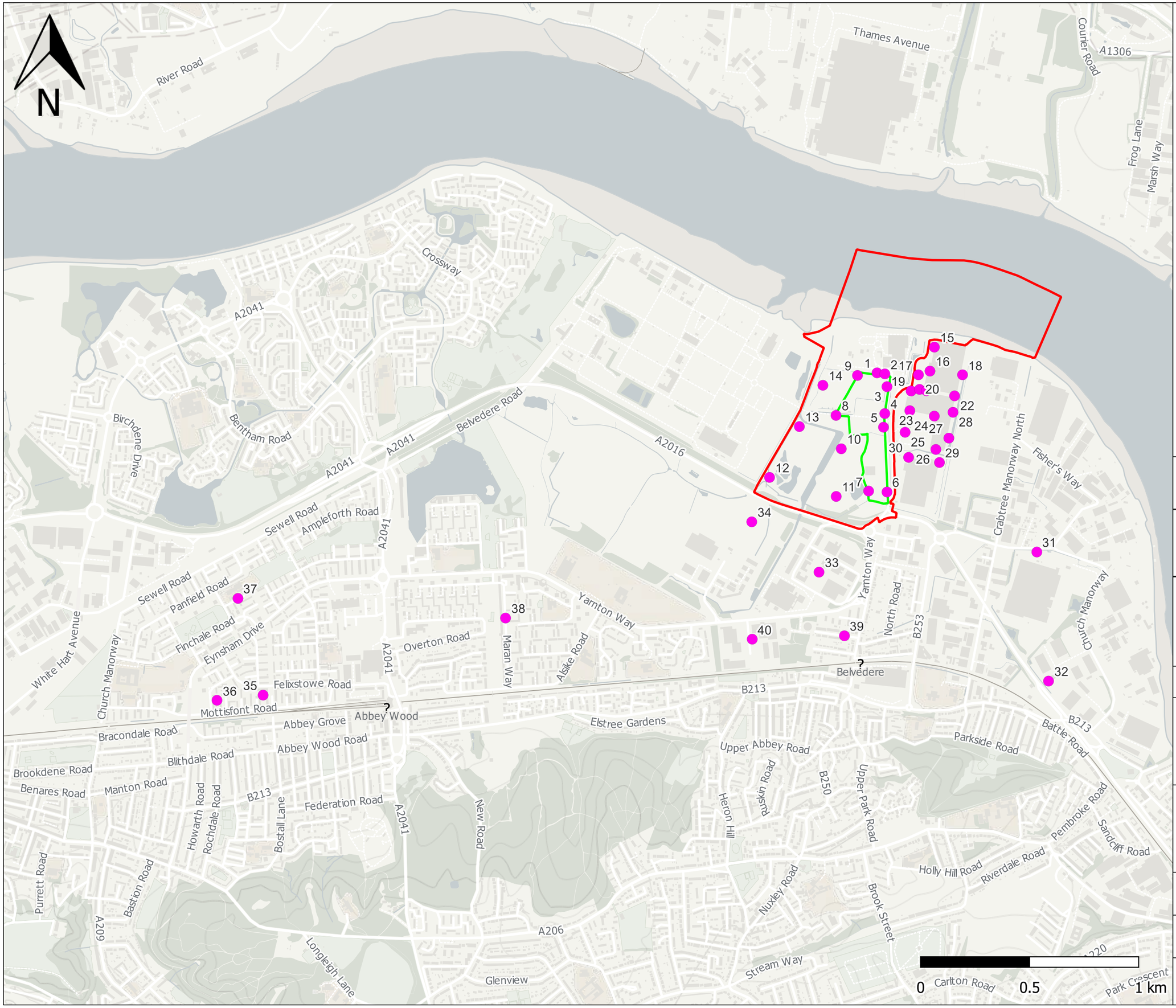
PROJECT: Cory Decarbonisation Project

TITLE: Water Levels Adjacent to the Carbon Capture Facility

SCALE @A3:	CHECKED:	APPROVED:
1:1000	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-11



LEGEND:

- Site Boundary
- Carbon Capture Facility
- Inspection Points

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Tel: +44 (0) 20 7337 1700
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CLIENT: Cory Environmental Holdings Ltd

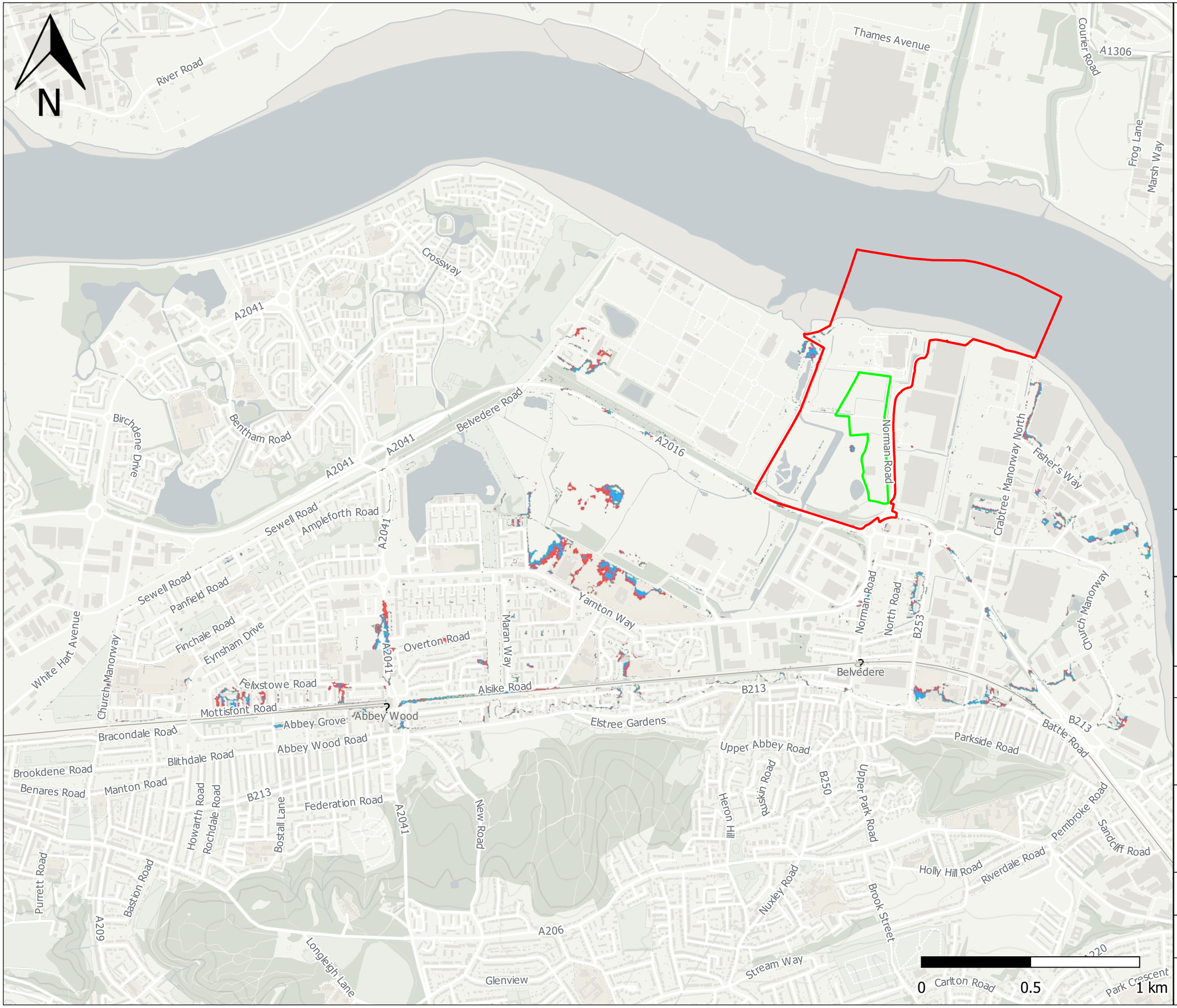
PROJECT: Cory Decarbonisation Project

TITLE: GIS Point Inspection Locations

SCALE @A3:	CHECKED:	APPROVED:
1:16000	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-12



LEGEND:

Site Boundary

Carbon Capture Facility

FLood Depth (m)

<= 0.1

0.1 - 0.2

0.2 - 0.3

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CLIENT: Cory Environmental Holdings Ltd

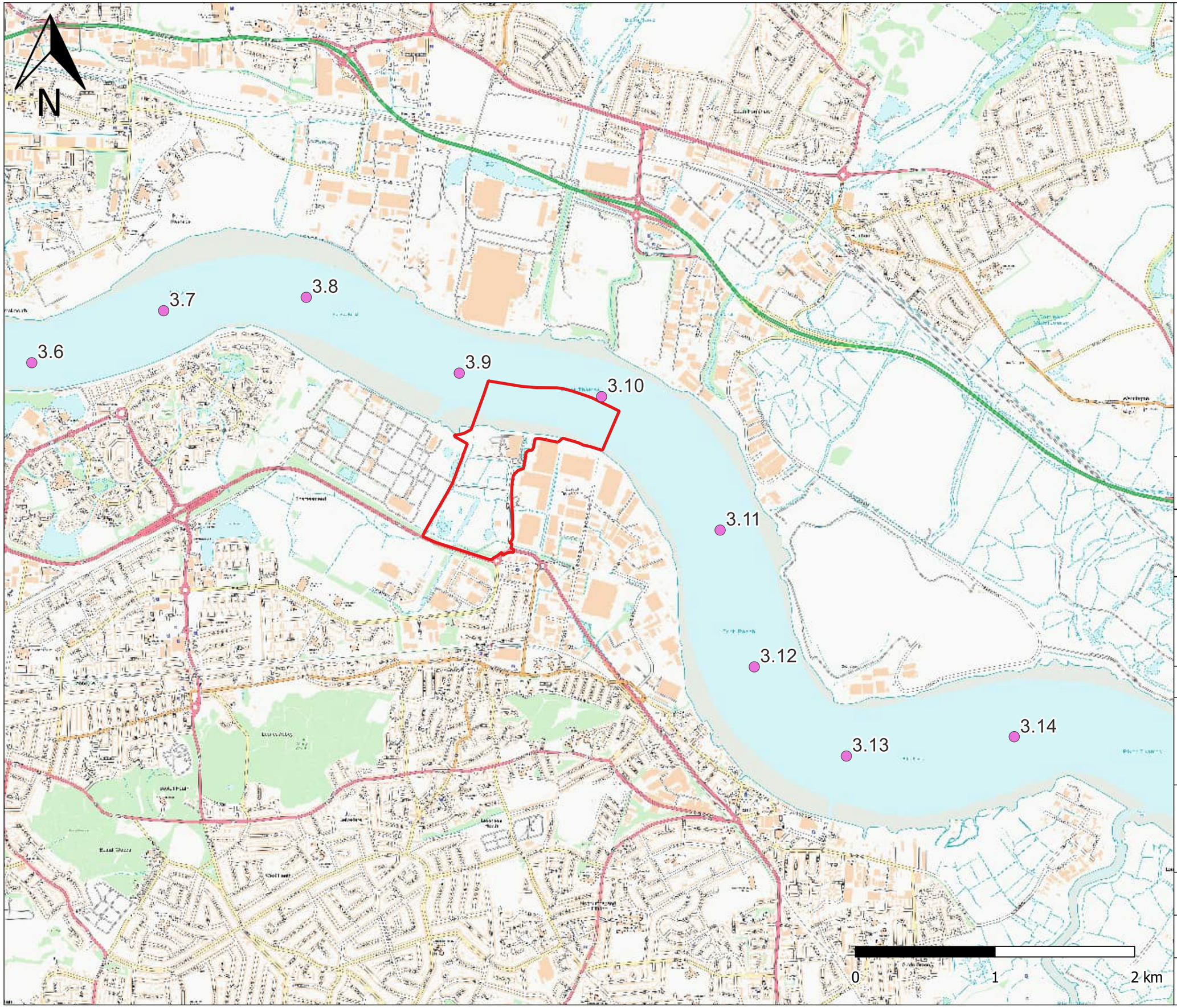
PROJECT: Cory Decarbonisation Project

TITLE: Areas Expected to Experience the Maximum Increase in Flood Depth with the Proposed Scheme

SCALE @A3:	CHECKED:	APPROVED:
1:16000	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-13



LEGEND:

Site Boundary

TE2100 Nodes

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CLIENT: Cory Environmental Holdings Ltd

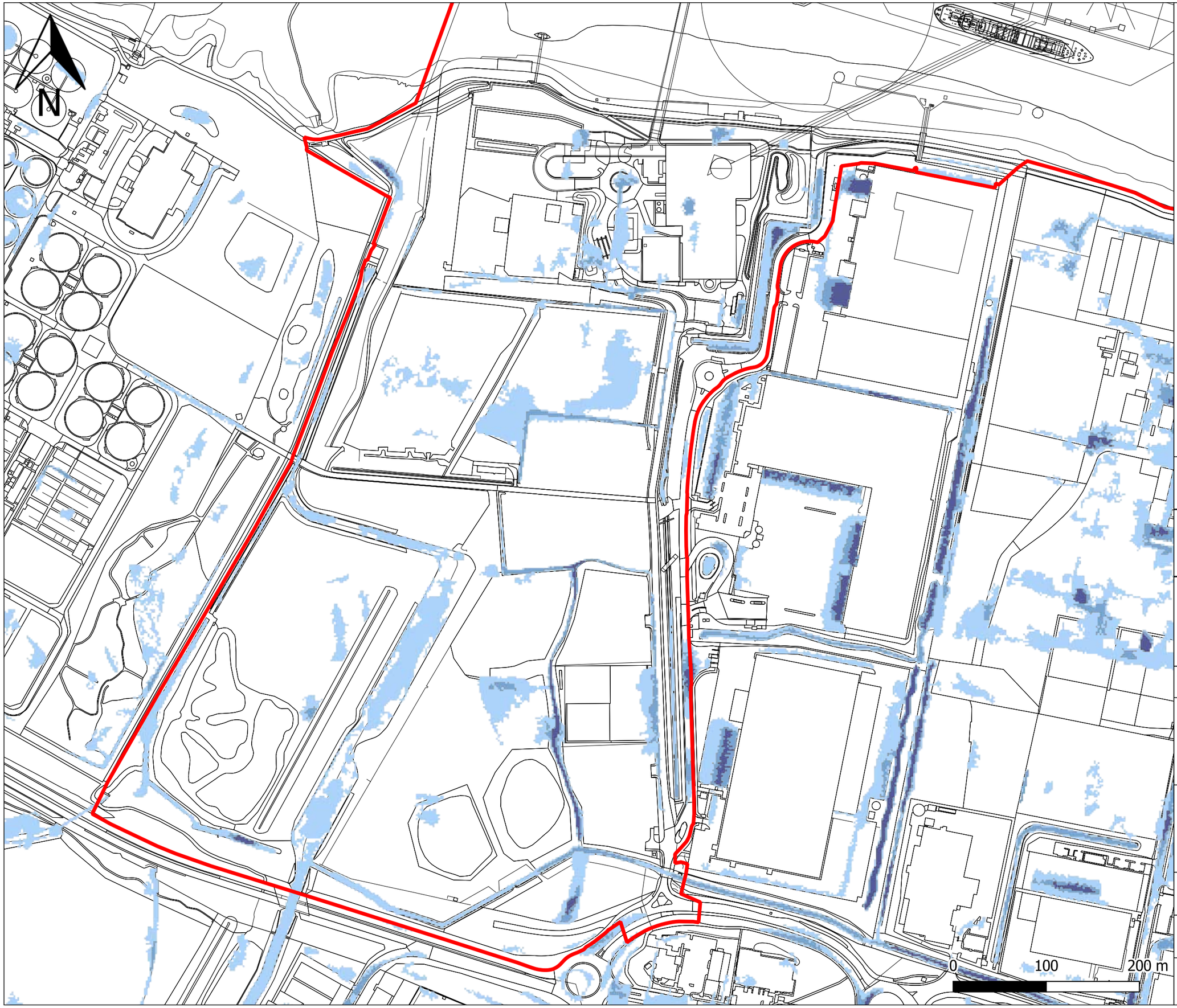
PROJECT: Cory Decarbonisation Project

TITLE: TE2100 Model Node Location Plan

SCALE @A3:	CHECKED:	APPROVED:
1:25000	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-14



LEGEND:

Site Boundary

Risk of Flooding from Surface Water

3.3% AEP

1% AEP

0.1% AEP

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CLIENT: Cory Environmental Holdings Ltd

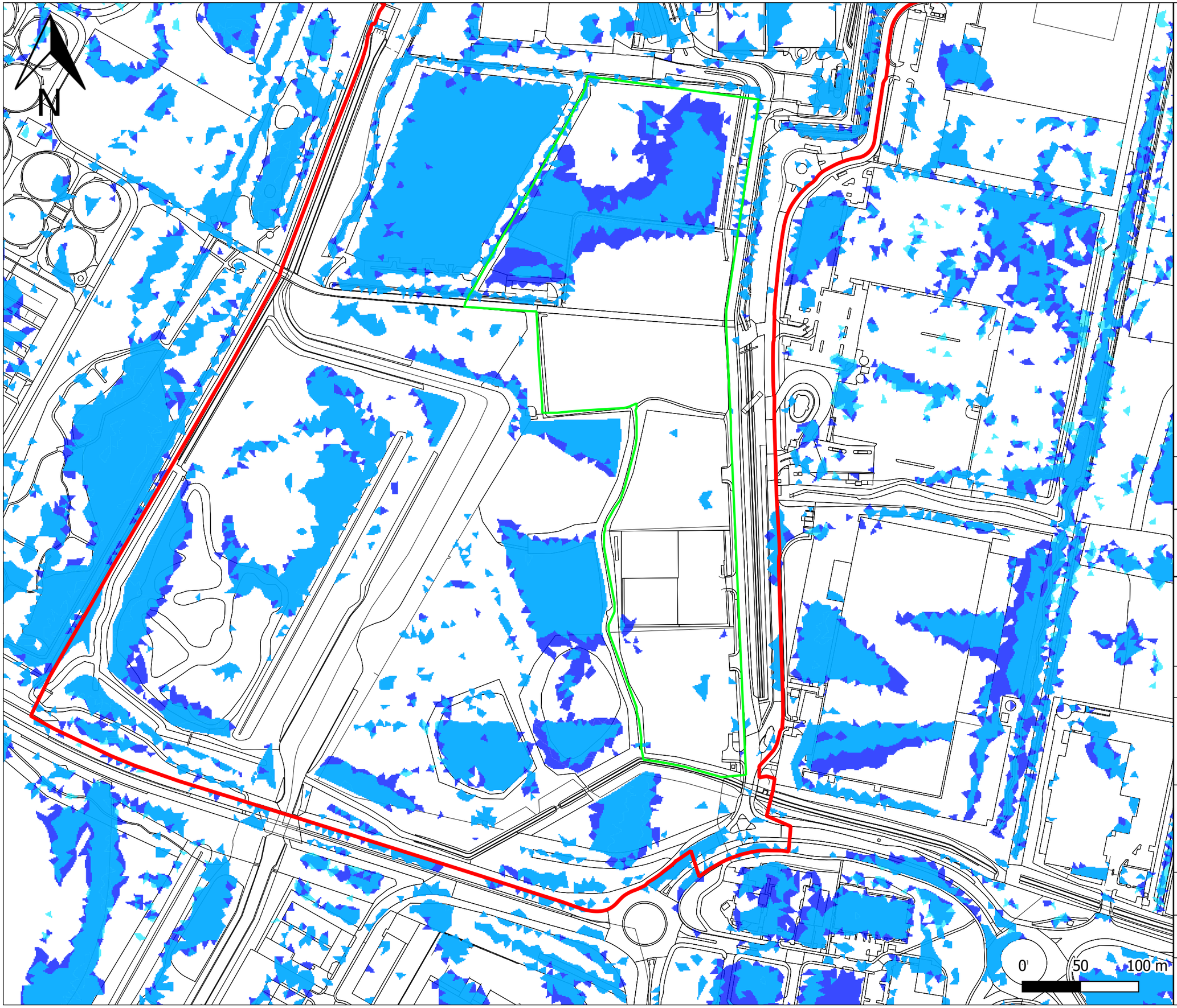
PROJECT:

Cory Decarbonisation Project

TITLE:

Environment Agency's Risk of Flooding from Surface Water Map

SCALE @A3:	CHECKED:	APPROVED:
1:3750	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-15	



LEGEND:

- Site Boundary
- Carbon Capture Facility
- 100yr +40% CC Extent
- 1000yr Extent

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CLIENT: Cory Environmental Holdings Ltd

PROJECT:

Cory Decarbonisation Project

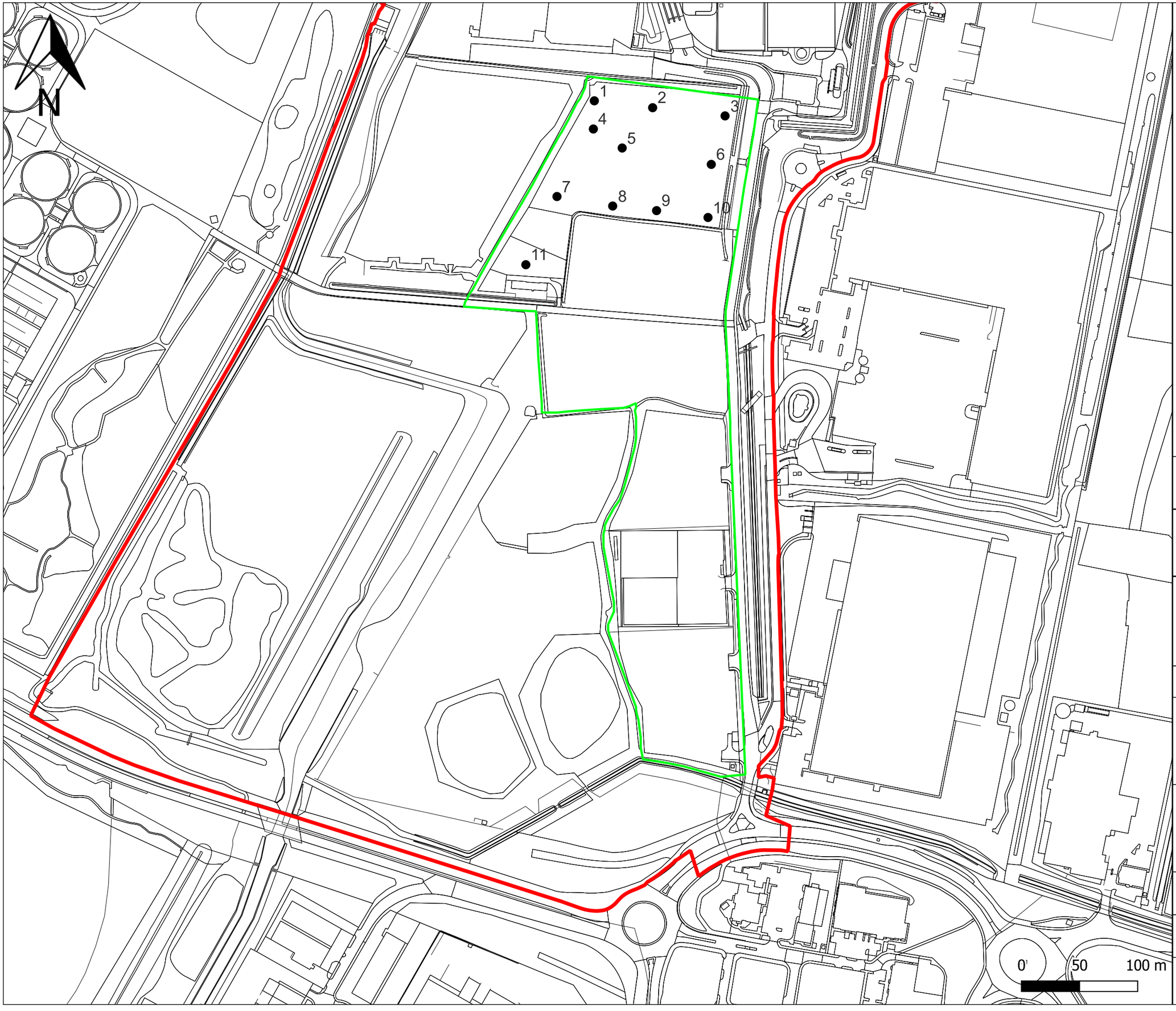
TITLE:

Flood Extents from the Marsh Dykes Modelling Study

SCALE @A3:	CHECKED:	APPROVED:
1:3000	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-16



LEGEND:

- Site Boundary
- Carbon Capture Facility
- Point Locations

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CLIENT: Cory Environmental Holdings Ltd

PROJECT:

Cory Decarbonisation Project

TITLE:

Environment Agency's Marsh Dykes Model Inspection Point Locations

SCALE @A3:	CHECKED:	APPROVED:
1:3000	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-17	

N

LEGEND:

- Site Boundary
- Carbon Capture Facility
- Flow Arrows

1% AEP 360-min storm
40%CC SW 70% (m)

- 0.05m - 0.1m
- 0.1m - 0.3m
- 0.3m - 0.5m
- 0.5m - 1m
- >1m

0 50 100 m

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Tel: +44 (0) 20 7337 1700
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CLIENT: Cory Environmental Holdings Ltd

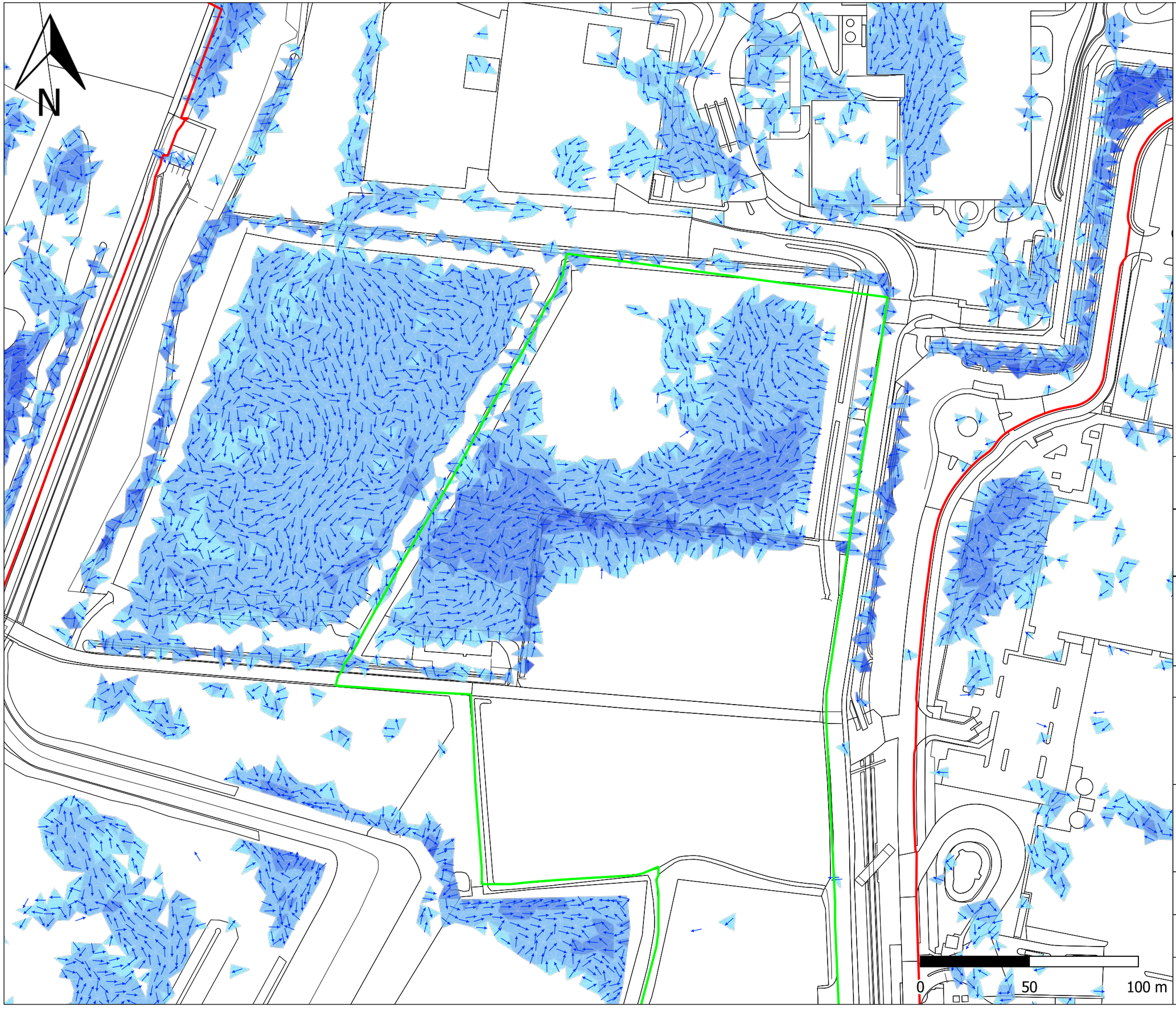
PROJECT: Cory Decarbonisation Project

TITLE: Cory Marsh Dykes Model 1 in 100 year plus 40% Climate Change Flood Extents and Flow Directions

SCALE @A3:	CHECKED:	APPROVED:
1:1600	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-18



LEGEND:

- Site Boundary
- Carbon Capture Facility
- Flow Arrows

0.1% AEP 360-min storm (m)

- 0.05m - 0.1m
- 0.1m - 0.3m
- 0.3m - 0.5m
- 0.5m - 1m
- >1m

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CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Marsh Dykes Model 1 in 1000 year Flood Extents and Flow Directions

SCALE @A3:	CHECKED:	APPROVED:
1:1600	SH	AS

VERSION:	DRAWN:
1	11/03/24

PROJECT No:	DRAWING No:
70090329	Figure 8-19

N

LEGEND:

- Site Boundary
- Carbon Capture Facility
- Flow Arrows

100 year + 40% CC
with Porous Polygons(m)

- 0.01m - 0.05m
- 0.05m - 0.1m
- 0.1m - 0.3m
- 0.3m - 0.5m
- 0.5m - 1m
- >1m

0 50 100 150 m

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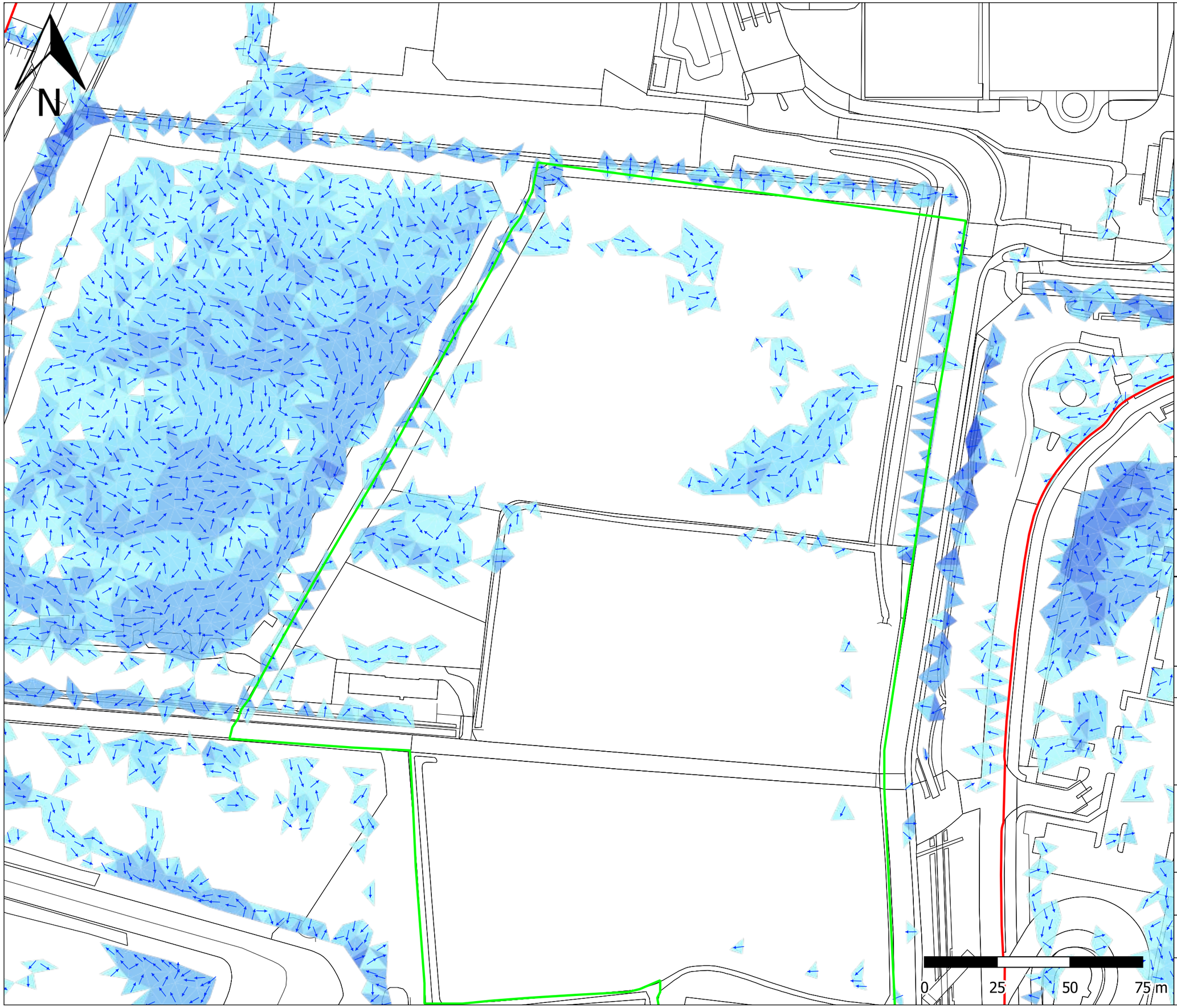
CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Marsh Dykes Model 1 in 100 year plus 40% Climate Change Results with Porous Polygons for Riverside 1 and Riverside 2

SCALE @A3:	CHECKED:	APPROVED:
1:1900	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-20	



LEGEND:

- Site Boundary
- Carbon Capture Facility
- Flow Arrows

100 year + 40% CC
with Porous Polygons(m)

- 0.01m - 0.05m
- 0.05m - 0.1m
- 0.1m - 0.3m
- 0.3m - 0.5m
- 0.5m - 1m
- >1m

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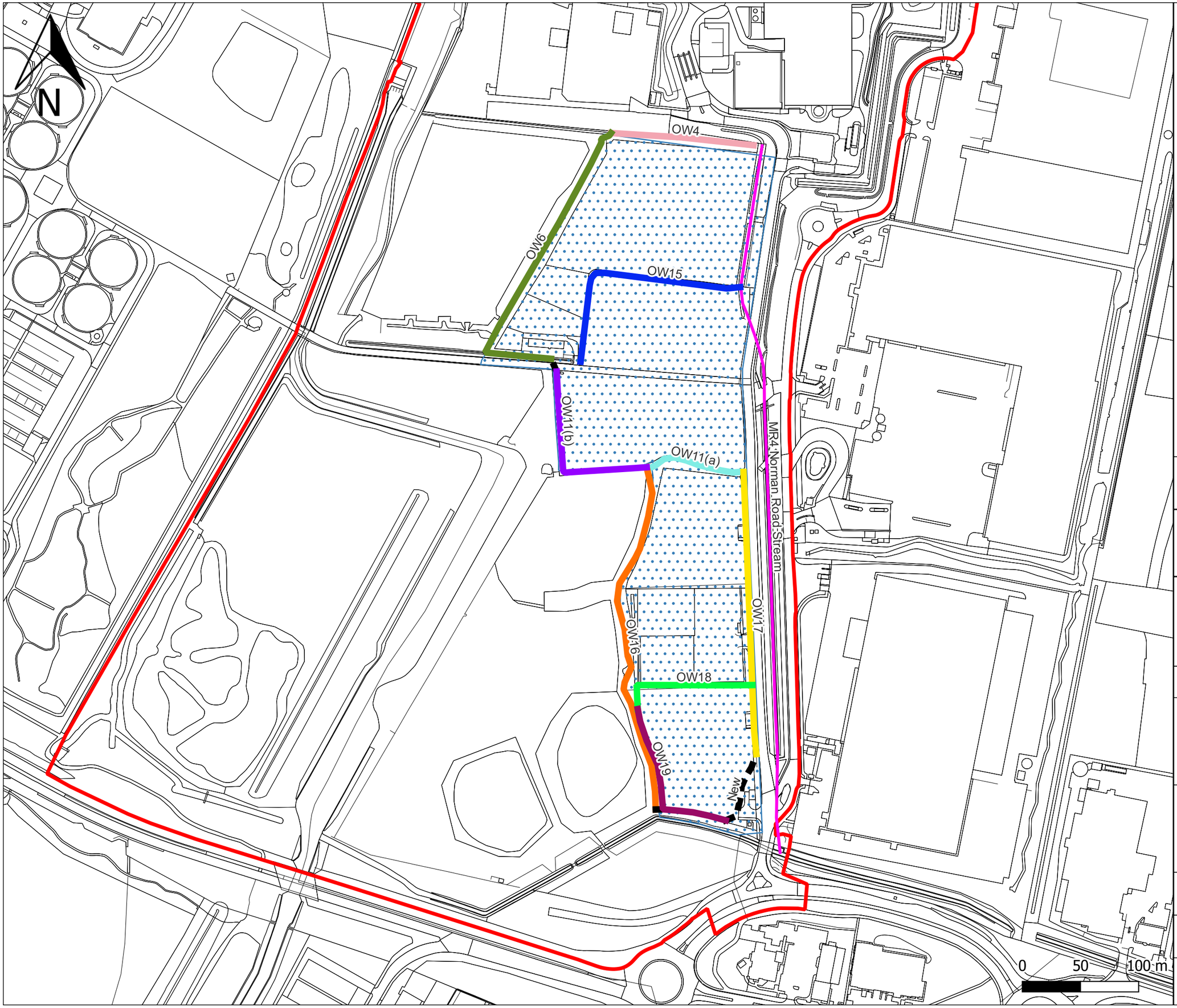
CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Cory Marsh Dykes Model 1 in 100 year + 40% Climate Change Results with Porous Polygons for the northern section of the Carbon Capture Facility

SCALE @A3:	CHECKED:	APPROVED:
1:1900	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 8-21	



LEGEND:

- Site Boundary
- Carbon Capture Facility

Onsite Watercourses

- OW4
- OW6
- OW11(a)
- OW11(b)
- OW15
- OW16
- OW17
- OW18
- OW19
- Indicative New Connecting Watercourse
- MR4 Norman Road Stream

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CLIENT: Cory Environmental Holdings Ltd

PROJECT: Cory Decarbonisation Project

TITLE: Potential Changes to Watercourses

SCALE @A3:	CHECKED:	APPROVED:
1:3000	SH	AS
VERSION: 1	DRAWN: 11/03/24	
PROJECT No: 70090329	DRAWING No: Figure 10-1	

N

0 50 100 m

LEGEND:

- Site Boundary
- Carbon Capture Facility
- Fluvial Flood Zone 3a
- Fluvial Flood Zone 3b

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CLIENT: Cory Environmental Holdings Ltd

PROJECT:

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TITLE:

Fluvial Flood Zone 3a and Fluvial Flood Zone 3b Extents

SCALE @A3:	CHECKED:	APPROVED:
1:5000	SH	JG

VERSION:	DRAWN:
1	03/05/24

PROJECT No:	DRAWING No:
70090329	Figure A

DECARBONISATION

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Moorgate, London
EC2M 2EF
Contact Tel: 020 7417 5200
Email: enquiries@corygroup.co.uk
corygroup.co.uk