The Lake Lothing (Lowestoft) Third Crossing Order 201[*]

Lake Lothing THIRD CROSSING

Document 6.3: Environmental Statement Volume 3 Appendices

Appendix 6A

Scoping Report

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Lake Lothing Third Crossing

Environmental Impact Assessment Scoping Report

February 2017

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Document Control Sheet

Project Title	Lake Lothing Third Crossing
Report Title	Environmental Impact Assessment Scoping Report
Report ref no.	1069948-MOU-EGN-LL_C13-RP-LE-0001
Version	CO1
Status	Final
Report Date	February 2017

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
0.1	Draft	Various	Dec 16	H Roberts	Dec 16	N Venema	Dec 16
0.2	Draft	Various	Jan 17	H Roberts	Jan 17	N Venema	Jan 17
0.3	Draft	Various	Feb 17	H Roberts	Feb 17	N Venema	Feb 17
1.0	Final	Various	Feb 17	H Roberts	Feb 17	N Venema	Feb 17

Distribution

Date	Organisation	Contact	Format	Copies
Feb 17	Suffolk County Council	Michael Wilks	e	1
Feb 17	Suffolk County Council	Jon Barnard	e	1
Feb 17	Planning Inspectorate	-	e and paper	1

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Contents

Acronyms

AADT	Annual Average Daily Traffic
AAP	Area Action Plan
ABP	Associated British Ports
ACM	Asbestos Containing Material
ADMS	Atmospheric Dispersion Modelling System
AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
BAP	Biodiversity Action Plan
BCR	Benefit Cost Ratio
BGS	British Geological Survey
BS	British Standard
CEA	Cumulative Effects Assessment
CEMP	Construction Environmental Management Plan
CORE	Centres for Offshore Renewable Engineering
CRTN	Calculation of Road Traffic Noise
CWS	County Wildlife Site
DCO	Development Consent Order
Defra	Department of the Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	The Design Manual for Roads and Bridges
EA	Environment Agency
EAR	Environmental Appraisal Report
EFT	Emission Factor Toolkit
EHO	Environmental Health Officer
EIA	Environmental Impact Assessment
ES	Environmental Statement
EQS	Environmental Quality Standard
EU	European Union
FRA	Flood Risk Assessment
GI	Ground Investigation
GIS	Geographic Information System

GLVIA	Guidelines for Landscape and Visual Impact Assessment
GVA	Gross Value Added
HAWRAT	Highways Agency Water Risk Assessment Tool
HDV	Heavy Duty Vehicle
HER	Historic Environment Record
HLC	Historic Landscape Characterisation
HRA	Habitats Regulations Assessment
IAN	Interim Advice Note
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
LAQM	Local Air Quality Management
LDO	Local Development Order
LEP	Local Enterprise Partnership
LNR	Local Nature Reserve
LNSR	Lowestoft Northern Spine Road
MAGIC	Multi-Agency Geographic Information for the Countryside
MMO	Marine Management Organisation
NIA	Noise Important Area
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NMU	Non-Motorised User
OBC	Outline Business Case
OS	Ordnance Survey
PVB	Present Value of Benefit
PINS	Planning Inspectorate
PRoW	Public Right of Way
SAC	Special Area of Conservation
SCC	Suffolk County Council
SLRR	South Lowestoft Relief Road
SoS	Secretary of State
SPA	Special Protection Area
SPZ	Source Protection Zone

SRN	Strategic Road Network
SUDS	Sustainable Urban Drainage System
TA	Transport Appraisal
TEN-T	Trans European Network - Transport
TUBA	Transport User Benefit Appraisal
UKPN	UK Power Network
WDC	Waveney District Council
WFD	Water Framework Directive
WHO	World Health Organisation
WSI	Written Scheme of Investigation
ZTV	Zone of Theoretical Visibility

Tables

1 Introduction

1.1 Background

1.1.1 Mouchel has been appointed by Suffolk County Council (SCC) to prepare a Scoping Report for the Environmental Impact Assessment for the Lake Lothing Third Crossing (hereinafter referred to as the proposed scheme).

1.1.2 The proposed scheme consists of a new single carriageway road across Lake Lothing linking the B1531 Waveney Drive on the south side of Lake Lothing to the C971 Peto Way on the north side of Lake Lothing. On the north side the road will join Peto Way between Rotterdam Road and Barnards Way. On the south side of Lake Lothing the new road will follow the alignment of the existing Riverside Road from a remodelled junction with Waveney Drive.

1.1.3 The new crossing consists of a multi-span bridge which includes a new opening bridge in Lake Lothing, a new rail bridge on the north side over the existing East Suffolk Line and a new underpass bridge on the south side. On the south side there will be a new access road from Waveney Drive west of Riverside Road leading to the underpass bridge which is required to provide access to existing property that would otherwise become inaccessible due to changes in level on Riverside Road. The scheme will include associated changes to the local highway network and new landscaping. The new crossing of Lake Lothing will provide a footway on both sides with one side being wider to accommodate a shared use combined footway and cycleway.

1.1.4 The scheme boundary plan (Figure 1) shows the draft red line boundary for the development and the layout drawing (Figure 2) shows the draft general arrangement of the proposed scheme.

1.1.5 The proposed scheme is a Nationally Significant Infrastructure Project (NSIP) following a Direction from the Secretary of State (SoS)1. On the 24th of February 2016, SCC formally requested that the SoS should use his power under section 35 of the Planning Act 2008 to direct that the proposed scheme, and its associated matters, should be treated as development for which development consent is required.

1.1.6 In the direction of the 22nd of March 2016, the SoS confirmed that he was satisfied that the proposed scheme was nationally significant for the following reasons:

- It provides a connection to/from the Trans European Network–Transport (TEN-T) and the Strategic Road Network. The TEN-T link is to the A12/A47, one of only a limited number of routes in the East of England which is recognised as such; and

[1] Technically a project which is the subject of a s35 direction is a “project of national significance” but there is no material difference in substantive or procedural terms between a DCO for such a project and a DCO for an NSIP thus for convenience the proposed scheme will be referred to as an NSIP.

- It would act as a tactical diversion route for the strategic road network (SRN), the A12/A47 when the Bascule Bridge, a nationally recognised pinch point, is closed thereby reducing delays and congestion on the SRN;

1.1.7 In addition, the proposed scheme;

- Supports national growth potential by directly delivering over 9,000 jobs with a further 3,500 indirect jobs, thus supporting the proposed employment growth;
- Improves connection to/from the Great Yarmouth and Lowestoft Enterprise Zone; and
- Delivers the Port of Lowestoft's role in being the hub for the off-shore wind farms that are part of the East Anglia Array, a major energy supplier for the UK.

1.1.8 This Direction is included in Appendix A.

1.1.9 Development that has been identified as a NSIP is required to apply to the Planning Inspectorate for a Development Consent Order (DCO) that forms the basis of the planning consent for the project. In the case of the proposed scheme, the applicant is SCC and the determining authority is the SoS.

1.2 Environmental Impact Assessment

1.2.1 Under Schedule 2 of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2009, hereinafter referred to as the Regulations, the proposed scheme qualifies as a development that may require an Environmental Impact Assessment (EIA) insofar that it constitutes the "construction of roads (unless included in Schedule 1)".

1.2.2 The need for an EIA is therefore informed by the parameters defined in Schedule 3 of the Regulations and having considered the nature of the proposed scheme, and the quality of the receiving environment, SCC are of the opinion that the development has the potential for likely significant effects upon the environment and, therefore, an EIA is required. An Environmental Statement (ES) will therefore be prepared and will accompany the DCO application.

1.3 Implementing European Directive 2014/52/EU

1.3.1 On the 14th of December 2016, the Department for Communities and Local Government launched a consultation on implementing European Directive 2014/52/EU (hereinafter referred to as the Directive) into English law and specifically an update to the Regulations.

1.3.2 Member States of the European Union (EU) are required to transpose the requirements of the Directive by 16th May 2017 although, as stated in Article 3(2) of the Directive, where a Scoping Opinion for a proposed scheme has been sought

before the 16th of May 2017, the provisions of the existing EIA regime will apply to that scheme.

1.3.3 This Scoping Report has therefore been prepared to meet the requirements of the existing Regulations at the time of submission.

1.4 The EIA Scope

Purpose of the Scoping Report

1.4.1 Scoping is an important part of the EIA process and aims to determine which environmental aspects are assessed and presented in the ES.

1.4.2 This Scoping Report will present which of these environmental aspects are considered to be relevant allowing for the relevant baseline and emerging design proposals that are available. It will also describe how the assessment of the relevant environmental aspects will be undertaken and what methods will be used to identify and quantify the impacts. Where baseline surveys and consultation undertaken to date supports the methodologies proposed, this evidence has been presented. Relevant reports have also been appended as appropriate.

1.4.3 It is understood that the scope of an EIA is a continually evolving process and following receipt of the Scoping Opinion, or a change in the proposed scheme or the environmental baseline, then there may be a resulting change in the scope of the ES. This Scoping Report, as well as the Scoping Opinion, will therefore be issued as a technical appendix to the ES and a full audit trail along with a suitable justification for all scope amendments will be provided.

Scoping Requirements and Recommendations

1.4.4 The Regulations state that the request for a Scoping Opinion should contain:

- a plan sufficient to identify the land;
- a brief description of the nature and purpose of the development and of its possible effects on the environment; and
- such other information or representations as the person making the request may wish to provide or make.

1.4.5 In addition, the Planning Inspectorate, in Advice Note Seven[2], requests that a plan should contain the following information:

- the proposed DCO site boundary;
- the location of the proposed NSIP, including any associated development;
- any permanent land take required for the NSIP;
- any temporary land take required for construction, including off-site construction compounds;

[2] Screening and Scoping under the EIA regulations. Version 3, the Planning Inspectorate, April 2012

- any existing infrastructure which would be retained or upgraded for use as part of the NSIP and any existing infrastructure which would be removed; and
- features including planning constraints and designated areas on and around the site, such as national parks or historic landscapes.

1.4.6 Where practical, the information should be included on a single plan. Where more than one plan is used, the plans should be at the same scale and a key plan should be used where appropriate.

1.4.7 The Planning Inspectorate recommends that this information is presented in a Scoping Report and that it should ideally contain the following topics in Table 1.1.

Table 1.1 – Content of the Scoping Report

Scoping Topic	Location in the Scoping Report
An outline of the main alternatives considered and the reasons for selecting the preferred option.	Chapter 3
Results of desktop and baseline studies, where available.	Chapters 4 and 5, and Appendices
Guidance and best practice to be relied upon, and whether this has been agreed with the relevant bodies.	Chapters 4 and 5
Methods used or proposed to be used to predict impacts and the significance criteria framework used.	Chapter 5
Any mitigation proposed and predicted residual impacts.	Chapter 5
Where cumulative development has been identified, how the developer intends to assess these impacts in the ES.	Chapter 5
An indication of any European designated conservation sites that are likely to be significantly affected by the proposed development and the nature of the likely significant impacts on these sites.	Chapters 4 and 5
Where a developer seeks to scope out matters, a full justification for scoping out such matters.	Chapter 5
Key topics covered as part of the developer's scoping exercise.	Chapters 4 and 5
An outline of the structure of the proposed ES.	Chapter 6

1.5 The need for the scheme

National and regional support

1.5.1 The national significance and need for the project derives from its benefit to the Strategic Road Network (SRN). For this reason, it has been identified as a project of

national significance and is included in the National Infrastructure Delivery Plan 2016-2013 and its associated National Infrastructure Pipeline[4].

1.5.2 Lowestoft is the eastern-most terminus of the SRN, with its end point being the Bascule Bridge. Following the detrunking of the A12 between Seven Hills near Ipswich and the Bascule Bridge in 2001, access to Lowestoft via the SRN is by the A47 and then A12(N) from Great Yarmouth. Conversely, traffic wishing to access the SRN from the south is directed over the Bascule Bridge.

1.5.3 The Department for Transport publication, Action for Roads[5], identified capacity issues of increasing severity on the A12 south of Great Yarmouth into Lowestoft (including the Bascule Bridge), with congestion predicted to be 'severe' on most of that section by 2040. A similar story is told in Annex A of the National Networks National Policy Statement (NPS)6.

1.5.4 Consequently, Highways England's 2015 Route Strategy for the East of England7 identifies river crossing capacity on the A12 at Lowestoft to be a key challenge in the region. Evidence prepared to support the Route Strategy in 2014, records that the "bascule bridge significantly influences capacity, speed and reliability of the route in Lowestoft"8 and is the least reliable section of the SRN in the East of England, recording average peak (defined as Monday to Friday 7-10am and 4-7pm) speeds of less than 20mph. However, no solutions were put forward to resolve this.

1.5.5 Consequently, by providing additional north-south capacity across Lake Lothing the proposed scheme addresses these issues by improving journey times through the SRN in Lowestoft and increasing network resilience. At the Outline Business Case stage this was demonstrated by a BCR of 8.08, meaning the proposed project is very high value for money.

1.5.6 The historic need for the Project can further be traced back to the 1989 Roads for Prosperity White Paper as part of a scheme that included the South Lowestoft Relief Road (SLRR) and the Lowestoft Northern Spine Road (LNSR). The SLRR was promoted, constructed and part-funded by Suffolk County Council, and opened to

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[3]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/510525/2904569_NIDP_2016-2021_updated.pdf

[4] https://www.gov.uk/government/publications/national-infrastructure-pipeline-2016

[5]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/212590/action-for-roads.pdf

[6]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

[7]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416730/East_of_England.pdf

[8]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/364207/East_of_England.pdf

traffic in 2007. A similar arrangement has followed for the LNSR which opened in 2015. There now therefore remains a central gap of less than 650m between these two roads, as the crow flies, but the actual driving distance (via the Bascule Bridge) is nearly 2km. A new crossing of Lake Lothing, effectively linking these highway schemes, is the crucial remaining piece of the jigsaw.

1.5.7 Bridging this gap is not only important for the efficient functioning of the SRN, but to more widely address the congestion and severance within Lowestoft, caused by the current arrangement of crossing points of Lake Lothing. In turn, improved accessibility throughout the town, to the Port of Lowestoft and to key redevelopment sites identified with the Lake Lothing and Outer Harbour Area Action Plan, enhances the opportunities for regeneration, investment in the Port and fully realising the growth potential of the Great Yarmouth and Lowestoft Enterprise Zone.

Consultation undertaken

1.5.8 In addition to the above data gathering and surveys, the following organisations have been contacted or consulted prior to submission of the Scoping Report in order to gather further information regarding environmental constraints and other considerations:

- The Planning Inspectorate (PINS);
- Suffolk County Council (SCC) Archaeology Officer;
- SCC Landscape Officer;
- Waveney District Council (WDC) Landscape Officer;
- SCC Senior Ecologist;
- Waveney District Council (WDC) Environmental Health;
- Natural England;
- Environment Agency;
- Highways England;
- Associated British Ports (ABP);
- Network Rail;
- Anglian Water;
- UK Power Networks (UPKN);
- National Grid;
- Marine Management Organisation (MMO); and
- Historic England.

1.6 Content of the Scoping Report.

1.6.1 This Scoping Report includes the following information:

- Chapter 2 – an outline description of the proposed scheme and description of the key design components and construction activities which would be involved in its implementation;
- Chapter 3 – description of the alternative options considered for the scheme;
- Chapter 4 – description of the nature and status of the environment associated with the location for the proposed scheme;
- Chapter 5 – an explanation of how likely significant effects on the environment have been identified, description of the effects identified and of the studies and assessments which are being, or will be, undertaken and description of the methods of assessment and impact criteria which are being adopted;
- Chapter 6 – an outline of the proposed format for the ES.

2 Proposed Scheme

2.1 Location

2.1.1 The location of the proposed scheme is indicated in Figure 1.

2.1.2 Lake Lothing is a large saltwater lake which separates the town of Lowestoft in a north - south direction. At its widest point, it spans 180m and forms the Inner Harbour of the Port of Lowestoft. The area is broadly defined by a mixture of commercial and residential properties which flank both the north and south of the water body.

2.1.3 The main transport links in the area include the A146 which links Lowestoft to Norwich, and the A12 which runs towards Great Yarmouth and southwards towards Ipswich and Felixstowe.

2.1.4 Running almost in parallel to the northern edge of the Lake and Denmark Road, the East Suffolk Line serves Lowestoft railway station. The railway crosses Lake Lothing at its western end adjacent to the A1177 at Mutford Bridge.

2.1.5 There is a network of rights of way and on-road cycleways (see Figure 12) in proximity to the proposed scheme which provide links across the town and into the wider countryside and open areas.

2.2 The proposed scheme

2.2.1 The proposed scheme comprises a new single lane carriageway on a bascule bridge over Lake Lothing connecting Peto Way in the north with Waveney Drive to the south, thus allowing strategic traffic an alternative route around the town centre.

2.2.2 An indicative red line plan that takes into account the factors outlined at paragraph 1.4.5 above is shown in Figure 2. The land requirements for the scheme, in particular those associated with the construction phase (i.e. land required temporarily) and associated development (for example alterations/improvements to existing roads) will be refined further, as informed by environmental assessment and further design work.

2.2.3 At this preliminary stage, the following assumptions are made on the construction stage:

- Use of floating barges to construct bridge piers and bridge deck;
- Creation of coffer dams;
- Piling of foundations;
- Site compounds on each side of the Lake for storage and delivery of materials;
- Loading areas for materials and workforce for constructing main bridge piers and deck;
- Temporary working space to construct the works;
- Working space to divert Statutory Undertakers apparatus affected by the works;

- Diversion of access roads to maintain access to local businesses in the Riverside Business Park;
- Site batching plant for the production of concrete;
- Limited 24 hour construction;
- Temporary road closures and diversions;
- Site offices/workshops associated with the construction; and
- Parking for workforce and staff with up to 150 employed at the peak of construction.

The Route

2.2.4 The proposed scheme is approximately 0.75km in length and its layout is illustrated in Figure 2. It starts at a new junction on Peto Way, between Rotterdam Road and Barnards Way, and spans both the East Suffolk Line and Lake Lothing on a north – south alignment.

2.2.5 On the southern side of the Lake, the new crossing follows the line of Riverside Road, rising from a remodelled junction at the intersection Riverside Road and Waveney Drive. Improvements between this remodelled junction and the existing Waveney Drive/Tom Crisp Way roundabout to the A12 may be required. Local roads which presently connect directly to Riverside Road will be served in the main from a new connection to Waveney Drive, with a number of options currently under consideration including a new junction opposite the eastern end of Waveney Crescent (not illustrated) or a new junction/roundabout to the west of Compass House (Figure 2).

2.2.6 At the time of the submission of this Scoping Report, there remain potential options with regard to the final junction arrangements at both the north and south of the proposed scheme. Alternative arrangements will be considered through consultation and further refinement of the design.

Design Standards and Cross Section

2.2.7 The new crossing will be designed using the Design Manual for Roads and Bridges (DMRB) and is currently being designed to have a:

- Design speed of 30mph (50kph);
- Carriageway width of 7.3m (2 x 3.65m wide traffic lanes);
- Safety strip of 0.5m between the proposed footway and carriageway to the east of the crossing and the combined footway/cycleway to the west of the crossing;
- Footway width of 2.0m (on the west side of the new carriageway); and
- Segregated footway and cycleway of 3.5m (on the east side of the new carriageway).

2.2.8 These elements are shown in Figure 3.

Structures and Earthworks

2.2.9 A new bascule (lifting) bridge will be constructed to allow the passage of vessels within the Inner Harbour. When closed, the bridge will have a clearance of approximately 12m above the highest astronomical tide level which will enable smaller boats to pass under the bridge. This 12m clearance combined with its location west of some of the docks, means that it will have to open less frequently than the existing Bascule Bridge at the harbour entrance.

2.2.10 In response to a request from ABP, vessel simulation modelling is being undertaken and the current estimate for the clear span between the new bascule bridge abutments is 35m, allowing a clear width of 32m between fenders. This is shown on Figure 3.

2.2.11 The new bridge will require a control tower which could be positioned on the bascule bridge pier. It would need to be continually staffed. Alternatively, SCC is in discussion with ABP and Highways England about the provision of a joint control tower to serve both the existing Bascule Bridge and the Lake Lothing Third Crossing, either housed in the existing Bascule Bridge, or some other location in between. The new bridge will be a single carriageway with raised verges, footways and a cycleway linked to existing networks.

2.2.12 The access to the proposed scheme will be via approach spans which are still under review due to a number of conflicting constraints (e.g. land requirements, maintenance of existing access, provisions for different stakeholders, engineering and cost issues).

2.2.13 A series of fenders will be provided within the Lake to provide protection to the bridge piers against impact from ships. These will be provided on both approaches to the bridge.

2.2.14 Geotechnical Site Investigations (GI) are scheduled to commence in spring 2017 which will provide information to progress the foundation design for the new structures. It is anticipated that all the material for the new earthworks embankments will need to be imported although the opportunity to use existing materials on site for part of this material will be reviewed once results from the GI are available.

2.2.15 At this scoping stage, there is uncertainty about whether two additional piers will be required within the Lake or whether the existing quay walls are suitably retained and can withstand the loadings placed upon them. Should ground investigations identify an unacceptable loading, then two additional piers will be required in the Lake adjacent to the quay walls.

Main Junction Arrangements

2.2.16 Presented in Figure 2 are possible roundabout/junction arrangements at both the north and south of the proposed scheme. However, these are subject to further assessment and design evaluation of the benefits offered by both signalised junctions and roundabouts, and consultation. The connection to Waveney Drive that will provide

access to existing Riverside Road properties, is likewise subject to further evaluation and consultation to identify an optimum solution.

The northern junction

2.2.17 On the northern bank, a new roundabout is proposed to be installed to the west of the current Denmark Road roundabout to connect the proposed crossing option with the existing localised road network. Heading south towards Lake Lothing, the new road layout will link into the construction of a new embankment which connects to the elevated bascule bridge, enabling users of the crossing to span the Lake and connect into the new road layout on the southern bank.

The southern junction

2.2.18 On the southern shore, the new crossing will follow the line of Riverside Road, initially at a high level, descending to a new roundabout/signalised junction at the intersection of Riverside Road and Waveney Drive, west of the Lings Motor showroom. Possible improvements between this roundabout/signalised junction and the existing Waveney Road/Tom Crisp Way roundabout would provide access to the A12. Local roads which presently connect directly to Riverside Road would be served in the main from a new connection to Waveney Drive.

Drainage

2.2.19 Drainage arrangements for the new carriageway are anticipated to consist of combined kerb drainage units and kerb and gulley arrangements. It is anticipated that the new drainage will outfall directly into Lake Lothing subject to discussions with the Environment Agency on any specific treatment requirements.

Lighting

2.2.20 The full extent of the proposed scheme will be lit. The lighting design will be developed during detailed design and will utilise LED luminaires with specialised optics in proximity to the waterways to minimise obtrusive light. Discussions will continue with Associated British Ports and Network Rail to ensure their requirements are considered and a suitable design developed.

Technology

2.2.21 New technology and signalling arrangements will be provided as part of the proposed scheme consisting of CCTV monitoring, electronic signage confirming the new bascule bridge status and associated warning signs and barrier systems. The locations of electronic signage will be informed by detailed review of the likely traffic movements around Lowestoft.

Road Restraint

2.2.22 New near side road restraint will be provided for the full length of the new crossing using a combination of steel and concrete barrier systems.

Landscaping

2.2.23 The proposed scheme will include landscaping to soften the appearance of the scheme at the tie-ins and to integrate with the wider townscape. Proposals are likely

to include amenity tree and shrub planting, having regard to biodiversity interest that will reflect the wider townscape and provide areas of interest to the adjacent hard landscape.

Construction Programme

2.2.24 Subject to planning approval, it is anticipated construction of the proposed scheme would commence in early 2020 and complete in around 24 months.

Construction Activities

2.2.25 Construction of the proposed scheme is likely to involve the following key activities:

- Site establishment, clearance and preparation;
- Diversion of Statutory Undertaker's equipment;
- Establishment of contractor's site compounds;
- Levelling and major and minor earthworks using scrapers, bulldozers and dump trucks;
- Piling is likely to be required at structure locations;
- The import and export of material (fill, spoil and road stone) to establish the carriageway;
- The use of generators, temporary machinery and lighting;
- Construction vehicle movements to deliver and dispose of materials;
- The requirement for temporary diversions and position of temporary access restrictions;
- Possible de-watering activities; and
- Restoration of temporarily used sites on completion.

3 Alternatives

3.1 Introduction

3.1.1 This chapter outlines the alternative scheme options that have been considered. The Regulations, in Schedule 4, Part 1, and Paragraph 18 states that an Environmental Statement must include "An outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking in to account the environmental effects."

3.1.2 This chapter therefore provides an outline of what options and alternatives to the proposed scheme have been considered to date, and where the environmental effects have been considered, this is duly noted.

3.1.3 At the outset of the Outline Business Case (OBC) stage of the development of the proposed scheme, a number of scheme objectives were identified and a series of alternative options were developed and are discussed in detail below.

3.1.4 A total of 15 high level options were considered using criteria which reflected the ambitions and objectives of the scheme. As this chapter will illustrate, the decision to progress the central option at the scoping stage is the result of assessments that strived to ensure the chosen scheme performed well in economic, social and environmental terms, resulting in the selection of the optimised solution.

3.2 Study Options (OBC Stage)

3.2.1 The overall aim of the proposed scheme at the outset of the development of the OBC was "to stimulate regeneration, sustain economic growth, and enhance Lowestoft as a place to live and work in, and to visit". The specific proposed scheme objectives set in 2015 were:

- To open up opportunities for regeneration and development in Lowestoft;
- To provide the capacity needed to accommodate planned growth;
- To reduce community severance between north and south Lowestoft;
- To reduce congestion and delay on the existing bridges over Lake Lothing;
- To reduce congestion in the town centre and improve accessibility;
- To encourage more people to walk and cycle, and reduce conflict between cycles, pedestrians and other traffic;
- To improve bus journey times and reliability; and
- To reduce accidents.

3.2.2 In order to produce options to align with these project aims, a combination of desktop studies, historical studies and site observations were used to produce a list of spanning bridge, tunnel, non-road and low-cost alternative options.

3.2.3 Having taken into account the principal physical and environmental constraints of the project suitable 'corridors' were considered which broadly categorised the scheme into three distinct locations:

- A western crossing, linking Peto Way with Waveney Drive;
- A central crossing, linking Denmark Road with Waveney Drive;
- An eastern crossing, close to the existing Bascule Bridge.

3.2.4 The following sections follow these general corridor categorisations to more effectively describe how final options selection was achieved and to demonstrate why options at specific locations were rejected.

3.3 Options generation

3.3.1 Using the locational distinctions outlined above, a 'long-list' of 15 options was compiled. For the purpose of option comparison, a series of objectives and parameters were developed, enabling all locations and design possibilities to be thoroughly examined against each other. The requirements of the scheme were developed as listed below:

- Provide a 7.3m single carriageway road with footways and a cycle lane;
- Connect to the existing network with at-grade junctions, wherever possible;
- Provide clearance above the railway line;
- Allow large vessels to turn within the confines of the channel;
- Relate logically to the existing network;
- Have minimal impact on existing development; and
- Avoid conflicting with planned new development, as envisaged in the Lake Lothing and Outer Harbour Area Action Plan.

3.3.2 Options that were considered, but not included in the long list, at this point included:

- Fixed Bridge Options – A non-lifting bridge would need to have a 35m clearance, would be more expensive than other options and more visually intrusive and more difficult to tie back in to the existing network due to the level changes involved;
- Floating bridge options – this option was not feasible due to restrictions associated with the railway line on the northern shore of the Lake. A floating

bridge would have to open for any size vessel whereas a conventional bridge would allow for smaller vessels to pass through; and

- Dual carriageway options – as well as costing more, Lowestoft's road network has been developed exclusively with single carriageway roads.

3.3.3 The options appraisal identified a long list of options comprised of bridges, tunnels, junction improvements and road pricing, which are listed in Table 3.1 below. It is noteworthy that the number reference of the options has continued to evolve in conjunction with the design generation.

Table 3.1 – OBC Scheme Options

Name	Type	From (N)	To (S)
W1	Bascule Bridge	Peto Way	Waveney Drive
W2	Bascule Bridge	Peto Way/ Denmark Road	Waveney Drive
W3	Bascule Bridge	Peto Way/ Denmark Road	Waveney Drive/ Riverside Road
C1	Bascule Bridge	Peto Way/ Denmark Road	Waveney Drive/ A12 Horn Hill
C3	Bascule Bridge	Denmark Road	Waveney Drive/ A12 Horn Hill
C4	Bascule Bridge	Denmark Road	Waveney Drive/ A12 Horn Hill
E1	Bascule Bridge	Commercial Road	Belvedere Road
E2	Bascule Bridge	Katwijk Way/ Denmark Rd	Belvedere Road
E3	Bascule Bridge	Katwijk Way	Belvedere Road
E4	Bascule Bridge	Commercial Road	Belvedere Road
L1	Lock/flood barrier with lifting bridges	Denmark Road	Waveney Drive
T1	Road tunnel	Peto Way/ Denmark Way	Waveney Drive
J1	Junction improvement	Various measures	Considered as an alternative to a crossing
S1	Smarter Choices	Various measures	Considered as an alternative to a crossing
P1	Road Pricing	Introduce road pricing to discourage traffic	Considered as an alternative to a crossing

3.3.4 Of the 15 options identified in Table 3.1 and taken forward for further assessment, options J1, S1 and P1 were not considered viable alternatives for the following reasons.

3.3.5 Option J1 comprised a package of measures to increase capacity and improve traffic flow at problem junctions throughout Lowestoft without providing a third crossing, but rather "fine tuning" the existing network. This option was rejected as a viable alternative because it would fail to address the fundamental problem of physical

severance caused by Lake Lothing and would therefore not fully meet the objectives of the scheme.

3.3.6 Option S1 was a package of 'smarter choices' to encourage people to make fewer journeys by private car. Earlier work by SCC suggested that against the achievements in modal shift to date and the congestion at the existing crossings that would still be expected even with this option implemented, it would be insufficient to meet the scheme objectives. This option was therefore rejected because it would be unlikely to fully address the scheme objectives, including the reduction of severance and unlocking of opportunities for regeneration.

3.3.7 Option P1 comprised the introduction of road pricing to discourage traffic from congested routes and to encourage people to make fewer journeys by private car. It was considered unlikely that this would be appropriate in the present economic climate, particularly in Lowestoft where parts of some wards are among the 5% most deprived in England. It could also dissuade investment in the town contrary to the scheme objectives to encourage regeneration and redevelopment

3.3.8 On a smaller scale, tolling a new crossing over Lake Lothing alone would discourage its use and thus fail to relieve congestion at the existing crossings points and in particular on the Strategic Road Network.

3.3.9 Options J1, S1 and P1 were accordingly not taken forward for further assessment.

3.3.10 Option L1 was also discounted due to the impact on the operation of the Port, concerns over the intrusive nature of such a structure and the fact that proposals for a strategic flood barrier for Lowestoft have since been developed, making the flood defence capabilities of option L1 likely redundant.

3.4 Discounting of Options

3.4.1 Having selected a long-list of 11 remaining options, it was necessary to identify which did not represent realistic solutions. The need for the selected scheme to perform well across economic, environmental and social indicators required a process of sifting and discarding of options to ensure that final options made a significant contribution to achieving the scheme objectives.

3.4.2 During the next stage of sifting some further potential options were discarded because they:

- Did not achieve scheme objectives;
- Did not fit with existing local or national strategies and priorities;
- Would cause severe adverse impacts;
- Are not considered to be technically sound;
- Are unlikely to be affordable; and
- Are unlikely to be acceptable to stakeholders and the general public.

3.4.3 The reasons why these remaining 11 options were narrowed down to three final options are set out in Table 3.2 below.

Table 3.2 – Summary of the options assessed

Option	Outline of key environmental issues	Decision outcomes
Western Option (W1, W2, W3)	Impact of Leathes Ham Local Nature Reserve. All western options would create disturbance and land take to this protected area which is used by breeding wildfowl. Options run through Brooke Yachts and Jeld-Wen Mosaic County Wildlife site which has a known population of reptiles, hosts the only mudflat habitat within Lake Lothing and has suitable habitat for nesting birds. Potential to impact bats and reptiles. Potential disturbance of contaminated land. Increased level of landscape impacts.	W1 and W2 do not effectively connect to the existing road network. W1 and W2 would increase traffic flows on Kirkley Run. W3 would require greater land take and greater severance of commercial land both north and south of the Lake. Traffic issues likely at Victoria Road as a result of the options.
Central crossing options (C1, C2, C3)	Potential impact to bats and reptiles although further, more detailed, assessment required to identify to what extent this is a constraint.	All options passed assessment criteria. Received over 60% support in public consultation undertaken in 2014 as being the preferred location. Poses a potential problem for river navigation to the port, ABP preferring an eastern option. Least impact on the Sustainable Urban Neighbourhood development to the south of the Lake (outlined within the Area Action Plan)
Eastern Crossing Options (E1, E2, E3 and E4)	Unknown at this stage.	Options E1, E2 and E3 are unlikely to meet a number of scheme objectives. E1, E2 and E3 would not significantly improve access to regeneration areas south of Lake Lothing. Severance would be an issue as Lake Lothing would continue to create a barrier of more than 2.5km long between the north and south halves of the town. Eastern options do not tie well into the existing network. E1 only connects directly into Commercial Road, providing no traffic relief. A new bascule bridge would have to open every time existing Bascule Bridge opens. Need to relocate the railway.

Option	Outline of key environmental issues	Decision outcomes
Tunnel Option (T1)	Mitigation to prevent loss of important strategic/ functional floodplain at Leathes Ham and Brooke Yachts and Jeld-Wen Mosaic would also be required as the area is designated as an important location for biodiversity. T1 Option runs through the Brooke Yachts and Jeld-Wen Mosaic County Wildlife site which has a known population of reptiles, hosts the only mudflat habitat within Lake Lothing and has suitable habitat for nesting birds. This ex-industrial area has a mixture of grassland and ruderal habitats with fringing mudflats. Potential to impact bats and reptiles. Assessments have determined that the tunnel option is likely to cause potentially Large Adverse impacts to floodplain and water abstractions and significant measures to mitigate these impacts would be required. Other impacts may include increased discharge into water bodies and therefore a slight decrease in water quality whilst there will likely be an increase in the potential of accidental spillage contaminating groundwater or surface water	Most expensive option for both construction and maintenance. Option does not provide attractive pedestrian or cycle routes and therefore fails to meet key objectives. Construction programme for the tunnel option suggests that bridge options would be delivered considerably quicker. It is also likely that additional, previously unseen or unknown complications associated with the tunnelling option could arise, placing further delays, cost and increasing risk onto the project. In addition to key environmental issues, the topography of the area would require additional compulsory acquisition of significant third party land to enable compliant entry and exit gradients.

3.5 Final Alternatives Shortlisted

3.5.1 Following the discounting of options stage, three proposals were progressed to consideration within the OBC submission to Department for Transport (DfT). These were:

- A western bridge option;
- A western tunnel option; and
- A central bridge option.

Western option (formerly referred to as W3) (Bridge)

3.5.2 The western bridge option of W3 was considered a viable option and was selected to have further assessment undertaken. Options W1 and W2 were eventually rejected as the assessment considered it likely they would cause adverse impacts on residents and the environment.

3.5.3 This western bridge option would run from a new roundabout at Peto Way, to the north of Leathes Ham, and span both the railway line and Lake Lothing on a north-south alignment. In order for the new roundabout and bridge to not sever Peto Way, the existing Peto way traffic would be diverted under a new underbridge and connect into

a new roundabout. To the south of the Lake, the new crossing would connect into Waveney Drive, to the east of Kimberly Road.

Western Tunnel Option (T3)

3.5.4 The tunnel option (an evolution of T1) flows in a very similar alignment to the western bridge option9, running from a new roundabout on Peto Way, to the north east of Leathes Ham, passing beneath both the railway line and Lake Lothing on a north-south alignment. The existing alignment of Peto Way will be altered so that it can adjoin the newly created roundabout. To the south of the Lake, the tunnel would connect to Waveney Drive to the east of Kimberly Road.

Central Option

3.5.5 The central option follows the same alignments all central bridge options, although this specific option generation connects into Denmark way to the north into Riverside Road to the south by means of a bascule bridge. The finished bridge height will need to be elevated to span across the railway line, before linking into a new roundabout and road layout near Denmark Road.

3.6 Comparison of final alternatives

3.6.1 The adoption of the proposed scheme has been a combination of the following seven aspects:

- Delivery of scheme objectives;
- User benefits, based on time and vehicle operating cost savings;
- Cost of construction;
- Benefit to cost ratio;
- Traffic impacts;
- Environmental impacts; and
- Public and stakeholder support.

3.6.2 Each of the three final options were considered and appraised against these seven aspects with greater detail on the outcome below.

Delivery of scheme objectives

3.6.3 Traffic forecasts undertaken at the OBC stage showed that the western and tunnel options would be less effective than the central option in reducing traffic on the existing crossings. The tunnel option would unlikely be able to deliver any benefits to pedestrians and cyclists.

[9] While it was it was initially assumed that a tunnel might follow either a western or a central alignment, a central option was ruled out due to the difficulty in achieving a satisfactory vertical alignment

3.6.4 It was concluded that the central option would most closely align with the scheme objectives.

User Benefits

3.6.5 Using the Transport User Benefit Appraisal (TUBA) model, the Present Value of Benefit (PVB) in Table 3.3 below are predicted.

Table 3.3 – User benefits

Option	PVB (£)
Western bridge option	338,700
Central bridge option	453,300
Western tunnel option	338,300

Construction Cost

3.6.6 At 2015 prices, the schemes were estimated to have construction costs of:

- Western bridge option - £85 million;
- Central bridge option - £79 million; and
- Western tunnel option - £118 million.

Benefit to Cost Ratio

3.6.7 Adopting the DfT model for assessing transport scheme benefits in the OBC, the following BCRs were calculated;

- Western bridge option – 5.9;
- Central bridge option – 8.5; and
- Tunnel option – 4.27.

Traffic Impacts

3.6.8 The effectiveness of each option to reduce traffic is shown in Table 3.4.

Table 3.4 - Traffic impacts in peak hours

AM Peak 2020	Forecast traffic (2 way) veh/hr		
	On Mutford Lock	On new crossing	On Bascule Bridge
Do Nothing	2,763	0	2,742
Western Bridge	1,923 (-30%)	1,579	2,327 (-15%)
Central Bridge	1,814 (-34%)	2,245	1,814 (-34%)
Western Tunnel	1,894 (-31%)	1,619	2,318 (-15%)
PM Peak 2020	**Forecast traffic (2 way) veh/hr**		
	On Mutford Lock	**On new crossing**	**On Bascule Bridge**
Do Nothing	2,972	0	3,058
Western Bridge	2,318 (-22%)	1,653	2,663 (-13%)

Central Bridge	2,314 (-22%)	2,313	2,053 (-33%)
Western Tunnel	2,201 (-26%)	1,832	2,600 (15%)

3.6.9 As shown in Table 3.4 there is little to differentiate between the effectiveness of all three options in reducing traffic on Mutford Lock. However, the central bridge option is clearly more effective than the western bridge and western tunnel option at reducing flow upon the existing bascule bridge and thus the Strategic Road Network.

Environmental Impacts

3.6.10 An Environmental Appraisal Report (EAR) was prepared at OBC stage to accompany the submission to DfT. The submission did not include an assessment of landscape or air quality and concluded against the remaining environmental aspects as follows:

Noise

3.6.11 All three options were considered to be likely to result in slight adverse impacts upon the noise environment with nothing to significantly differentiate between them.

Greenhouse gases

3.6.12 The TUBA model identified greenhouse gas savings associated with all three options, but the central option provided greater savings than the western tunnel or western bridge options.

Townscape

3.6.13 All three options were considered to be likely to result in slight adverse impacts upon the townscape with nothing to significantly differentiate between them.

Historic environment

3.6.14 All three options were considered to be likely to result in slight adverse impacts upon the historic environment with nothing to significantly differentiate between them.

Biodiversity

3.6.15 All three options were considered to be likely to result in moderate adverse impacts upon biodiversity with nothing to significantly differentiate between them.

Water environment

3.6.16 It was identified that the western bridge and western tunnel options were likely to have large adverse impacts upon the water environment, largely due to their proximity and the land take from the Leathes Ham waterbody. A moderate adverse impact was concluded for the central option.

Summary

3.6.17 It was accordingly concluded that lesser environmental impacts were likely with the central crossing option compared to the western tunnel and western crossing option.

Public Support

3.6.18 Consultation undertaken in 2014 pursuant to an earlier Options Appraisal prepared by WSP had previously considered broad options for a crossing location and the results are shown in Table 3.5. A tunnel option was not under consideration at this time.

Table 3.5 – Public consultation (2014)

Preferred location	Percentage
West	23.9%
Central	60.6%
East	8.3%
Other	4.4%
No Response	2.8%
TOTAL	100%

Stakeholder support

3.6.19 A survey of businesses was undertaken by Suffolk Business School in October 2015 to support the preparation of the Outline Business Case. It included a question as to which corridor (west, east or central) was preferred for a third crossing. The results of this are shown in Table 3.6

Table 3.6 – Stakeholder survey

Corridor	First choice	Second choice	Least preferred
West	61 (40%)	61	20
Central	70 (48%)	66	5
East	18 (12%)	9	99
No response	0	13	25
TOTAL	149	149	149

Preferred option

3.6.20 The assessment, therefore, demonstrated across a number of criteria that the central bridge option should form the preferred scheme on account of it being the least expensive and delivering the highest benefit, whilst having fewer environmental impacts and a high level of public and stakeholder support.

3.6.21 It was however identified during the course of stakeholder engagement in both 2014 and 2015 that a central option could have an impact on the operation of the port which would need to be mitigated through the design process.

3.7 Future alternatives

3.7.1 As discussed in Section 2.1.1 there are, at the time of the submission of this Scoping Report, alternative options being considered with regard to the design of the junctions that will connect the proposed scheme to the existing road network.

3.7.2 It is therefore proposed that the alternatives chapter within the ES will present information that identifies two types of alternatives;

- The consideration of alternative locations, as presented in this chapter (albeit no further assessment would, or is required to, be undertaken); and
- The consideration of alternative junction arrangements within the chosen central corridor.

4 The Existing Environment

4.1 Introduction

4.1.1 Information relating to the status of the environment within the proposed scheme corridor and wider study area, has been collated through desk studies and a series of site based information collection surveys. Consultation with key stakeholders has also been undertaken and, where this has informed our proposed scope, this has been identified.

4.1.2 The following environmental constraints identified in Section 4.2 through to 4.12.1, have been identified and are presented on the following Figures appended to this Scoping Report. A number of Figures depict a particular junction arrangement, but that is indicative only and as outlined above in Chapter 2 is subject to further refinement, assessment and consultation

Table 4.1 – Figures

Figure Number	Description
Figure 1	Site Location Plan
Figure 2	Proposed scheme
Figure 3	Alternatives
Figure 4	Non-Ecological Environmental Constraints Plan
Figure 5	Ecological Constraints Plan
Figure 6	Air Quality Monitoring Sites and Affected Network
Figure 7	Zone of Visual Influence
Figure 8	Bat potential, Bat transects and Reptiles (2016/2017)
Figure 9	Bird surveys
Figure 10	Proposed Noise Monitoring Locations Plan
Figure 11	Public Rights of Way and Cycle Routes

4.2 Air Quality

4.2.1 The level of air pollution adjacent to roads and within urbanised areas is typically a function of vehicle emissions. Emissions of nitrogen oxides (NOx, including nitrogen dioxide, NO2) and particulate matter (PM10 and PM2.5)10 from vehicles are of greatest concern with respect to human health.

[10] PM_{10} - assessed as the fraction of airborne particles of mean aerodynamic diameter less than 10 micrometres
$PM_{2.5}$ – assessed as the fraction of airborne particles with an aerodynamic diameter less than 2.5 micrometres

4.2.2 Concentrations of these pollutants are most likely to approach their respective air quality limit values, established by UK legislation11 for the protection of human health, in proximity to the aforementioned areas. Therefore, the below review of the existing environment and subsequent air quality assessment scope will focus on these pollutants.

4.2.3 Information was collated from the following sources to inform the review of existing air quality conditions:

- Waveney District Council local air quality management (LAQM) reports and published monitoring data;
- Department for Environment Food and Rural Affairs (Defra) mapped background air pollutant concentrations specific to the proposed scheme; and
- Ordnance Survey (OS) mapping and address layer data to identify potentially sensitive receptors in proximity to the proposed scheme and surrounding areas.

Local Air Quality Management Review

4.2.4 A review of the latest LAQM report published by Waveney District Council, 2015 Air Quality Updating and Screening Assessment, confirmed that there are no Air Quality Management Areas (AQMAs) declared within the District, with no requirement for the Council to progress to a detailed assessment of air quality for any pollutant.

4.2.5 Waveney District Council does not currently operate an automatic continuous air quality monitor and does not monitor levels of PM10 and PM2.5 within Lowestoft.

4.2.6 The Council does operate a network of NO2 diffusion tube monitoring sites, five of which are located adjacent to roads that are likely to be affected by the proposed scheme, comprising:

- A146 Bridge Road;
- A12 Belvedere Road; and
- A12 Pier Terrace/ B1532 London Road South junction.

4.2.7 The annual mean NO2 concentrations at these locations, obtained from Waveney District Council for the period 2010 – 2016 inclusive, demonstrate that there have not been any exceedances of the respective air quality limit value (40 $\mu g.m^{-3}$). The maximum monitored annual mean concentration recorded in the last two years (2015/16) was 35.3 $\mu g.m^{-3}$ adjacent to the A12/ B1532 junction located to the south of the existing A12 Bascule Bridge.

Background Pollutant Concentrations

4.2.8 Defra publishes modelled background air pollutant data for the UK, based on a 1 km^2 grid, which accounts for a multitude of local emissions sources including road vehicles,

[11] HMSO (2010) Statutory Instrument 2010 No. 1001, *The Air Quality Standards (England) Regulations 2010*, London: HMSO

industrial installations, domestic heating and other transport modes, in addition to regional sources and imported emissions. The modelled background data is available for years 2013 to 2030 inclusive.

4.2.9 For the purposes of reviewing the existing background and predicted future background levels, the maximum, minimum and average annual mean concentrations of each pollutant (NO2, PM10, PM2.5) based on the 1 km^2 grids encompassing the proposed scheme and surrounding area, are presented in Table 4.2 below for the current year and a future year.

Table 4.2 – Defra mapped background annual mean concentrations (µg/m^3) for each pollutant in current (2016) and future year

Pollutant	2016 Background Concentration			Background Concentration		
	Maximum	Minimum	Average	Maximum	Minimum	Average
NO_2	14.5	8.1	9.7	12.2	6.7	8.0
NO_x	20.6	10.9	13.2	16.9	8.8	10.6
PM_{10}	16.7	13.2	15.0	16.1	12.6	14.4
$PM_{2.5}$	11.5	9.6	10.6	10.9	9.1	10.0

4.2.10 The predicted current and future background concentrations presented in Table 4.2 are well below the respective health-based annual mean limit values for NO2 (40 µg.m-3), PM10 (40 µg.m-3), and PM2.5 (25 µg.m-3). Similarly, the annual mean NOx limit value (30 µg.m-3) set for the protection of vegetation and ecosystems, is not predicted to be exceeded.

Potentially Sensitive Receptors

4.2.11 The influence of vehicle emissions on ambient air quality is negligible beyond 200m of the respective road source, predominantly due to horizontal and vertical atmospheric mixing. As such, an initial desk-based review of potentially sensitive receptors to air quality was undertaken to identify those located within 200m of the proposed scheme alignments and associated affected links. This review was based on OS mapping and address layer data. Sensitive receptors as defined in the Design Manual for Roads and Bridges (DMRB) Section 11.3.1 (HA207/07) include:

- Residential dwellings;
- Designated ecological sites;
- Locations of the young and elderly;
- Hospitals; and
- Schools.

4.2.12 A summary of the sensitive receptor locations identified within 200m of the affected road network is presented in Table 4.3.

4.2.13 The proposed scheme will change the physical arrangement of the local road network and therefore alter vehicle flow characteristics, including flow volumes, composition,

and speeds. Thus, there is the potential for vehicle emissions to impact local concentrations of air pollutants at the identified sensitive receptors, which will warrant further assessment as outlined in 5.1.1.

Table 4.3 – Identified potentially sensitive receptor locations based on OS mapping review

Property Type	Count
Residential	19,532
Designated ecological sites	0*
Education	23
Health Care (Hospitals, Care Homes etc.)	26

* No sites identified within 200m of affected road links based on current data. However, this will be revisited if updated traffic data is provided. Sprat's Water and Marshes, Carlton Colville SSSI, Broadland Ramsar and SPA and The Broads SAC are located within 200 m of the A146 Beccles Road.

4.3 Cultural Heritage

4.3.1 To understand the cultural heritage of the area a desktop study (Appendix B), supplemented by an initial walk over survey, was conducted by an appropriately qualified and experienced archaeologist. The desktop study examined known and potential cultural heritage assets situated within 500m of the shortlisted alignments discussed in Section 3.5.

4.3.2 A small number of heritage assets located at greater distance from the shortlisted alignments were also considered by the desktop study if their setting could be affected, or if they allowed greater understanding of the archaeological and historical context of the Lowestoft area.

4.3.3 The desktop study examined the following sources of information:

- Suffolk Historic Environment Record (HER) – for all records relating to known heritage assets and secondary source material including archaeological reports;
- Suffolk Record Office – for all historic maps, and other documentary evidence;
- The Suffolk Historic Landscape Characterisation;
- Historic England Archive/National Heritage List for England; and
- Publicly available aerial photos from Vision of Britain, Google Earth & Bing Maps.

Designated Heritage Assets

4.3.4 The desktop study established that:

- No World Heritage Sites, Scheduled Monuments, Registered Battlefields or Registered Park and Gardens are located within 500m of the proposed scheme;
- One conservation area is located within 500m of the proposed scheme: Lowestoft South, *circa (c.)* 400m east; and

- Two listed buildings (The Port House: Grade II, and The Royal Norfolk and Suffolk Yacht Club: Grade II*) are situated c.700m east of the proposed scheme and have intervisibility with it.

4.3.5 Other listed buildings and two distant Conservation Areas (Lowestoft North and Oulton Broad) situated beyond the 500m study area are screened from the proposed scheme by topography and the existing built environment.

Undesignated Heritage Assets

4.3.6 A total of 57 undesignated heritage assets and archaeological events were recorded within the study area, comprising:

- 47 non-designated heritage assets; and
- 10 archaeological events.

4.3.7 The heritage assets are dominated by demolished World War II defensive sites, the majority comprising anti-air raid / anti-aircraft sites and extensive 'stop line' defences. Other heritage assets include an area of undated cropmarks, dispersed findspots of prehistoric flint tools or Roman coins and Lake Lothing itself, which is believed to have originated as a medieval turbary (peat cutting).

4.3.8 The walkover survey established that the setting of a small number of historic buildings of local interest located on the northern side of Lake Lothing and with intervisibility with the proposed scheme could be affected:

- 3 – 11 Station Square;
- Terraced Houses fronting the north side of Commercial Road from its junction with Station Square;
- A two storey brick built 20th century industrial building located on the north side of Commercial Road; and
- A one storey brick built 20th century industrial building and an adjacent iron railway footbridge located on the north side of Commercial Road near the entrance to Associated British Ports land.

4.3.9 The setting of one historic building of local interest located south of the existing Bascule Bridge and with intervisibility with the proposed scheme could be affected:

- Pier Terrace.

4.3.10 The presence of the heritage assets noted above and the historic importance of Lake Lothing as a port, suggests that there is a moderate potential for the survival of sub--surface archaeological remains, particularly of World War II defensive structures.

Geoarchaeological and Palaeoenvironmental Evidence

4.3.11 The desktop study suggested that palaeoenvironmental and archaeological evidence of the prehistoric periods may be preserved in proximity to the proposed scheme beneath and within Holocene peat and alluvium.

4.3.12 The study also showed that the Cromer Forest Bed Formation may be located at depth below Lowestoft. This geological formation contains internationally important evidence of pre-modern human activity, including the earliest evidence yet recorded for the presence of pre-modern humans in northern Europe (c.800,000 Before Present).

4.3.13 A deposit model (Appendix C) was subsequently completed to assess whether Holocene deposits and the Cromer Forest Bed Formation survived in proximity to the proposed scheme. The deposit model examined existing borehole and archaeological information and results indicate that:

- Holocene alluvium and localised deposits of peat survive toward the southern end of the proposed scheme, but these deposits are absent from the area situated in closer proximity to the southern side of Lake Lothing;
- Extensive deposits of Holocene alluvium and localised areas of peat survive to the north of Lake Lothing. The deepest sequence of the Holocene deposits was identified adjacent to the north quay wall; and
- The Cromer Forest Bed Formation may be absent. However, the depth, distribution and the level of detail recorded by existing investigations was not deemed sufficient to enable definitive interpretation.

4.4 Townscape and Visual Impact

4.4.1 The urban, industrial water space that makes up Lake Lothing provides a link with The Broads National Park and the North Sea via Oulton Broad in the east and the Lowestoft Inner Harbour. The linear body of water is fringed by a variety of land uses that contribute to a varied character, represented primarily by industrial and maritime activity.

4.4.2 Maritime (recreational) activity is largely confined to the western end of Lake Lothing where numerous pontoons provide mooring to leisure craft. In contrast, the eastern end of Lake Lothing has a more industrial nature associated with it, in addition to the larger scale sea faring ships that routinely dock along the waterside, industrial, railway and large scale commercial development dominate.

4.4.3 Beyond the immediate environments associated with the banks of the Lake, the land use quickly reverts to residential development which extends to the north and south. To the north in particular, the townscape is tight knit, small scale housing that is regular in pattern. This breaks down to the north east where older properties on a more irregular layout interrupt this pattern.

4.4.4 To the south of Lake Lothing the townscape is again characterised by a dense housing pattern which becomes more open in nature to the west, with larger gardens and less regular street patterns.

4.4.5 The townscape surrounding Lake Lothing is an area that within the Lowestoft Lake Lothing and Outer Harbour Area Action Plan is identified for regeneration aimed at

delivering more diverse mixed use townscapes; improving access to the water's edge, with the frontage onto the Lake being a primary focus.

4.4.6 With the exception of the South Lowestoft Conservation Area, that encompasses the eastern end of Lake Lothing and the North Lowestoft Conservation Area that extends northwards from Milton Road East, there are no designations that relate to the topic of townscape.

4.4.7 A national cycle route circumvents Lake Lothing to the east, crossing at the existing bridge to the east; this affords transitional but periodic views of the body of water where the route ties into the edges of the lake.

4.5 Ecology and Nature Conservation

4.5.1 A desk study, Phase 1 Habitat survey and species specific surveys for reptiles and bats have been undertaken to identify changes to known biodiversity resources and include both designated and non-designated sites.

4.5.2 In addition to the studies and surveys that have been undertaken to date in support of this Scoping Report, a Habitats Regulations Assessment (HRA) screening exercise is being undertaken and is identified further in Section 5.4.17.

4.5.3 The appraisal has considered two study areas:

- Main Study Area: Defined as extending to a distance of 500m around the proposed scheme alignments; and
- Broad Study Area: comprises of the wider environment to encompass potential impacts in respect to specific sites, for example 30km for SACs designated for bats.

4.5.4 The surveys have been undertaken with reference to the following guidance:

- TAG Unit A3 Chapters 5 and 9 (which also references DMRB Volume 11 Section 3 Part 4);
- 'Guidelines for Ecological Impact Assessment in the UK' (Chartered Institute for Ecological and Environmental Management (CIEEM),2006); and
- DMRB Volume 11 Section 4 Assessment of the Implications (of Highways and/or Road Projects) on European Sites (including Appropriate Assessment).

Desk-Based Studies

Internationally Designated Sites

4.5.5 The Broad Study Area of the proposed scheme includes the following Natura 2000 sites;

- The Broads Special Area of Conservation (SAC);
- Broadland Special Protection Area (SPA);_
- Broadland Ramsar;
- South North Sea pSAC;

- Outer Thames Estuary SPA; and
- Outer Thames Estuary pSPA Extension.

Nationally Designated Sites

4.5.6 The desk-based search established there is one statutory designated site within 2km of the proposed scheme. This is the Leathes Ham Local Nature Reserve (LNR) (see Figure 6).

4.5.7 Determination of potential ecology constraints for the proposed scheme were discussed in consultation with the Lead Advisor for Planning and Conservation at Natural England and the senior ecologist at SCC. Through this consultation, it has been advised that available information sources and protected species records from the area will accompany protected species survey baseline information.

4.5.8 Further survey work and assessments will need to consider that the proposed scheme passes through suitable reptile and nesting bird habitat sites and within 0.5km of known populations of reptiles. There are also buildings within 50m of the proposed scheme that could offer bat roosting sites.

4.5.9 Discussion is still required with respect to surveying the marine environment within the proposed option footprint. At this stage, it is likely a benthic survey will be necessary in line with the result of discussions with the Marine Management Organisation (MMO) and Environment Agency.

4.5.10 A marine survey to assess the ecological condition of marine habitats and species will be designed and conducted in line with MMO requirements.

4.5.11 Local Nature Reserves (LNR) are sites of local or district-wide importance, designated for the enjoyment, study or conservation of wildlife, geological features and landforms. Leathes' Ham LNR is a freshwater lake with a mix of wooded and grassland habitat that is home to many bird species.

4.5.12 Three County Wildlife Sites (CWS) exist within the study area, namely:

- Brooke Yachts and Jeld-Wen Mosaic County Wildlife Site;
- Kirkley Ham County Wildlife Site; and
- Habour Kittiwake Colony County Wildlife Site.

4.5.13 Leathes Ham LNR and the three CWSs are identified on Figure 6.

Species Records

4.5.14 The review of existing records of species within 2km of the proposed scheme has established the following: Records of brown long-eared bat *Plecotus auritus*, pipistrelle *Pipistrellus sp.*, water vole *Arvicola amphibious*, grey seal *Halichoerus grypus* and common lizard *Zootoca vivipara* exist within 2km of the proposed scheme. Approximately 150 species of birds have been recorded within 2km, including notable species such as barn owl *Tyto alba*, black redstart *Phoenicurus ochruros*, green sandpiper *Tringa ochropus,* hen harrier *Circus cyaneus*, kingfisher Alcedo *atthis*, little

tern *Sternula albifrons*, peregrine *Falco peregrinus* and red throated diver *Gavia stellate*.

4.5.15 Biological records show several priority species (S41 NERC Act as amended) that have been recorded within 2km. Species recorded include hedgehog *Erinaceus europaeus*, common toad *Bufo bufo*, common frog *Rana temporaria* and smooth newt *Lissotriton vulgaris*. These species are afforded no formal protection within the UK but must be taken into consideration during the planning phase.

Habitats

4.5.16 The types and extent of habitats identified within 100m of the proposed scheme alignments are described in Table 4.4 and shown in the Lake Lothing Third Crossing – Extended Phase 1 Habitat Survey Report (2015) (Appendix D).

Table 4.4 – Habitats Survey

Habitat	Description
Amenity Grassland	There is an area of amenity grassland on the corner of Rotterdam Road and Denmark Road comprising a playing field and recreational area. This habitat is of low ecological value and is not an ecological constraint to the proposed works.
Hard Standing	Several areas of old hard standing are present, containing numerous cracks within which vegetation has become established. Species present include buddleia *Buddleja globose*, gorse, willow herb and several species of grasses. This habitat is of little ecological value and is not a constraint to the proposed works.
Tall Ruderal	Small isolated areas of this habitat were present to the north of the railway line adjacent to Denmark Road. These areas were dominated by bramble, with willow herb, common nettle, ragwort *Jacobaea vulgaris*, common hogweed *Heracleum sphondylium*, ivy, bindweed *Convolvulus arvensis*, broom *Cytisus scoparius* and dog rose *Rosa canina*.
Unimproved Neutral Grassland	Small areas of grasses were interspersed within the tall ruderal, and these consisted of perennial rye grass *Lolium perenne*, timothy-grass *Phleum pratense*, false oat grass *Arrthenatherum elatius* and willow herb. There were also some woody species within the tall ruderal, including elm, hawthorn and sycamore. This habitat is found throughout the UK and is not an ecological constraint to the works.

Species

4.5.17 A summary of species potential, and results of surveys undertaken to date within the study area is provided in Table 4.5 and shown on Figures 9 and 10.

Table 4.5 – Species surveys proposed and undertaken

Species	Description
Invertebrates	An area of rough grassland centred on grid reference TM538925 is a dedicated wildlife area for the five-banded weevil wasp *Cerceris quinquefasciata*. This nationally rare and UK BAP Priority Species is a sand-burrowing insect and there is additional habitat associated with the sandy substrate associated with amenity planting on the south side of Lake Lothing.

Species	Description
Reptiles	The mosaics of tall ruderal vegetation, grasslands and hard standings provide suitable habitat for reptiles, which include common lizard, slow worm, and grass snake. Any populations are likely to be of no more than local biodiversity value. Surveys have been undertaken on the southern side of Lake Lothing across three areas of suitable habitat in late summer 2016 and no reptiles have been recorded.
Bats	Assessment of structures for bat roost potential was undertaken by Mouchel in August 2016. Structures considered to have bat roost potential were considered in the context of their proximity to the location of the proposed scheme to determine the requirement to undertake appropriate surveys. Structures which were not located immediately adjacent to the proposed route alignment were scoped out of any further surveys. Four sites were identified as requiring further surveys for bat roost presence. No evidence of roosting bats was recorded from any of the buildings surveyed during the surveys undertaken during 2016. Further surveys will be undertaken during 2017. Activity levels recorded during the emergence surveys and the walked transect surveys was generally low, typically with just a single bat pass recorded. Surveys undertaken at the car garage on the northern side of Lake Lothing recorded activity by *Nathusius' pipistrelle*. This species, although widespread, is rare within the UK. Further surveys will be undertaken during 2017 to obtain more information on the use of the habitats within the scheme by this species.
Birds	There are trees and areas of vegetation that provide suitable habitat for breeding birds. The former industrial sites associated with the south side of Lake Lothing provide excellent foraging and nesting habitat for black redstarts. Dedicated surveys for this species will be undertaken in 2017. A winter bird survey is being undertaken to assess the populations of species utilising Lake Lothing that may be associated with the Broadland SPA site.
Badgers	No field signs of badger *Meles meles* were found during the surveys. Suitable habitat is available for this species adjacent to the railway line, however, there is little connectivity to the wider area and it is considered unlikely that this species is present.
Otters and Water Voles	Lake Lothing provides low quality habitat for otters and water voles. No evidence of these species was found during the surveys, and it is therefore unlikely that these species could be affected by the proposed scheme.
Other Species	There are suitable habitats within the survey area that may support species that do not receive legal protection but are recognised as UK and Suffolk Priority Species (also known as Biodiversity Action Plan (BAP) species). These include hedgehog *Erinaceus europaeus*, additional invertebrate and fish species. These are identified further in Appendix F.

The Suffolk County Biodiversity Action Plan

4.5.18 Included in Appendix F is a list of the Biodiversity Action Plan (BAP) species that have been considered and informed the species specific surveys that are proposed.

4.6 Geology, Soils and Contamination

Designated Sites

4.6.1 No geological designated sites exist within 500m of the proposed scheme.

Bedrock Geology

4.6.2 As indicated on the British Geological Survey (BGS) website[12] the bedrock geology across the study area comprises the Crag Group. This is a sedimentary green to orange sandstone containing haematite. In the lower deposits, the material predominantly comprises flint gravel.

Superficial Geology

4.6.3 The BGS website indicates that the edges of the site is underlain by sand of the Happisburgh Glacigenic Formation while the central parts of the site immediately adjacent to the watercourse are underlain by alluvium deposits comprising clay, silt, sand and gravel.

Soils and Sediment

4.6.4 The nature of onsite soils and sediments is undetermined. A ground investigation will be undertaken to characterise these. The Soilscapes website[13] indicates the soils at the site comprise the following: fen peat soils, freely draining slightly acidic sandy soils and freely draining slightly acidic loamy soils. However, due to previous development across the site, it is unlikely that significant amounts of naturally occurring soils are present and made ground is more likely to be prevalent.

Potentially Contaminated Sites

4.6.5 Mouchel prepared an Environmental Desk Study Report presented in Appendix G (a separate document to this scoping report), which includes a review of information from a GroundSure report. This records that no locations within the site are determined as contaminated land under Part 2A legislation, but does record a number of historical ground workings, as well as industrial uses; all of which may have introduced contaminated material on to site, including ponds, unspecified pits, lake, unspecified wharf, quay and a refuse heap, rail, ship building and an ice works.

4.6.6 There are records relating to three historic landfills within the site (all in the south east corner), one historic Environment Agency landfill and two Local Authority landfills (both

[12] British Geological Survey [online]. Available from: http://mapapps.bgs.ac.uk/geologyofbritain/home.html [Accessed 12 December 2016].

[13] Soilscapes. Available from: http://landis.org.uk

recorded as refuse tips on 1963 historic mapping). GroundSure does not provide any further information such as waste types or licence numbers.

Existing Ground Investigation / Remediation Information

4.6.7 Ground investigation and remediation verification has been undertaken on the site of the Council Offices, Canning Road (south west corner of the site) by RSA Geotechnics Ltd and JPC Environmental Services. Details are presented in the Mouchel Desk Study presented in Appendix G (a separate document to this scoping report). The ground investigation undertaken by RSA Geotechnics Ltd identified the presence of elevated polyaromatic hydrocarbons, Total Petroleum Hydrocarbons, Asbestos and Lead within soils which may pose a potential risk to human health. It was concluded that there was negligible risk to controlled waters and to the site from ground gas. No ground investigation information has been made available for elsewhere on the site.

4.6.8 Remedial works comprising clean cover capping of landscaping areas, removal of all underground fuel storage tanks, and removal of asbestos containing material (ACM) were undertaken.

4.6.9 The site currently occupied by the Register Office on Canning Road, was part of the same site as the Council Offices but was not included in previous ground investigation or remediation works. It is likely that similar contamination will exist on this site as was found on the site of the Council offices pre-remediation.

4.7 Noise and Vibration

4.7.1 The proposed scheme will change the physical arrangement of the local road network and therefore alter vehicle flow characteristics, including flow volumes, composition, and speeds. There is the potential for changes to noise and vibration impacts at the sensitive receptors, which will warrant further assessment as outlined in Section 5.7.

4.7.2 A high level review based on proximity to the proposed scheme has been undertaken to indicate likely impacts and this has included screening traffic data to calculate the noise Study Area, and to provide an indicative distribution of the likely impacts.

Existing Noise Climate

4.7.3 Surveys of the existing noise climate at noise sensitive receptors located close the scheme are proposed for February 2017. The measured levels will inform the construction noise assessment.

4.7.4 Noise monitoring surveys will cover day, evening and night-time periods, and include both weekday and weekend. Six representative locations have been agreed with SCC and WDC and these are shown in Figure 11.

4.7.5 Attended short-term (15 minute) measurements during key times/ days of construction works will be completed and if representative and secure locations are available, non-attended long-term (at least four days covering week days and weekends) monitoring will be completed.

Defra Noise Important Areas

4.7.6 Defra Noise Important Areas (NIA) are locations where the 1% of the population are affected by the highest noise levels from major roads according to the results of Defra's strategic noise maps.

4.7.7 There are no NIAs in the immediate vicinity of the proposed scheme.

4.7.8 There are three NIAs within 1.6km of the proposed scheme (ref. 5003, 5004 and 11285). They are located on Bridge Road and Normanston Drive to the west of the proposed scheme. The NIAs are all associated with traffic using the Mutford Lock crossing as shown in Figure 5.

Potentially Sensitive Receptors

4.7.9 An initial desk-based review of potentially sensitive receptors to noise and vibration was undertaken to identify those located within 300m of the proposed scheme alignments. This review was based on OS mapping and address layer data.

4.7.10 Sensitive receptors as defined in HD213/11 include dwellings, hospitals, schools, community facilities and designated areas.

4.7.11 A summary of the sensitive receptor locations identified within 300m of the affected road network is presented in Table 4.6. The total study area has been defined using preliminary traffic data and based on the guidance given in HD213/11.

Table 4.6 – Sensitive receptors within 300m

	Distance from proposed scheme				Total Study*
	0-50m	50-100m	100-200m	200-300m	
Dwellings	75	162	446	887	15,388
Other Receptors	2	3	3	4	135

4.8 People and Communities – Effects on All Travellers

4.8.1 Public Rights of Way (ProW) are minor public highways that exist for the benefit of the community at large, in much the same way as the public road network. They include footpaths, cycleways, bridleways and other routes that are used by Non-Motorised Users (NMUs). Within the study area there are a number of footpaths, cycleways, bridleways and other public accesses that serve local communities and visitors to the area. These are shown in Figure 12 and include:

- National Route 517 located on Hervey Street;
- A traffic free route on Denmark Way which is considered a part of the National Cycle Network 517; and
- To the south of the proposed scheme the A12 also forms part of National Route 517.

4.9 People and Communities - Communities and Private Assets

4.9.1 Land-used within the footprint of the scheme is predominantly a mix of industrial and commercial.

4.9.2 Private operational assets within the immediate vicinity of the proposed scheme include the following commercial properties:

- Nexen Lift Trucks;
- Lings Garage;
- Essex & Suffolk Water;
- Network Rail;
- Commercial property located within the Associated British Port of Lowestoft adjacent to Commercial Road; and
- A services tunnel that lies beneath Lake Lothing to the east of the proposed scheme.

4.9.3 DMRB Volume 11, Section 3 identifies community facilities as:

- Doctors' surgeries;
- Hospitals;
- Aged persons homes;
- Schools;
- Shops;
- Post Offices;
- Churches; and
- Parks, play areas sport centres etc.

4.9.4 No community facilities are situated within the immediate study area of the proposed scheme.

4.10 People and Communities – Socio Economics including Recreation

4.10.1 Lake Lothing creates a significant barrier to movement within and across Lowestoft and the wider area. Lake Lothing splits Lowestoft in two, with the main employment area located to the northern side and a sizeable residential population to the south. Crossing Lake Lothing constrains the transport options within the town, with two lifting bridges crossing at the eastern and western ends of the town and so forming bottlenecks where several roads merge into one. The Bascule Bridge currently has narrow pavements adjacent to the road carriageway with no separate provision for cycles. At Mutford Bridge there is a separate shared cycle/ pedestrian crossing.

Lowestoft Socio-Economic Environment (Census 2011)

4.10.2 Lowestoft is Waveney's largest town and the second largest in Suffolk. It is the most easterly town in the country and is situated between the eastern edge of The Broads National Park and the North Sea. Lowestoft shares many issues with Great Yarmouth to the north and the towns form the Great Yarmouth and Lowestoft sub region.

4.10.3 Lowestoft has a traditional economic structure characterised by a large manufacturing sector, a smaller services sector and a noticeable dependence on larger employees

within key sectors such as food and drink. The manufacturing sector has continued to decline and growth in employment has occurred in retail, tourism, service, construction and public service sectors.

4.10.4 Work industries in Lowestoft comprise wholesale and retail, which provides 19% of residents with employment; human health which provides 14% of residents with employment; manufacturing which provides 11% of the local residents with employment; and construction which accounts for 9% employment for local residents (Census, 2011). The tourism industry provides 12% of all jobs in the District. The town enjoys a reasonable level of tourism in the summer months with a large number of tourist attractions in close proximity, the most significant being the award-winning beaches.

4.10.5 The 2011 census data suggests that there were 7,097 detached houses or bungalows, 6,569 semi-detached houses or bungalow, 9,157 terraced houses or bungalows, and 3,999 flats in Lowestoft. At least 1,107 new houses were built during the time period ranging from 2011 to 2013 and at least 25% households have dependent children. In 2011, Lowestoft was home to at least 26,783 cars; i.e., one car per dwelling (Census, 2011). In terms of health, 38% of the local population is in very good health, 37% in good health, 17% in fair health and 8% in bad to very bad health (Census, 2011). At least 9% of Lowestoft's 18-year olds were not in education, training or work. At least 33% of Lowestoft's young population does not have any academic qualifications, schooling or training. Lowestoft has a total of 16,537 men aged between 16 and 65 years in work and a total of 17,181 women working.

4.10.6 The decline in oil and gas exploration and fishing in UK waters has impacted on economic and employment levels in the town but the UK's need for alternative energy sources places the area in a position to encourage investment, most notably the establishment of OrbisEnergy and at the Port to support the operations and maintenance of offshore windfarms. The locations of offshore wind farms around the UK sees Lowestoft in a prime position to reap the benefits from the multi-billion windfarm development entitled the 'East Anglian Array' which is to be built off the Suffolk and Norfolk coast, and forms part of the Round Three phase of developments. The 'East Anglian Array' windfarm will be one of the largest with hundreds of turbines located off the coast of Lowestoft and Great Yarmouth.

4.10.7 The energy sector will be a key growth area for Suffolk in the future and much work is already being undertaken to ensure that Suffolk makes the most of the opportunities that lie ahead. The development of the PowerPark in Lowestoft will provide a focus for additional public sector support to encourage research and development of all types of renewable and low carbon energy production. OrbisEnergy will provide a catalyst for the development of the PowerPark, and although located in Lowestoft, work will also be undertaken to develop the energy supply chain across the whole of Suffolk. This will include providing support and advice to enable local businesses to enter the supply chain or to help businesses diversify their products to capture the benefits of being in the supply chain.

4.10.8 Energy developments in and around Suffolk, most notably the East Anglia Array Windfarm and Sizewell C are likely to employ large numbers of construction workers.

The developers currently estimate that 3000, and up to 25,000 jobs will be created respectively during construction.

4.10.9 The Port of Lowestoft is Britain's most easterly port, and is owned by Associated British Ports. It is ideally located to service traffic to and from the industrial heartlands of Northern Europe, Scandinavia and the Baltic states. Lowestoft has experienced a significant increase in throughput in recent years, and offers a wide range of facilities for container, bulk and general-cargo.[14]

4.10.10 The port serves as a major centre for servicing the North Sea offshore oil and gas industry. A large number of small-to-medium sized enterprise (SME) based supply chain companies exist in the port area with transferable skills and products linked to the offshore industry (gas and oil).

4.10.11 The port has been actively involved in development, construction and operations and maintenance of the offshore wind farms. The Operations and Management for Greater Gabbard (offshore windfarm) run from the port. The successful Round Three developers for the East Anglia Array, ScottishPower Renewables, have agreed a 30 year deal with the Port of Lowestoft to act as a construction & operations hub for the East Anglia ONE. Lowestoft is also home to other leading companies in the energy sector, including Scottish and Southern Energy, Airtricity, Smoulders (formerly SLP), Siemens and Bond Helicopters.

4.10.12 The port generates interest from the culture and tourism sectors in respect of the town's fishing heritage and there is a modern fish market with fish auction and processing facilities. Fifteen inshore fishing vessels are run from the Hamilton Dock in the Outer Harbour. Traditional boat building/repairs also operate in the port. There are significant developments in the marine leisure industry in the outer and inner harbours. The Royal Norfolk and Suffolk yacht club is located on the south side of the outer harbour.[14]

Lowestoft's Highway Network

4.10.13 Recent improvements to the highway network mean that Lowestoft now has a northern spine road (Peto Way) and a southern relief road (Tom Crisp Way) designed to modern standards. There is a gap of less than 650m between these routes, but the actual driving distance (via the Bascule Bridge) is nearly 2km.

Loss of Traditional Industries

4.10.14 Lowestoft is an area of deprivation and has been since the demise of the fishing industry. Lake Lothing used to be the industrial heart of the town, an important centre for shipbuilding and other traditional industries, but these have declined sharply, leaving the area in need of regeneration and growth.

4.10.15 The decline in employment in key industries has been a problem for over 20 years. The last shipyard closed in the mid-1990s and from a peak in the 1950s and 1960s, Lowestoft's offshore fishing fleet is now reduced to only a small number of inshore

[14] Suffolk's Local Economic Assessment 2011

vessels. The manufacturing sector has continued to fall and employment has depended increasingly upon a small number of larger employers, particularly in engineering and food processing such as Birds Eye. The decline in oil and gas exploration in UK waters has impacted on economic and employment levels but the growth of offshore renewable energy generation provides significant potential.

4.10.16 Compensatory growth employment is also occurring in retail, tourism, service, construction and public service sectors. The proportion of people claiming Job Seeker's Allowance is 4.6%, compared to 2.3% in Suffolk and 3.1% in England. The Waveney Core Strategy highlights the problem of long-term unemployment and the high proportion of low skilled jobs.

4.10.17 According to the Index of Multiple Deprivation (2010), the level of employment deprivation in Lowestoft is relatively high. Parts of the Kirkley, Harbour and Normanston wards are among the 5% most deprived in England. All parts of these wards are amongst the 35% most deprived in England.

Difficulty Accessing Regeneration Sites

4.10.18 For Lowestoft to experience more inward investment, regeneration and growth, brownfield sites, include those vacated by declining industries in the area around Lake Lothing, could be redeveloped to attract new investment, create new jobs and enhance the built environment. For these developments to be successful and sustainable in the long term, they need high quality infrastructure, including excellent transport facilities including roads, public transport, and provision for people walking and cycling within an attractive and inspiring environment.

4.10.19 The great challenge for Lowestoft is that the area in most need of regeneration and inward investment, the area around Lake Lothing, is also an area where the transport networks have significant problems, due to the limited crossing opportunities and congestion at the existing bridges.

Community Severance

4.10.20 Community severance can generally be described as the separation of residents from the places they visit within their community caused by a busy road or other transport link, such as a railway. In Lowestoft, severance is caused by Lake Lothing itself, the railway line and congestion at the two existing crossings.

4.10.21 Despite being at the heart of the town, Lake Lothing divides Lowestoft into two halves, similar in size but different in character. The area to the north of the lake is home to about 36,000 people, and includes the main shopping centre and marina. The area to the south is home to about 26,000 people and includes the main seafront, pier and beach.

4.10.22 No community assets are situated within the immediate study area of the proposed scheme.

4.11 Road Drainage and the Water Environment

4.11.1 A desk study comprised a review of various information sources in order to obtain information relating to the water environment assembled from other studies and

designated and non-designated sites. Information sources which have informed the desk study review include:

- Environment Agency 'What's in My Backyard' (WIMBY) Online Mapper;
- British Geological Survey's Onshore GeoIndex Online Mapper;
- Ordnance Survey Opendata; and
- Defra's online GIS portal - http://www. magic.defra.gov.uk/

4.11.2 The study area has been defined as the physical area of the proposed scheme under consideration and a buffer of 1km either side of the route alignments and any surface or groundwater bodies or water dependent conservation sites located up to 1km downstream.

Surface Water

4.11.3 Lake Lothing is a saltwater lake, connected to the North Sea, allowing marine access to the upstream Oulton Broad, via Mutford Lock, and the wider Broads National Park area to the west of Lowestoft.

4.11.4 Historically Lake Lothing was an enclosed inland lake, although in more recent times it has been physically adapted to create a link between the North Sea with the harbour of Lowestoft. Where the proposed scheme crosses the water body, it spans approximately 100m with artificial banks developed on either side.

4.11.5 A watercourse known locally as the Kirkley Stream, flows north to converge with Lake Lothing at approximately TM 5398 9269, downstream of the crossing location. This watercourse drains the south of Lowestoft and has an approximate catchment size of 11km^2. Between Kirkley Fen Park (TM 5373 9207) and the confluence with Lake Lothing, the lower course of this channel is culverted representing approximately 500m of channel length. It is likely that there are also a number of smaller watercourses also culverted and flowing directly into Lake Lothing.

4.11.6 Whereas Lake Lothing is a heavily modified lake with a tidal regime, Oulton Broad is distinctly different in its composition due to the artificial barrier at Mutford Lock. Oulton Dyke links Oulton Broad to the River Waveney located to the west, with a number of smaller channels directly draining the local urban area into Oulton Broad. There is also an extensive network of artificial channels located west of Oulton Broad, draining the areas of White Cast Marshes, Share Marsh and Oulton Marsh.

4.11.7 Under the Water Framework Directive (WFD), the Environment Agency have determined that Lake Lothing lies within the 'Bure & Waveney & Yare & Lothing' surface water body (GB510503410700), classified as a heavily modified, transitional water body. This estuarine water body is evaluated as having a current overall status of 'Poor' (Environment Agency, 2016), based on the 2015 dataset, with this status due to biological and ecological results.

Groundwater

4.11.8 Under the WFD, the Environment Agency has determined the study area lies within the 'Broadland Rivers Chalk & Crag' groundwater body (GB40501G400300), classified

as holding a 'Poor' status for both quantitative and chemical classifications (Environment Agency, 2016), based on the 2015 dataset.

4.11.9 The aquifer is designated as a principal bedrock aquifer with a high vulnerability, superficial deposits aquifers are cited as Secondary A (Environment Agency, 2016).

4.11.10 Lake Lothing's floodplain is largely underlain with superficial alluvium deposits, although smaller areas of Happisburgh Glacigenic. Formation sands are found locally, set further back from the banks of Lake Lothing (Environment Agency, 2016). These sands are likely to be thin and may provide local water supplies.

4.11.11 A Source Protection Zone (SPZ) is centred on a large groundwater abstraction located at an approximate national grid reference of TM 5225 9420, 1km north of Lake Lothing (Environment Agency, 2016). The use of this abstraction is unknown at present. Taking a precautionary approach, it has been assumed to be for the purpose of public water supply or consumption.

4.12 Flood Risk

4.12.1 The proposed options predominantly lie within floodplain cited as Flood Zone 3 (defined as land having a 1 in 100 or greater annual probability of river flooding (1%) or land having a 1 in 200 or greater annual probability of sea flooding (0.5%)), with this typically adjacent and relatively close to the banks of Lake Lothing and Oulton Broad, plus the area where Kirkley Stream is culverted. Flood Zone 3 is the highest risk zone defined by the Environment Agency (Environment Agency, 2016).

4.12.2 Smaller areas of Flood Zone 2 are also within the study area (defined as land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%)), primarily for the proposed option at Riverside Road, where the route connects into the existing road network (Environment Agency, 2016).

4.12.3 The EA Flood Map for planning does not show any defences in Lowestoft. The Lake Lothing quay walls are classified as informal defences and are generally at the same level as the ground behind them.

4.13 Traffic and Transport

Highway Network

4.13.1 Lake Lothing separates the north and south parts of the town of Lowestoft. The A12 forms a north-south route on the eastern (seaward) side of Lowestoft, providing access to the town centre (on the north side) and crossing Lake Lothing by means of a bascule bridge at the entrance to the inner harbour.

4.13.2 To the west, another north-south route is provided by the A1117 (the Northern Spine Road) which crosses Lake Lothing by means of another lifting bridge at Mutford Lock, and the A146. There are no other road crossings. The two north-south routes are

linked by the A1144 and Peto Way/ Denmark Road (north of Lake Lothing) and the B1531 Victoria Road/Waveney Drive (south of Lake Lothing).

4.13.3 The A146 links Lowestoft to Norwich City Centre and Norwich Airport. The A12 runs northwards to Great Yarmouth, and southwards to Ipswich and on to London and Felixstowe via A14.

4.13.4 The A12 and the existing eastern crossing of Lake Lothing are part of the SRN. Local roads, which are not part of the SRN, are also a crucial part of the overall transport system.

Congestion

4.13.5 Lake Lothing divides Lowestoft between the northern and southern parts of the town. The road crossings in the east and west are inadequate for existing traffic demand. Whilst there have been improvements to local roads in recent years, the third crossing remains a missing link in the local highway network. Severance of the town is also caused by the railway line, and by the congestion at the two road crossings.

4.13.6 The severance caused by Lake Lothing and the associated traffic congestion has undesirable impacts on the length of car journeys (increasing fuel consumption and emissions), reduced attractiveness for walking and cycling trips, and reduced access to services and facilities.

4.13.7 Because of the limited number of crossings, there is significant congestion at the existing road bridges, especially at peak times, and this increases traffic delays and worsens the severance impacts described above.

4.13.8 A very simple overview of the congestion problem can be obtained by examining the peak hour traffic speeds shown in Google Maps. In the morning peak, there is slow-moving traffic on the northbound approaches to both the lifting bridge at Mutford Lock and the Bascule Bridge. In the evening peak, traffic moves slowly on both the northbound and southbound approaches to each bridge.

4.13.9 The problem of congestion at the bridges is, of course, much worse when they have to be periodically raised to allow shipping to pass through Lake Lothing. The majority of bridge openings are planned to occur outside of peak periods of demand, but many openings are unplanned and unscheduled and can occur at any time (for larger vessels that can request opening upon arrival at the Port). This has an additional negative effect on journey time reliability. Another factor affecting congestion and delay is the level crossing just north of the lifting bridge at Mutford Lock.

Barriers to Walking and Cycling

4.13.10 The limited number of road crossings of Lake Lothing, and the distance between them, increases the length of some cycling and walking journeys, making these sustainable modes of travel less attractive.

4.13.11 For a pedestrian or cycle route to be attractive, it needs to be direct (between key origins and destinations), safe, secure and pleasant to use. The limited opportunities to cross Lake Lothing by cycle or on foot is a serious weakness in the town's cycle network, which means it is unlikely to fulfil its potential to carry a greater proportion of

work, leisure and other trips. The existing bridges do not have adequate facilities for cyclists. At Mutford Lock there is a shared pedestrian/ cycle path on the southbound side only, whilst the Bascule Bridge to the east has footpaths on both sides but no cycle facilities.

4.13.12 Lowestoft's wider cycle network comprises sections of National Cycle Network Route 517, and the Regional Cycle Network, as well as other signposted on-road cycle routes, advisory cycling routes and some traffic free cycle routes.

Difficulties for Local Bus Services

4.13.13 Lowestoft has a mostly commercially operated bus network. The bus services cover key corridors through the town, with all serving the town centre from outer lying areas. Key service provision is between 07:00 hours and 19:00 hours with fewer services operating outside of these periods. Services between the north and south of the town, or from the south to the town centre, can suffer from severe delay to their journey when traffic is disrupted by congestion around the Bascule Bridge.

4.13.14 The public transport network has evolved around the two existing bridges, which means that north-south services tend to be peripheral to the built-up area (and especially to the area around Lake Lothing).

Collisions

4.13.15 There are noticeable clusters of collisions in the area surrounding Lake Lothing in the five year period 2010 to 2014. These clusters occur at the Bascule Bridge and its approaches; notably, at the A12 at Horn Hill and on the northern approach to the lifting bridge at Mutford Lock.

4.13.16 There are also significant numbers of accidents on the busy routes leading to and from the existing crossings, especially on the A12 via the Bascule Bridge, which is part of the SRN and a major through route within Lowestoft.

4.13.17 The A12 Pier Terrace/ London Road South junction is ranked as the sixth most serious for accidents in Suffolk.

Access to Regeneration Land

4.13.18 Access to the regeneration development parcels around Lake Lothing is limited due to the capacity constraints of the local road network which cause congestion during the peak hours and throughout the day.

4.13.19 The lack of opportunities to cross Lake Lothing by cycle or on foot means there are gaps in this network, and in the accessibility of the potential regeneration sites around the Lake. For this reason, there has been a long standing aspiration to provide an additional pedestrian and cycle crossing of Lake Lothing, either as part of a new road crossing or as a stand-alone scheme.

4.13.20 To minimise the traffic impacts of new development, the Lowestoft Transport Strategy emphasises the need to reduce the need to travel. Developers will be expected to actively promote walking, cycling and bus use. Travel plans, with robust targets for parking and car use, enforced through the planning process, will form the basis of this approach, and sustainable transport infrastructure will be improved, where possible,

through development and the Local Transport Plan. Nevertheless, new development on this scale will inevitably also produce a net increase in vehicular traffic, with more car and commercial vehicle trips using local roads.

4.13.21 The third crossing of Lake Lothing would address this issue, and greatly improve access to the proposed development. The traffic modelling completed to support the OBC takes account of the trip generation from the proposed developments. The improved accessibility to regeneration sites resulting from the new crossing (and the problems that may occur without it) are therefore taken into account.

5 Potential Environmental Impacts and Proposed Assessments

5.1 Introduction

5.1.1 Identification of the impacts and likely significant effects on the environment associated with the proposed scheme, and of the studies and assessments which it is intended should be undertaken to investigate them, has been largely informed by the guidance provided in Volume 11 of the DMRB. The DMRB provides guidance for all aspects of the planning, design and assessment of major road schemes. Volume 11 of the DMRB specifically addresses environmental assessment.

5.1.2 The guidance in Volume 11 identifies impacts and effects which can be anticipated where a major road scheme is being introduced into the environment. The guidance has been used to enable the assessment team to establish which of these impacts and effects could potentially occur, and the specific nature of them for the proposed scheme. Where it has been concluded assessment is required, there is a description of the assessment considered appropriate and methods of assessment which are to be adopted.

5.1.3 Where appropriate, and to accord with the recommendations within paragraph 11.2 of Advice Note 7[2], suitable guidance and assessment methodologies have been proposed and adopted. Where this is the case, it is clearly identified.

5.1.4 The primary purpose of the ES is to identify the likely significant effects upon the environment, both positive and negative, which the decision maker will take account of when granting consent for a development.

5.1.5 There is no legal definition of 'significant' and professional judgement needs to be applied in each individual case to allow an informed and appropriate assessment to be presented. However, as a general approach, it is usually the case that a moderate or higher beneficial or moderate or higher negative effect is deemed to be significant.

5.2 Air Quality

5.2.1 The air quality impact assessment will consider emissions associated with both the construction and operation phases of the proposed scheme, with a focus on vehicle emissions. Given the scale and location of the scheme, there is the potential for changes in vehicle emissions to impact local air quality at identified discrete sensitive receptor locations, and result in changes to regional emissions from the scheme as a whole.

Potential Impacts

Construction Phase

5.2.2 Construction phase activities associated with the proposed scheme may result in the generation of fugitive dust emissions, including fine particulates (PM_{10} and $PM_{2.5}$). If transported beyond the boundary of site works, fugitive dust has the potential to adversely impact designated sites and result in soiling of surfaces through deposition. In the absence of appropriate mitigation, short-term impacts to human health have the

potential to arise due to exceedances of the 24-hour mean PM_{10} air quality limit value (50 $\mu g.m^{-3}$).

5.2.3 The risk and severity of such potential impacts occurring is typically a function of the distance between the activity and receptor, local meteorological conditions, moisture content of materials being disturbed, and the nature and duration of the respective activities. Beyond 200m of the site works, impacts associated with construction activities are not discernible due to the effect of atmospheric mixing and deposition.

5.2.4 Other potential impacts during construction can be associated with elevated concentrations of NO_x, NO_2 and fine particulates at sensitive receptors within 200m of exhaust emissions from non-road mobile plant, construction vehicles and diesel generators.

Operation Phase

5.2.5 Operation phase air quality impacts will be associated with changes to vehicle flow characteristics, and thus emissions of NO_x, NO_2, PM_{10} and $PM_{2.5}$. This has the potential to result in localised impacts to air pollutant concentrations at identified sensitive receptors within 200m of road emissions sources.

5.2.6 Changes in vehicle emissions of NO_x and NO_2 have the potential to impact designated ecological sites, particularly ecosystems and habitats sensitive to changes in nitrogen deposition and elevated concentrations of NO_x.

5.2.7 There is the potential for impacts to regional emissions, including those of NO_x, PM_{10}, $PM_{2.5}$, total hydrocarbons (HC), and carbon dioxide (CO_2), as a result of changes to vehicle flow characteristics across the entire road network. However, the change in regional emissions of these species would be expected to be relatively small within the context of total road emissions from the region.

Scope of the assessment and proposed method of assessment

Construction Phase

5.2.8 The assessment of local air quality impacts due to the release of fugitive dust, particulates, and exhaust emissions during the construction phase will be undertaken in accordance with the methodology detailed in the Institute of Air Quality Management (IAQM) guidance[15], with reference to DMRB HA207/07.

5.2.9 The assessment will focus on potential impacts associated with the following types of activity that occur throughout the works:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

[15] IAQM (2014) *Assessment of Dust from Construction and Demolition*

5.2.10 Dust impacts associated with annoyance due to soiling, health effects due to an increase in exposure to PM_{10} and $PM_{2.5}$, and potential harm to ecological receptors will be assessed. Factors including the scale and nature of the activity, in addition to the sensitivity of the area, will be considered when assessing the risk of impacts.

5.2.11 The study area will be defined by the location of sensitive receptors identified within 200m of the respective activities. Further banding of these receptors will be completed for increasing distance from the source activities to inform the relative risk of impact.

5.2.12 The construction phase period will be in excess of six months and is likely to require traffic management measures to facilitate construction vehicle movements, and ensure local traffic journey times are not significantly affected. Therefore, as a six months or greater construction period requires a further assessment scenario, an assessment of the change in vehicle emissions from the affected road links during construction is likely to be required to determine the potential impact on local pollutant concentrations at identified sensitive receptors within 200m of the affected roads.

5.2.13 The level of assessment of construction phase vehicle emissions will be dependent on the provision of appropriate construction traffic data. In the absence of this information, a qualitative assessment of construction traffic emissions would be undertaken. This would incorporate the potential influence of exhaust emissions from non-road mobile machinery on local air quality.

5.2.14 The assessment of potential construction phase impacts is used to define appropriate mitigation measures that should be implemented through a construction environmental management plan (CEMP), which are commensurate to the scale and duration of the activities. This is to ensure that there will be no significant effect with respect to both fugitive dust and exhaust emissions.

Operation Phase

5.2.15 The assessment of local air quality and regional emissions impacts associated with operation of the proposed scheme will be informed by the approaches detailed in DMRB HA207/07, with reference to respective Defra air quality technical guidance[16] and IAQM guidance[17].

Local Air Quality Assessment

5.2.16 The local air quality assessment will focus on the following scenarios, for which traffic data will be provided to facilitate atmospheric dispersion modelling:

- Base year (2016);
- Opening year without proposed scheme (Do Minimum); and
- Opening year with proposed scheme (Do Something).

[16] Defra (2016) *Local Air Quality Management Technical Guidance (TG16)*, London: Defra

[17] IAQM (2015) *Guidance on land-use planning and development control: Planning for air quality*

5.2.17 Screening of the Do Minimum and Do Something traffic data will be completed to identify affected road links that adhere to the following criteria as provided by DMRB HA207/07:

- Road alignment will change by 5 m or more; or
- Daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more.

5.2.18 Preliminary traffic data provided for the proposed scheme opening year were screened to provide an indication of the likely study area for the local air quality assessment. The identified affected links are presented in Figure 7. These traffic data will be revised prior to progressing the air quality assessment. However, given the number of road links likely to meet the DMRB criteria, a detailed local air quality assessment will be progressed.

5.2.19 Emissions inventory databases for each pollutant (NO_x, PM_{10}, $PM_{2.5}$) will be developed for all three of the above scenarios using Defra's latest emission factor toolkit (EFT v7.0), which accounts for vehicle flow characteristics, such as:

- Link flow volumes as annual average daily traffic (AADT);
- Link average speed (km/hr);
- Vehicle breakdown (e.g. percentage HDVs); and
- Link length.

5.2.20 Each scenario emissions database will be entered to an atmospheric dispersion model (ADMS-Roads v4) to enable prediction of pollutant concentrations at the identified sensitive receptor locations. The modelling exercise will utilise hourly sequential meteorological data from the most representative observation site within proximity to the proposed scheme.

5.2.21 The base year model results will be verified in accordance with Defra's technical air quality guidance[17]. Model verification requires analysis of model outputs versus monitored data for equivalent locations within the study area. Therefore, baseline air quality monitoring is required to provide representative coverage of the identified affected links.

5.2.22 There is a network of five NO_2 diffusion tube monitoring locations operated by Waveney District Council, which do not provide adequate coverage of the proposed scheme alignment and affected roads. As such, a scheme specific network of 46 tubes (including a co-located tube in Norwich) has been established for a minimum six month monitoring period, covering a number of the likely affected road links. The locations of these tubes were agreed through consultation with Waveney District Council and Suffolk County Council and are included in Figure 7.

5.2.23 The results of the baseline survey, which will be bias adjusted and annualised for comparison with the annual mean NO_2 limit value, will be used in the model verification exercise and to inform the review of existing air quality conditions within the study area. The derived model verification factor will be applied to all subsequent model outputs of NO_x/ NO_2. In the absence of local PM_{10} and $PM_{2.5}$ monitoring, the same verification factor will be used to adjust concentrations of these pollutants, in accordance with Defra guidance.

5.2.24 Current information available from Defra stipulates that concentrations of NO_2 near to roads are not reducing as expected, meaning future projected reductions in vehicle NO_x/NO_2 emissions are considered too optimistic. To account for this, Highways England has published Interim Advice Note (IAN) 170/12v3 (2013) – *Updated air quality advice on the assessment of future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 Air Quality*. The guidance presents a methodology for the verified modelled NO_2 concentrations to be adjusted to account for the long term NO_2 profiles. This approach will be adopted for the proposed scheme air quality impact assessment.

5.2.25 The results of the atmospheric dispersion modelling at each identified sensitive receptor will be compared to the respective air quality limit values to evaluate the potential for exceedances in all scenarios.

Significance

5.2.26 The magnitude of change of predicted concentrations at each receptor location, as a result of the proposed scheme, will be derived through analysis of the Do Something versus Do Minimum scenario data. The significance of potential changes to local air quality will be determined with reference to the criteria provided by IAQM[17] and Highways England[18].

5.2.27 The IAQM[17] provides magnitude of change criteria that are equivalent to a percentage of the respective annual mean NO_2 and PM_{10} limit values (40 $\mu g.m^{-3}$), as presented in Table 5.1. The IAQM guidance assigns 'impact descriptors' to each receptor, dependent on the predicted annual mean concentration in the Do Something scenario relative to the national limit value.

[18] Highways England (2013) *Interim Advice Note 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07)*

Table 5.1 - IAQM magnitude of change criteria and associated impact descriptors for individual receptors (based on annual mean NO_2 and PM_{10})

Annual mean concentration at receptor (Do Something)	% Change in concentration relative to limit value			
	1% (0.4 µg.m^{-3})	>1-5% (0.4-2 µg.m^{-3})	>5-10% (2-4 µg.m^{-3})	>10% (>4 µg.m^{-3})
≤75% of limit value (≤30 µg.m^{-3})	Negligible	Negligible	Slight	Moderate
76-94% of limit value (30 – 38 µg.m^{-3})	Negligible	Slight	Moderate	Moderate
95-102% of limit value (38 – 41 µg.m^{-3})	Slight	Moderate	Moderate	Substantial
103-109% of limit value (41 – 44 µg.m^{-3})	Moderate	Moderate	Substantial	Substantial
≥110% of limit value (≥44 µg.m^{-3})	Moderate	Substantial	Substantial	Substantial

5.2.28 Highways England guidance[18] adopts the same magnitude of change criteria for NO_2 and PM_{10}, but focusses on receptors that exceed the annual mean limit value. Changes in pollutant concentration greater than one percent of the limit value (i.e. >0.4 µg/m^3, based on the Do Minimum versus Do Something opening year model results, are compared with guideline bands that inform the potential significance of the proposed scheme, as presented in Table 5.2.

5.2.29 The guideline band ranges set the upper level of likely non-significance and the lower level of likely significance. Between these two levels are the ranges where likely significance is more uncertain and greater onus is afforded to professional judgement.

Table 5.2 – Highways England magnitude of change criteria and guideline to number of receptors constituting a significant effect (based on annual mean NO_2 and PM_{10})

Magnitude of Change (µg.m^{-3})	Number of receptors with:	
	Worsening of pollutant concentration already above limit value or the creation of new exceedance	Improvement of pollutant concentration already above limit value or the removal of an exceedance
Large (>4 µg.m^{-3})	1 to 10	1 to 10
Medium (>2 to 4 µg.m^{-3})	10 to 30	10 to 30
Small (>0.4 to 2 µg.m^{-3})	30 to 60	30 to 60

5.2.30 The magnitude of change criteria and associated impacts will be adjusted accordingly to facilitate analysis of the predicted $PM_{2.5}$ concentrations at each receptor.

5.2.31 The overall significance of the proposed scheme will be determined using professional judgment, as informed by the outcomes of the detailed atmospheric dispersion

modelling and associated analysis within the context of both the IAQM and Highways England guidance.

Regional Emissions

5.2.32 The regional emissions assessment will focus on total annual mass emissions of NO_x, PM_{10}, $PM_{2.5}$, total hydrocarbons (HC), and carbon dioxide (CO_2) associated with the aforementioned scenarios, in addition to:

- Design year (2036) without proposed scheme (Do Minimum);
- Design year (2036) with proposed scheme (Do Something).

5.2.33 Screening of the Do Minimum and Do Something traffic data will be completed to identify affected road links that adhere to the following criteria as provided by DMRB HA207/07:

- A change of more than 10% in AADT; or
- A change of more than 10% to the number of heavy duty vehicles; or
- A change in daily average speed of more than 20 km/hr.

5.2.34 Traffic data for affected road links in each scenario will be entered to Defra's EFT v7, enabling the calculation of total annual mass emissions of the respective vehicle exhaust species. This will allow the magnitude of change of the proposed scheme on mass emissions to be predicted, which will be evaluated within the context of total regional road emissions data published by the National Atmospheric Emissions Inventory (NAEI).

5.3 Cultural Heritage

Introduction

5.3.1 This scoping report has been prepared with reference to Volume 11 of the Design Manual for Roads and Bridges (DMRB), HA208/07 (Cultural Heritage).

5.3.2 The DMRB identifies three specific areas of interest under the overarching aspect of cultural heritage; archaeological remains, the built heritage and historic landscapes.

5.3.3 Archaeological remains consider those materials created or modified by past human activities, which includes a wide range of visible and buried artefacts, field monuments, structures and landscape features. Built heritage considers architectural, designed or other structures with a significant historical value, such as listed buildings. The historic landscape concerns perceptions that emphasise evidence of the past and its significance in shaping the present landscape.

5.3.4 Within the context of the DMRB a cultural heritage asset is considered an individual archaeological site or building, a monument or group of monuments, an historic building or group of buildings and/or a historic landscape.

Potential Impacts

5.3.5 The proposed scheme has the potential to impact known and unknown archaeological remains, built heritage assets and the historic landscape.

5.3.6 Impacts during the construction phase may include physical removal of assets during ground work, compaction caused by made ground, damage caused by the operation of construction plant, change to the preservation of assets through alteration of its physical or chemical environment and alteration of setting through the removal of landscape elements. Impacts are also possible during the operational phase, for example through maintenance works and long term change in setting.

5.3.7 The potential impact on archaeological remains, built heritage assets and the historic landscape is summarised below.

Archaeological Remains

5.3.8 The number and density of recorded archaeological assets is relatively low, but this is perhaps a consequence of the limited scale and distribution of recent archaeological work rather than an accurate reflection of the archaeological assets present.

5.3.9 The proposed scheme may impact the remains of one recorded archaeological asset; the site of a World War II Type 22 pillbox and possible civil defence site is recorded at the roundabout forming the junction between Waveney Drive and Riverside Road.

5.3.10 The proposed scheme may impact sub-surface archaeological assets and palaeoenvironmental evidence of the prehistoric periods, which may be preserved where deposits of alluvium and peat survive.

5.3.11 The proposed scheme may impact archaeological assets of the historic periods although the survival of historic archaeological assets pre-dating the late post medieval period may have been adversely affected by extensive 19th and 20th century development.

Built Heritage

5.3.12 The proposed scheme does not directly impact designated built heritage assets. However, there may be indirect impacts resulting from visual intrusion or severance of views upon the setting of two designated heritage assets comprising the Port House, and the Royal Norfolk and Suffolk Yacht Club.

5.3.13 Undesignated built heritage assets of local significance are also likely to be indirectly impacted by the proposed scheme.

Historic Landscape

5.3.14 The proposed scheme is likely to result in change to key elements of the historic landscape through severance of long distance views, including the open aspect of the inner harbour.

Scope and proposed method of assessment

5.3.15 A cultural heritage chapter will be prepared for the Environmental Statement. The chapter will present results of a “Detailed Assessment” as defined by the Design Manual for Roads and Bridges Volume 11, Section 3, Part 2.

5.3.16 The assessment will involve reference to Annexes 5, 6 and 7 of the Design Manual for Roads and Bridges (DMRB), HA208/07 (Cultural Heritage) including consideration of

the value of cultural heritage assets, examination of the magnitude of impact and assessment of the significance of effect of the proposed scheme.

5.3.17 The study area for the cultural heritage assessment will be defined according to the sensitivities of the cultural heritage assets in the receiving environment and the potential impacts of the proposed scheme. This could extend to the visual envelope of the works as defined by the townscape and visual impact assessment (Figure 8 and Section 5.4.

5.3.18 The scope and scale of fieldwork to inform detailed assessment has been defined in consultation with the Suffolk County Council Archaeological Service and Historic England and will include, but not be limited to:

- A programme of archaeological monitoring during trial trenching and trial pitting for geotechnical ground investigation works;
- A Written Scheme of Investigation for the archaeological monitoring (included in Appendix H);
- A geoarchaeological deposit model (included in Appendix C);
- A programme of geoarchaeological assessment (including potential recovery of undisturbed cores for geoarchaeological assessment and analysis) of results of borehole ground investigations; and
- A Written Scheme of Investigation for the geoarchaeological assessment and analysis.

Value of Cultural Heritage Assets

5.3.19 Assessment of the value of cultural heritage assets will involve consideration of how far the asset(s) contribute to an understanding of the past, through their individual or group qualities, either directly or potentially. These are professional judgements, but they are also guided by legislation, national policies, acknowledged standards, designations, criteria and priorities.

5.3.20 The DMRB recommends the adoption of six ratings for value in relation to archaeological remains and built heritage: very high, high, medium, low, negligible and unknown. Definitions for each rating are outlined in Table 5.3 and Table 5.4.

Table 5.3 – Factors for assessing the value of archaeological remains

Value	Example
Very High	World Heritage Sites (including nominated sites) Assets of acknowledged international importance Assets that can contribute significantly to acknowledged international research objectives
High	Scheduled Monuments (including proposed sites) Undesignated assets of scheduled quality and importance Assets that can contribute significantly to acknowledged national research objectives
Medium	Designated or undesignated assets that contribute to regional research objectives
Low	Designated and undesignated assets of local importance

	Assets compromised by poor preservation and/or poor survival of contextual associations Assets of limited value, but with potential to contribute to local research objectives
Negligible	Assets with very little or no surviving archaeological interest
Unknown	The importance of the resource has not been ascertained

Table 5.4 – Criteria for establishing the value of built heritage assets

Value	Status and Definition
Very High	International importance i.e. World Heritage Sites.
High	National importance i.e. listed buildings at Grade I and II* Scheduled Ancient Monuments with standing remains, conservation areas containing very important buildings and undesignated structures of clear national importance.
Medium	Regional importance i.e. listed buildings at Grade II, conservation areas containing buildings that contribute significantly to its historic character, historic townscape with important integrity in their buildings, or built settings and undesignated structures of clear regional importance.
Low	Local importance i.e. undesignated assets of modest quality in their fabric or historical association and historic townscape of limited historic integrity (including buildings and structures included in local list prepared by local authority).
Negligible	Assets of no architectural or historical note
Unknown	Assets with some hidden i.e. inaccessible potential for historic or architectural significance.

Magnitude of Impact

5.3.21 Assessment of the magnitude of impact of the proposed scheme on cultural heritage assets will involve consideration of the degree of change that would be experienced by the asset and its setting if the scheme were to be completed as compared with a 'do nothing' situation. The assessment will take into account any mitigation that is part of the design.

5.3.22 The DMRB recommends the adoption of six ratings for magnitude of impact: no change, negligible, minor adverse, moderate and major. Factors for assessing the magnitude of impact are summarised in Table 5.5.

Table 5.5 – Factors for assessing the magnitude of impact

Magnitude of Impact	Example
Major	Change to most or all aspects of a cultural heritage asset, such that the resource is totally altered Comprehensive changes to setting
Moderate	Clear alteration to many aspects of a cultural heritage asset Considerable change to setting that affect the character of the asset
Minor Adverse	Slight alteration to cultural heritage asset. Sight alteration to setting
Negligible	Very minor changes to cultural heritage assets and their setting
No Change	No change to cultural heritage assets and their setting

Significance of Effect

5.3.23 Assessment of the significance of effect of the proposed scheme on cultural heritage assets combines the value of the resource and the magnitude of the impact (incorporating the agreed mitigation), for each cultural heritage asset.

5.3.24 The DMRB recommends the adoption of five ratings for significance of effect: neutral, slight, moderate, large and very large. The matrix for establishing significance of effect matrix is summarised in Table 5.6.

Table 5.6 – Significance of cultural heritage effects

Magnitude of Impact						
	Major	Neutral	Slight	Moderate / Large	Large / Very Large	Major
	Moderate	Neutral	Slight	Moderate / Slight	Moderate / Large	Large / Very Large
	Minor Adverse	Neutral	Slight / Neutral	Slight	Moderate	Moderate / Large
	Negligible	Neutral	Slight / Neutral	Slight / Neutral	Slight	Moderate / Slight
	No change	Neutral	Neutral	Slight / Neutral	Slight / Neutral	Slight
		Neutral	Slight	Moderate	Large	Very Large
		Value				

5.4 Townscape and Visual Impact Assessment

5.4.1 The Guidelines for Landscape and Visual Impact Assessment (GLVIA) Third Edition, identifies the importance of townscape and visual amenity, and sets out guidance on how development can influence and change the way in which these inter-related aspects are perceived. Major development such as that being proposed, will inevitably

result in impacts on the townscape character of the area within which they are located, and on views experienced by residents and visitors to the area.

Potential Impacts

5.4.2 The introduction of the Lake Lothing Third Crossing will result in a new prominent feature of a noticeably different scale and form within the urban fabric of Lowestoft, resulting in the removal or modification to existing townscape features and potential fragmentation of the current land use patterns.

5.4.3 The introduction of the visually prominent structure, supporting roads and associated traffic will also change existing views, where it either intrudes into or obstructs an existing view in whole or in part.

5.4.4 It has, therefore, been concluded that townscape character and visual impact assessments should be undertaken to establish to what extent the introduction of the proposed scheme and its traffic would affect the quality and value of the existing townscape and existing views.

Scope of the Assessments and Proposed Methods of Assessment

5.4.5 A methodology for the assessment of townscape character and visual amenity has been prepared and agreed with representatives from WDC and SCC. The key components of the methodology have been set out in the following paragraphs and a complete copy provided in Appendix I. Both assessments will be based on the guidance provided in GLVIA (Third Edition), published by the Landscape Institute and the Institute of Environmental Management and Assessment (IEMA, 2013). Reference will also be made to guidance provided in:

- Highways England Interim Advice Note (IAN) 135/10 – Landscape Effects;
- Landscape Character Assessment: Guidance for England and Scotland, published by Scottish Natural Heritage and the Countryside Agency (2002).

Townscape Character

5.4.6 The townscape character assessment will be based on the identification of the sensitivity of the townscape within the proposed study area, and the magnitude of impact within the townscape that will result from the construction and operation of the proposed scheme and the effect that this will have on the perception of townscape.

Baseline Environment and Sensitivity

5.4.7 The identification and evaluation of the existing townscape and visual context of the study area and wider area will involve the following tasks:

- Desk based analysis of OS mapping relating to landform, built form, vegetation, settlement patterns and the drainage regime in the wider area;
- Desk based analysis of aerial photography for the area;
- Preliminary review of the townscape units/types and relevant designations (e.g. Conservation Areas, Registered Parks and Gardens);

- Site surveys and identification of townscape units/types. Site recording involved annotation of 1:1,250 and 1:25,000 scale OS plans defining the units and the key elements determining character;
- Development and agreement of representative/key viewpoints to be assessed for potential effects on visual amenity;
- Site photography to illustrate character units, notable views / viewpoints and key landscape elements; and
- Drafting and description of local townscape character units within the context of the broader assessment and associated with the proposed scheme and wider setting including an evaluation of their quality, value and sensitivity to change in the context of the proposed form of development.

5.4.8 For townscape character, evaluation of the sensitivity to change will be based on the structure, quality and value of the existing townscape, and the extent to which it is considered as being capable of accepting change in the form of the proposed scheme. Sensitivity will be rated as being high, moderate or low. Magnitude of impact will be based on the extent to which the proposed scheme would be likely to emerge as a new component in the landscape and change the relationship between components that currently constitute character. The sensitivity of the receiving townscape and the magnitude of impact will be assessed to determine a significance of effect rating.

Visual Impact:

5.4.9 Establishment of the existing visual context for the proposed scheme will involve consideration of the information relating to existing townscape character established during the townscape character baseline assessment, the definition of a Zone of Theoretical Visibility (ZTV) for the proposed scheme, and the identification of visual receptors (represented by key viewpoints) within the visual envelope that will contribute to the definition of the study area.

5.4.10 The ZTV will be identified and refined through a combination of 3-D modelling and site work within a pre-defined limited study area that has been agreed as a 3km radius around the proposed scheme, beyond which the potential for significant effects are not anticipated to arise due to the scale and nature of the development.

5.4.11 The following tasks will be undertaken:

- Identification of key viewpoints that are representative of views from visual receptors, comprising residential properties and other sensitive locations used and visited by the public within the ZTV;
- Desk and site based appraisal of existing and predicted views for the identified viewpoint;
- Identification of mitigation in light of the identified impacts; and
- Evaluation of the order of impact for each viewpoint taking into account the sensitivity of the associated receptor and magnitude of the impact to determine if there would be a significant effect on the environment.

5.4.12 Key Viewpoints plotted via the desk based review and validated through site survey include the following:

- Residential clusters and individual properties;
- Roads with views of the proposed development site; and
- Recreational and public access areas, including footpaths and other rights of way.

5.4.13 Sensitivity to change will be primarily based on the type of receptor (dwelling, place of work, footpath), and will be qualified by the degree to which the receptor would be exposed to potential views of the route.

5.4.14 Magnitude of impact considers the extent of the development that is visible, the percentage of the existing view newly occupied by the proposed scheme and the viewing distance from the receptor to the development.

5.4.15 The prime criteria used to evaluate visual effects, will relate to the extent to which existing views associated with Key Viewpoints (such as residents, users of public facilities and visitors to open space and public areas) will change, taking into account mitigation measures.

5.4.16 The identification of the resulting effects will be established through an evaluation of the sensitivity of the baseline and the magnitude of the impact likely to occur as a result of the proposed scheme. Where appropriate, cumulative visual effects on the baseline environment will also be taken into account in respect of the proposed scheme and consented development within the study area.

5.4.17 At the time of writing, discussions with WDC and SCC have identified a total of eleven key viewpoints to be used for assessment purposes. The viewpoints have been selected on the basis that they provide representative views from a variety of receptors within the vicinity of Lake Lothing and are indicated on Figure 8.

5.5 Biodiversity and Nature Conservation

5.5.1 An HRA screening exercise is presently being undertaken to identify the potential significant effects upon the Natura 2000 sites identified in Section 4.5.5. The HRA process is separate to the DCO consenting process, but both will draw upon the same baseline and survey information and therefore will be progressed in parallel.

5.5.2 The DMRB recognises a number of nature conservation resources which could potentially be affected by the construction and future use of a road scheme of the type proposed. These comprise designated and non-designated sites, important habitats and habitat-types, and protected and notable species.

Potential Impacts

5.5.3 Taking into account the intended design form and likely construction requirements of the proposed scheme, and the data derived from the desk studies, the phase 1 survey undertaken and the species specific surveys undertaken to date, there are a number of impacts which could potentially result from implementation and future use of the

proposed scheme. These are described below and will form the focus of the assessments which are to be undertaken:

- Direct loss of wildlife habitats through land-take;
- Killing, injuring and disturbance of protected species during construction;
- Fragmentation of retained habitats and/or severance of wildlife corridors;
- Wildlife fatalities as a direct result of severance of foraging routes, breeding sites or territories;
- Contamination of watercourses and/ or waterbodies associated with road related run-off with consequent impacts on habitats and fauna; and
- Disturbance to nocturnal animals, such as bats, where road lighting introduces a new light source.

Scope of the assessment and proposed method of assessment

5.5.4 The assessments will be based on the methods outlined in the following guidance:

- The DMRB Volume 11, Section 3, Part 4 Ecology and Nature Conservation;
- IAN 130/10 – Ecology and Nature Conservation: Criteria for Impact Assessment, Highways Agency (2010); and
- Guidelines for Ecological Impact Assessment in the United Kingdom published by the Institute of Ecology and Environmental Management (IEEM) (2006).

5.5.5 Establishment of the baseline environment for nature conservation will involve a review of the existing information relating to designated and non-designated sites, habitats and fauna and consultation with SCC.

5.5.6 A number of surveys have been, or will be, undertaken (Table 4.5) and are proposed to verify and update baseline information related to habitats and fauna. These will comprise:

- Reptile surveys;
- Wintering bird surveys;
- Black Redstart breeding surveys;
- Benthic ecology survey;
- Bat roost surveys; and
- Invertebrate survey.

5.5.7 The surveys proposed to be undertaken have been discussed with Natural England and SCC.

5.5.8 Assessment of the significance of impacts on sites, habitats and species will be based on the guidance provided in the Guidelines for Ecological Impact Assessment. These define the ecological value of identified assets based on their geographic influence, which ranges in definition from sites of international importance down to those within the local and immediate zone of influence of the proposed scheme. Those assets with

a geographic value at the local level or above will be subject to detailed assessment other than where receptors of lesser value are subject to some form of legal protection or can act in combination to lead to a cumulative impact.

5.5.9 Criteria relating to confidence, magnitude, extent, duration, reversibility and timing will be considered in combination with value to define impact significance.

5.5.10 The assessment of impacts upon biodiversity will be undertaken as shown in Table 5.7 although as suggested in the IEEM guidelines, a determination of significance ought to be determined based upon professional experience.

Table 5.7 – Biodiversity Value

Magnitude of Impact	Biodiversity Value				
	International / European	UK / National	Regional	County	Local
Major Negative	Very Large Adverse	Very Large Adverse	Large Adverse	Moderate Adverse	Slight Adverse
Intermediate Negative	Large Adverse	Large Adverse	Moderate Adverse	Slight Adverse	Slight Adverse
Minor Negative	Moderate Adverse	Moderate Adverse	Slight Adverse	Slight Adverse	Slight Adverse
Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Positive	Very Large Beneficial	Large Beneficial	Moderate Beneficial	Slight Beneficial	Slight Beneficial

5.5.11 Based on the findings of the assessments mitigation measures relating to avoidance, reduction or compensation of impact will be identified prior to an evaluation of the consequent effects of the impacts. Typical mitigation measures could include, wildlife fencing, compensatory planting and habitat creation and adoption of working practices and programming to avoid or reduce disturbance.

5.6 Geology, Soils and Contamination

5.6.1 The DMRB indicates that assessments for major road schemes should consider impacts on notable geological features geological changes to land form, impacts on soil and ground quality, and disturbance of contaminated land.

Potential Impacts

5.6.2 As no designated sites exist within the study area, impacts to important geological sites are considered unlikely.

5.6.3 The construction of the proposed scheme could establish potential pathways whereby contaminants/pollutants associated with construction activities, and other contaminated land, could have an impact on sensitive receptors, such as human

beings, watercourses, aquifers, terrestrial habitats and fauna associated with the proposed scheme.

5.6.4 The hydrogeology and hydrology of the site indicates that there is a mechanism (termed a source-pathway-receptor linkage) which could allow the local groundwater environment and soils to be impacted by the proposed scheme. The introduction of large structures and associated earthworks as part of the permanent works, could potentially result in localised impacts on groundwater profiles.

Scope of the assessment and proposed method of assessment

5.6.5 There is the potential for disturbance of existing contaminated land (including lake bed sediments) and the possibility that construction could potentially establish pathways between pollutants and receptors. It is therefore intended that impacts on geology and soils will form part of the assessments within the ES.

5.6.6 The assessment will be based upon the guidance presented in DMRB Volume 11 Section 3 Part 11 Geology and Soils[19], although for geology and soils DMRB does not provide any specific methods of assessment or scales of measurement for either the value / sensitivity of the receptor or the magnitude of the impact. Assessment procedures contained within BS10175:2011[20] and CLR11[21] including an assessment of risk classification for the source-pathway-receptor protocol based on CIRIA C552[22] will be used in a phased approach together with professional judgement

5.6.7 Specific consultation with the Environment Agency and Environmental Health Officers (EHOs) will be undertaken to identify any potentially contaminated sites.

5.6.8 A ground investigation will be undertaken and will include a risk assessment which will assess the potential contaminant linkages identified in the desk study report.

5.6.9 This will allow the development of an updated site conceptual model to clarify potential source-pathway-receptor linkages, and assist with the assessment of potential impacts on groundwater.

5.7 Noise and Vibration

5.7.1 The noise and vibration assessment will consider impacts associated with both the construction and operation phases of the proposed scheme based on HD213/11 guidance. Given the scale and location of the scheme, there is the potential for

[19] The Highways Agency et al, (1993), Design Manual for Roads and Bridges, Volume 11, Section 3, Part 11, Geology and Soils.

[20] British Standards Institution (2011). BS 10175:2011 Code of Practice for the Investigation of Contaminated Land.

[21] The Environment Agency (2004). Model Procedures for the Management of Land Contamination. Contaminated Land Report 11.

[22] CIRIA (2001). C552. Contaminated Land Risk Assessment. A guide to good practice.

temporary and permanent changes in noise and vibration to impact sensitive receptor locations.

5.7.2 A quantitative assessment of road traffic and vibration will be completed in 2017, according to established prediction and assessment methodologies that are governed or guided by HD213/11[23] and CRTN[24].

5.7.3 The purpose of the scoping assessment is to determine whether the project has the potential to cause a change to the receiving environment, which could result in noise and vibration impacts, and to determine the likely extent of any further assessment.

Potential Impacts

Construction Phase

5.7.4 Construction phase activities associated with the proposed scheme may result in temporary noise and vibration impacts on residents and other sensitive receptors.

5.7.5 The risk and severity of such potential impacts occurring is typically a function of the distance between the activity and receptor, and the nature and duration of the activity.

Operational Phase

5.7.6 Operation phase noise and vibration will be associated with the introduction of new carriageway and changes to vehicle flow characteristics on existing roads.

5.7.7 Changes in noise and vibration have the potential to impact sensitive receptors within the HD213/11 Study Area.

5.7.8 As the three NIAs are associated with the Mutford Lock crossing, there may be a reduction in noise impacts in these areas as a result of changes in traffic flow, composition and speed.

Scope of the assessment and proposed method of assessment

Construction Phase

5.7.9 Prior to construction, an assessment of noise and vibration impacts due to construction works will be undertaken in accordance with the methodology detailed in BS 5228-1[25] and BS 5228-2[26]. Further consultation with WDC will be undertaken in order to agree an appropriate level of assessment within the ES, based upon the background noise

[23] The Highways Agency et al, (2011), Design Manual for Roads and Bridges, Volume 11 Section 3, Part 7, HD213/11, Noise and Vibration.

[24] Department of Transport and Welsh Office, The Stationery Office, (1988) Calculation of Road Traffic Noise.

[25] British Standards Institution (2014), BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

[26] British Standards Institution (2014), BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

measurements and the degree of information that is available on the construction methodology.

5.7.10 The assessment will focus on potential impacts associated with the following types of activity that occur throughout the works:

- Demolition;
- Earthworks; and
- Construction.

5.7.11 The level of assessment of construction phase traffic flows will be dependent on the provision of appropriate construction traffic data. In the absence of this information, a qualitative assessment of construction traffic emissions would be undertaken.

5.7.12 The assessment of potential construction phase impacts is used to define appropriate mitigation measures that should be implemented through a CEMP, which are commensurate to the scale and duration of the activities. If appropriate the Contractor will obtain consent from WDC under Section 61 of the Control of Pollution Act 1974. This consent would, where appropriate, include methods and mitigation for noise and vibration control.

Operation Phase

5.7.13 The assessment of noise and vibration impacts associated with operation of the proposed scheme will be informed by the approaches detailed in HD213/11.

5.7.14 Preliminary traffic data provided for the proposed scheme opening year were screened to provide an indication of the likely study area for the noise and vibration assessment, although this will be updated prior to the preparation of the ES. Given the number of road links likely to meet the HD213/11 criteria, a detailed assessment will be progressed.

5.7.15 The study area is defined as 600m from the scheme carriageway edge (including proposed, bypassed or improved routes), 600m from any other affected route within 1km of the scheme, and 50m from any affected routes beyond 1km.

5.7.16 An affected route is one which meets the threshold criteria, which is either a change of 1dB $L_{A10,18h}$ in the Short-term or a 3dB $L_{A10,18h}$ in the Long-term.

5.7.17 HD213/11 states that a change of 1dB in the Short-term (Opening Year) and 3dB in the Long-term (Design Year) are the smallest change that is considered perceptible.

5.7.18 Screening of the Do Minimum and Do Something traffic data will be completed to identify affected road links that result in HD213/11 threshold changes. Traffic related noise levels will be predicted with the proposed scheme in place, Do-Something, and without the scheme in place, Do-Minimum.

5.7.19 The assessment considers the Short-term, on scheme opening, and the Long-term, plus 15 years scenarios. The following comparisons are made:

- Do-Something verses Do-Minimum scenario in Opening Year; and
- Do-Something verses Do-Minimum scenario in Design Year.

The change in noise levels with and without the scheme in place describes the noise impact and will be assessed based upon the classification of magnitude of noise impacts taken from HD213/11 which is presented in Table 5.8 and Table 5.9 below.

Table 5.8 – Classification of Magnitude of Noise Impacts in the Short-term

Noise Change, $L_{A10, 18h}$	Magnitude of Impact
0.0	No change
0.1 - 1.9	Negligible
1.0 - 2.9	Minor
3.0 - 4.9	Moderate
5.0+	Major

Table 5.9 – Classification of Magnitude of Noise Impacts in the Long-term

Noise Change, $L_{A10, 18h}$	Magnitude of Impact
0.0	No change
0.1 - 2.9	Negligible
3.0 - 4.9	Minor
5.0 - 9.9	Moderate
10.0+	Major

5.7.20 The classification of receptor sensitivity is given in Table 5.10.

Table 5.10 – Receptor Sensitivity

Sensitivity	Description
High	Receptors sensitive to noise and vibration, including residential, schools (daytime), hospitals and places of worship
Medium	Receptors with moderate sensitivity to noise and vibration, hotels, including sports facilities, offices, cafes/restaurants
Low	Receptors not sensitive to noise, including industrial premises, transient receptors

Significance of effect

5.7.21 World Health Organisation (WHO) guidance provides values for community noise. It states that in outdoor living areas to protect the majority of people from being seriously annoyed noise levels should not exceed 55 dB LAeq,16h. To protect the majority of people from being moderately annoyed noise levels should not exceed 50dB LAeq,16h.

5.7.22 Free-field LAeq,16h free-field noise levels can be converted to LA10,18h façade noise levels by adding 4.5dB.

5.7.23 The significance of noise impacts is dependent on a number of factors, including magnitude and duration of impact, sensitivity of receptor, absolute predicted noise levels, existing noise environment (character), and population (density of receptors).

5.7.24 Based on guidance given in NPSE[27] and NPPF[28], the rating of significance of noise impact applies Effect Levels:

- NOAEL – No Observed Adverse Effect Level;
- LOAEL – Lowest Observed Adverse Effect Level; and
- SOAEL – Significant Observed Adverse Effect Level.

5.7.25 Significance of noise impact is based on magnitude of impact, sensitivity of receptor and predicted noise level.

Table 5.11 – Significance of Noise Impact

	Receptor Sensitivity		
Magnitude of Impact	Low	Medium	High
No change	No Impact	No Impact	No Impact
Negligible	No Impact	No Impact	Marginal
Minor	No Impact	Marginal	NOAEL
Moderate	Marginal	NOAEL	LOAEL*
Major	NOAEL	LOAEL*	SOAEL*

* A significant impact is deemed to occur at receptors predicted to experience a LOAEL or SOAEL impact and where the predicted $L_{A10,18h}$ noise level in the Do-Something scenario is >54.5 dB

5.8 People and Communities – Effects on All Travellers

5.8.1 The DMRB recognises that, by virtue of the linear nature of roads, there is a marked likelihood that rights of way and established means of access between communities and facilities can be subject to impact in the form of severance and loss of amenity, thus affecting the people that use and rely on them (local residents, ramblers, equestrians and cyclists). Guidance is provided for evaluating and assessing impacts on journey length and times, amenity value, and increases or reductions in community severance for users of rights of way and local roads.

Potential Impacts

5.8.2 The proposed scheme has the following potential effects on all travellers:

- Sever existing local roads, footpaths and other paths within the study area;

[27] Noise Policy Statement for England (2010)

[28] National Planning Policy Framework (2012)

- Affect the surrounding roads, particularly Waveney Drive, Riverside Road and Denmark Road; and
- Potential benefits to vehicle travellers providing an additional crossing of Lake Lothing.

Scope of the Assessments and Proposed Methods of Assessment

5.8.3 The assessment will involve the following stages:

- Assessment of any potential new or relief of severance, increase or decrease in journey times, whether the amenity value (views and exposure to traffic) of journeys would increase or decrease, and whether some people would be deterred from making journeys which they currently make. Significance ratings will be based on DMRB guidance provided in Volume 11, Section 3 part 9;
- Assessment of the impacts on driver stress (traffic flows, journey speed, fear, frustration and uncertainty) and views from the road. Significance ratings will be based on the DMRB guidance that is available in Volume 11 Section 3; and
- Propose mitigation measures where significant impacts are anticipated.

5.8.4 There are no Public Rights of Way (ProW) within the area of the proposed scheme (see Figure 12) and, therefore, no further assessment upon PRoW is proposed as part of the Effects on All Travellers assessment.

5.9 People and Communities – Community and Private Assets

5.9.1 The DMRB recognises that the form and scale of major road schemes will generally have potentially significant impact on the pattern of land use and individual land use entities within the area through which they are routed. In relation to land use, the guidance recommends that consideration should be given to four specific areas of interest:

- Demolition of private property and associated land-take;
- Loss of land used by the community;
- Effects on development land;
- Effects on agricultural land; and
- Effects on statutory undertakers' assets and operations.

Potential Impacts

5.9.2 Construction of the proposed scheme will involve the taking, or over sailing, of transport infrastructure (highway, port, rail), and commercial and industrial land. Part of the footprint of the scheme is derelict or unoccupied.

5.9.3 Certain dwellings and buildings may be affected by the proposals.

5.9.4 Planning consent for a retail park on the north bank exists while a Local Development Order (LDO) is currently in place for a number of land parcels within the proposed scheme boundary on the south bank of the Lake.

5.9.5 There will be no impact upon agricultural land or land used by the community.

Scope of the Assessments and Proposed Methods of Assessment

5.9.6 A review of information relating to existing land use and of the relationship between the currently proposed scheme to land use and established community facilities, indicate that an assessment of impacts on community and land use assets should form part of the assessments undertaken to inform the ES for the proposed scheme.

5.9.7 In accordance with Highways England IAN 125/15 Environmental Assessment Update, the assessment of impacts to community and private assets follows guidelines contained in the DMRB, Volume 11, Section 3, Part 6 Land Use, and the Community Effects section of the DMRB, Volume 11, Section 3, Part 8.

5.9.8 Data relating to land use and the location of community facilities will be collected, verified and assessed. Current development framework documentation and saved development plan documents will also be reviewed and the planning registers for WDC will be reviewed and impacts to development land assessed.

Maritime operations

5.9.9 An assessment of the impact of the proposed scheme upon maritime operations, including the operation of the port will use a vessel simulator that is being developed in conjunction with Lowestoft College.

5.9.10 The Kongsberg Polaris Full Mission Bridge Simulation Suite consists of a realistic mock-up of a ship's bridge complete with conventional controls and instruments you would expect to find on a modern bridge. Using this simulator it is possible to recreate the movement, controls and instruments precisely as a real ship would within the Lake. Weather, tide, visibility and sea state can be changed and varied. Facets can be introduced, including failure of the engines, steering, thrusters etc. Also included in the system is assessment software that will enable detailed evaluation of all aspects of the use of the system.

5.9.11 The model was created using the most recent bathymetric and topographic survey information supplied by the Harbour Authority to ensure accuracy. The proposed scheme bridge has been modelled as an elevated (12m clear height over water) twin leaf bascule bridge with fixed spans over the remaining waterway and operational quay areas of the port. The clear width between abutments on the bascule section was set at 35m. The clear width between fender panels within the passage was modelled at 32m, with 3 panels of approach fenders set at an angle of 25° to the passage centreline. The bridge piers have been modelled as piled structures based on the current design philosophy

5.9.12 Following creation of the model, two of the Harbour Authority's Pilots undertook two days of simulations to validate the accuracy of the model and to assess the impact of the proposed scheme on navigation and port operations.

5.9.13 Having received the feedback from the first simulations, the model is in the process of being revised to include design changes made to address the Pilot's comments and

once complete a second series of simulations will be undertaken to confirm that the revisions alleviate the identified issues.

5.9.14 With regard to potential impacts upon the numbers of vessels that can be accommodated within Lake Lothing following construction of the proposed scheme, the movement of vessels within the confines of the Lake are under the direction of the Harbour Authority for Port of Lowestoft. This function is performed by the appointed Harbour Master who has control over navigation for the safety of vessels therefore the timings for operation of the new bridge will be under their control.

5.9.15 The potential frequency of operation of the proposed bascule bridge will be assessed with active vessel surveys and reference to past movement information, where available.

5.9.16 The ES will present the conclusions of the vessel simulation modelling and an appraisal of any effects upon port operations both during construction and upon operation of the proposed scheme.

5.10 People and Communities – Socio-Economic including Recreation

Potential Impacts

5.10.1 The following impacts have been identified as ones which could be likely to have a significant effect:

- The creation of jobs and training opportunities within the local economy during the anticipated two-year construction period for the proposed scheme;
- Changes in accessibility for leisure-related vessels which gain access to the Broads via Lake Lothing and the consequent effect on tourism;
- Changes in accessibility for users of the SRN who gain access to the Broads and the consequent effect on tourism;
- The demand for temporary accommodation during the anticipated two-year construction period and the likely effect on established business / tourism accommodation within the town;
- Changes in social cohesion as a result of changes in accessibility to services / community facilities once the proposed scheme is open to use; and
- Cumulative impacts on the labour market as a result of concurrent construction activity on the proposed scheme and other major development projects.

5.10.2 As part of the scoping for the ES consideration has been given to anticipated employment opportunities which would be directly related to the use and future maintenance of the proposed scheme. It has, however, been concluded that such opportunities would be of small order and that it would consequently be unlikely that such employment opportunities could have a significant effect relative to the

Regulations. The topic has accordingly been excluded from the proposed scope for the ES.

5.10.3 Consideration has also been given to changes that would be likely to occur as a result of the improvement to the town's infrastructure that would be afforded by the implementation of the proposed scheme. Assessments relating to community severance and land use which have been identified and described under Effects on All Travellers and Private and Community Assets have clear socio-economic implications. The data derived from these assessments will therefore be analysed as part of the socio-economic assessments of the proposed scheme and conclusions will be drawn as to the broader benefit or disbenefits relative to local communities and the local economy in the context of the proposed assessment relative to social cohesion.

5.10.4 Socio-economic impacts focus on how the project elements would affect, place at risk, or enhance the well-being of people living and working in the direct area of influence. Well-being refers to a person's financial, physical and emotional conditions. Determinants of health and well-being include personal circumstances (e.g., housing, income, and family relations), social influences (e.g., social contact, crime, and discrimination), availability and access (e.g., community facilities, transportation, social services), economic conditions (e.g., employment, business activity, training), environment (e.g., open green spaces, water, air, waste), biological factors (e.g., age, gender, genetic factors) and lifestyle (e.g., exercise, leisure, etc.). Changes in people's daily routines and their lifestyles are considered in the concept of well-being.

Impact Assessment Methodology

5.10.5 It is proposed that all of the identified socio-economic assessments should be qualitative. This will involve the analysis of numeric data and descriptive criteria to enable substantiated conclusions to be drawn as to the nature and magnitude of change that would be likely to occur and whether such changes would be significant in the context of the Regulations.

5.10.6 The evaluation of impacts associated with jobs created during the anticipated two-year construction period will be based on consideration of the total number of jobs created for the two year period as a proportion of current jobs and job opportunities within the town relative to all employment sectors and the construction sector as a specific sector.

5.10.7 The evaluation of changes in accessibility for leisure-related vessels which gain access to the Broads via Lothing Lock will be based on an analysis of the findings of the assessment of impacts on maritime operations described under community and private assets. Data relating to numbers of vessels and use of Lake Lothing, including time required to pass through, will inform a qualitative assessment in the context of the activity as an important contributor to tourism within the local and wider area.

5.10.8 The evaluation of changes in accessibility for users of the SRN who gain access to the Broads will be based on an analysis of the findings of the assessment of impacts on community severance described under Effects on All Travellers (see Section 5.8). Data relating to reductions in distance travelled and changes in travel time will inform

a qualitative assessment in the context of the activity as an important contributor to tourism within the local and wider area.

5.10.9 The assessment of impacts associated with temporary accommodation required during the anticipated two-year construction period will be based on comparison of the project specific temporary demand against currently available business / tourism-related bed spaces.

5.10.10 The assessment of effects relative to social cohesion will be based on data derived from the assessments relating to community severance and land use which have been identified and described under Effects on All Travellers and Private and Community Assets.

5.10.11 Subject to responses to the scoping report it is intended that cumulative assessment should be limited to consideration of the proposed scheme in combination with the East Anglia Array and Sizewell C nuclear power station.

Evaluation of Effects

5.10.12 The importance of receptors is defined by how sensitive they are to changes in the socio-economic environment. Table 5.12 below identifies how receptors will be categorised.

Table 5.12 – Socio-economic sensitivity

Sensitivity	Criteria
High	A vulnerable receptor with little capacity to absorb change
Medium	A non-vulnerable receptor with limited capacity to absorb change
Low	A non-vulnerable receptor with capacity to absorb change

Magnitude of Effect

5.10.13 The magnitude of an effect is measured by a change in the baseline conditions that result from the proposed scheme. The following magnitude of effect parameters will be adopted.

Table 5.13 – Socio-economic magnitude of effect

Sensitivity	Criteria
Major	A long term and permanent effect that extends beyond the boundaries of WDC that affects the well-being of many socio-economic receptors and/or a high value resource.
Moderate	A medium term effect that lasts for longer than a year within the WDC area that affects the well-being of socio-economic resources and/or of medium value.
Minor	A short term effect that lasts for less than a year within the area of Lowestoft that affects the well-being of a few socio-economic receptors and/or a low value resource.
Negligible	A short term effect that does not extend beyond the extent of the proposed scheme that affects the well-being of a few socio-economic receptors and/or a low value resource.

5.10.14 Significance will be appointed to each type of effect as shown in Table 5.14.

Table 5.14 – Socio-economics significance of effect

	Negligible	Minor	Moderate	Major
Low	Not significant	Not significant	Not significant	Significant
Moderate	Not significant	Not significant	Significant	Significant
High	Not significant	Significant	Significant	Significant

5.11 Road Drainage and the Water Environment

5.11.1 The potential impacts and methodologies adopted to assess these are largely based on guidance provided in DMRB HD 45/09 (Highways Agency, 2009).

Potential Impacts on Surface Water

5.11.2 The potential significant impacts considered are:

- Pollution during construction due to increased generation and release of sediments and suspended solids, and increased risk of accidental spillage of pollutants such as oil, fuel and concrete associated with construction activities and site storage requirements;
- Pollution during road operation due to contaminants within routine road runoff. A broad range of potential pollutants, such as hydrocarbons i.e. fuel and lubricants, fuel additives, metal from corrosion of vehicles, de-icer and gritting material, can accumulate on road surfaces. These can subsequently be washed off the road surface during rainfall events, polluting the receiving surface water bodies;
- Pollution during road operation due to accidental spillage. On all roads, there is a risk that accidents or vehicle fires may lead to an acute pollution incident. Where commercial vehicles are involved, potential pollutants that may be spilled could range from hazardous chemicals to milk, alcoholic beverages, organic sludges and detergents. Spilled materials may drain from the road surface, polluting the receiving surface water bodies;
- Alterations to the hydromorphology (fluvial geomorphological) regime, such as increased erosion, deposition and channel migration processes. These changes can occur as a result of channel modification associated with increased road surface drainage, new crossing structures, culverting,

watercourse diversions and outfalls. A reduction in hydromorphological diversity can subsequently impact on water quality and biodiversity;

- Loss of standing waters where the route options would be constructed through or close to existing ponds; and
- Loss or change to water supplies due to degradation of water quality, changes in drainage patterns or disruption to supply infrastructure due to the route options.

Potential Impacts on Groundwater

5.11.3 The potential significant impacts considered are:

- Pollution of groundwater and aquifers as a result of construction activities, such as excavation of deep cuttings and seepage of spillages through ground profiles;
- Groundwater pollution during road operation due to contaminants within routine road runoff, where groundwater infiltration is proposed as part of the drainage strategy for the route options;
- Groundwater pollution during road operation due to accidental spillage;
- Direct loss or changes to groundwater aquifers and groundwater supported public and private water supplies, either below the footprint of the route options, or as a result of changes to groundwater flows and levels associated with the dewatering of deep cuttings and foundation excavations;
- Indirect loss or change to surface water receptors, as a result of dewatering of groundwater aquifers; and
- Loss or changes to Groundwater Dependent Terrestrial Ecosystems (GWDTEs), including peatland habitats, either below the footprint of the route options as a result of severance of habitat, or as a result of changes to groundwater flows and levels associated with dewatering activities.

Scope of the Assessment and Proposed Method of Assessment

5.11.4 The road drainage and the water environment assessment will involve the following key tasks:

- Consultations with the relevant statutory and non-statutory bodies to establish the principal water environment issues associated with the study area;
- Detailed desk studies and field surveys to ascertain the current baseline conditions on site;
- Assessment of the potential impacts related to the construction and operation of the proposed development;
- Identification of measures to avoid, minimise or mitigate predicted impacts.

5.11.5 The assessment will focus upon defining the characteristics and subsequent potential scheme impacts upon the surface water and groundwater receptors, including the

wider hydrological catchments as categorised by the EA under the WFD. This hydrological catchment-based approach enables due consideration to be given to both individual locations where interactions occur and any cumulative impacts within larger water body areas.

Scoped Out Impacts

5.11.6 The specific characteristics of the proposed scheme enable particular impacts to be considered as highly unlikely to occur. Based on professional judgement and taking account of water environment characteristics and scheme design, the following items are not intended to be considered further, thus enabling focus upon the more likely impacts on the water environment (as discussed in the following subheadings):

- Alterations to hydromorphological regime - scoped out due to heavily modified status of Lake Lothing, including engineered banks and Mutford Lock;
- Loss of standing water - scoped out due to the scale of the proposed development, the urban setting of the study area and the lack of standing water bodies below or adjacent to the options under development;
- Loss or change to Groundwater Dependent Terrestrial Ecosystems - scoped out due to the urban setting of the study area and the lack of such ecosystems below or adjacent to the options under development; and
- Changes to groundwater level or flows impact due to cuttings and related dewatering - scoped out as no cuttings are anticipated for this particular project, due to local topography, urban setting and flood risk characteristics.

Construction Pollution

5.11.7 Evaluation of the potential for pollution of surface waters as a result of spillage and of the release of sediments into watercourses or water bodies will involve a review of areas where construction would be required within or in close proximity (i.e. within 50m) to surface watercourses and water bodies.

5.11.8 The potential for pollution of groundwaters/aquifers is greatest where cuttings are proposed, cuttings are not planned for this scheme however groundwater vulnerability is classified as high for this area.

Pollution from Routine Runoff

5.11.9 DMRB HD 45/09 (Highways Agency, 2009) specifies procedures for the assessment of pollution impacts from routine runoff on surface waters, known as 'Method A'.

5.11.10 The Method A assessment comprises two separate elements:

- HAWRAT Assessment: the Highways Agency Water Risk Assessment Tool (HAWRAT) is a Microsoft Excel application designed to assess the short-term risks related to the intermittent nature of road runoff. It assesses the acute and chronic pollution impacts on aquatic ecology associated with soluble and sediment bound pollutants, respectively; and
- EQS Assessment: Environmental Quality Standards (EQS) are the maximum permissible annual average concentrations of potentially hazardous

chemicals, as defined under the WFD. The long-term risks over the period of one year are assessed through comparison of the annual average concentration of pollutants discharged with the published EQS for those pollutants.

5.11.11 To carry out these assessments a variety of baseline and drainage design information is required, including; traffic volumes, areas of impermeable and permeable road surfaces to be drained, proposed treatment train, receiving watercourse dimensions and flow data, water hardness, presence of sensitive sites (considered as international / national designated conservation sites) and in-stream structures or features which may influence the flow.

5.11.12 However, Method A was developed for assessment of discharges into freshwater bodies rather than transitional water such as Lake Lothing, with such water bodies having different characteristics, receptors and baseline conditions due to tidal influence and dilution factors. Therefore, the appropriate method of assessment for routine runoff shall require discussion and agreement with the EA.

5.11.13 The assessment method for groundwater is known as 'Method C', applied to drainage design features designed to discharge to groundwater specifically. The Method C assessment comprises a risk assessment procedure based on the source-pathway-receptor model, which considers the following parameters: traffic density, rainfall, soakaway design and geometry, depth to groundwater table, groundwater flow type, aquifer grain size and aquifer lithology.

Pollution from Accidental Spillage

5.11.14 The DMRB document HD 45/09 (Highways Agency, 2009) specifies procedures for the assessment of pollution impacts from accidental spillage, known as 'Method D'. A summary of the methodology is provided below, with full details provided in HD 45/09.

5.11.15 The assessment takes the form of a risk assessment, where the risk is expressed as the annual probability of a serious pollution incident occurring. This risk is the product of two probabilities:

- The probability that an accident will occur, resulting in a serious spillage of a polluting substance on the carriageway; and
- The probability that, if such a spillage did occur, the polluting substance would reach the receiving water body and cause a serious pollution incident.

5.11.16 The probability of a serious spillage occurring is dependent on a variety of factors; namely, traffic volumes, percentage of heavy goods vehicles in the traffic volumes, whether the road is motorway, rural or urban trunk road, the road type categories within the road drainage catchment under assessment (i.e. 'no junction', 'slip road', 'cross road' or 'roundabout'), and the length of each road type within the catchment.

5.11.17 The probability of a serious spillage subsequently causing a serious pollution incident is dependent on the receiving surface water body and the response time of the

emergency services; i.e., less than 20 minutes, less than one hour, or greater than one hour.

5.11.18 However, as for Method A, Method D was developed for assessment of discharges into freshwater bodies rather than the transitional water of Lake Lothing with associated tidal influence and dilution factors. Therefore, the appropriate method of assessment for accidental spillage shall require discussion and agreement with the Environment Agency.

Loss or change to groundwater aquifers and supported water supplies

5.11.19 Groundwater aquifers shall be identified and their sensitivity evaluated through review of BGS aquifer productivity and groundwater vulnerability mapping, and review of the WFD groundwater body status (BGS, 2016 and EA, 2016).

5.11.20 Groundwater abstraction data will be identified and receptors noted, with public water supplies of particular concern.

Indirect loss or change to surface water receptors

5.11.21 Surface water bodies such as streams, lakes and wetlands can receive or recharge groundwater, with movement likely between the two receptors. Any changes to groundwater as a result of dewatering may indirectly impact surface water bodies and result in changes to surface water flow.

5.11.22 For each of the options, the impact on surface water receptors shall be assessed qualitatively.

Impact Assessment Criteria

5.11.23 The predicted significance of impacts on surface waters and groundwater will be based on the importance or sensitivity of the relevant waterbody and the magnitude of the impact from the proposed development, as recommended in DMRB document HD 45/09 (Highways Agency, 2009).

5.11.24 The importance or sensitivity of the waterbodies has been evaluated taking into account their quality, rarity, scale and substitutability. The criteria used will be based on the guidance and examples given in HD 45/09, Table A4.3.

5.11.25 The magnitude of the various impacts is evaluated taking into account the extent of loss and effects on integrity of the relevant waterbody attributes. The criteria used will be based on the guidance and examples given in HD 45/09, Table A4.4.

5.11.26 The estimation of the impact significance will be derived by combining the estimated importance of the affected waterbodies and the magnitude of the impacts, taking into account mitigation and the guidance provided in HD 45/09, Table A4.5 and this is provided as Table 5.15 below.

Table 5.15 – Impact Magnitude/Significance Matrix

Importance of Waterbody	Magnitude of Impact			
	Major	**Moderate**	**Minor**	**Negligible**
Very High	Very Large	Large / Very Large	Moderate / Large	Neutral
High	Large / Very Large	Moderate / Large	Slight / Moderate	Neutral
Medium	Large	Moderate	Slight	Neutral
Low	Slight / Moderate	Slight	Neutral	Neutral

5.11.27 Where there is more than one option for significance rating, professional judgement shall be used to determine the significance for the particular impact.

5.12 Flood Risk

Potential Impacts on Flood Risk

5.12.1 Increase in flood risk caused by the development, both within the vicinity of the route options and also elsewhere in the catchment. This can involve a number of inter-related factors including:

- Increases in water level due to development within the channel or floodplain;
- Loss of floodplain storage due to road infrastructure occupying areas which were previously available for flood storage or flows; and
- Impediment of water flow caused by road infrastructure crossing existing drainage channels, causing potential blockage and altering local catchment area boundaries.

Scope of the Assessment and Proposed Method of Assessment

5.12.2 A Flood Risk Assessment (FRA) will be carried out in accordance with the National Planning Policy Framework (NPPF) and the supporting document Technical Guidance to the NPPF.

5.12.3 The objectives of the FRA are to:

- Assess the risk to the development from all potential sources of flooding;
- Establish the existing and future flood risk to the development;
- Assess the potential impacts of the proposed development on flood risk elsewhere; and
- Determine appropriate mitigation measures to manage flooding issues post development in a sustainable way.

5.12.4 The main source of flooding to the site of the new bridge is believed to be tidal. A 2D TUFLOW hydraulic model developed by CH2M Hill, on behalf of Waveney District Council as part of the Lowestoft Tidal Barrier project in 2014, will be utilised in this

study. The existing model will be reviewed and updates made as necessary following the outcome of the review although the assessment will assume that the Tidal Barrier is not constructed which will present a worst case scenario.

5.12.5 Depending on the hydrological analysis and the review of the existing tidal model, updates may also be required to the model boundary conditions representing the fluvial inflows to Lake Lothing and the tide levels at the harbour entrance.

5.12.6 A suite of sensitivity tests will be undertaken to determine the impact of a variety of parameters on the model results, including the roughness values representing land use within the model, fluvial inflows and tidal levels.

5.12.7 The model will be used to investigate two scenarios:

- baseline - to establish the existing flood risk to the third crossing site; and
- post-development - to establish the impact of the proposed third crossing on flooding elsewhere.

5.12.8 The water levels predicted by the model for the post-development scenario will be compared to the predicted water levels for the baseline scenario, to determine the impact of the proposed scheme on flood levels in Lowestoft. Three flood return periods will be investigated using the flood model developed for this project; these are: the 5% Annual Exceedance Probability (AEP) event, the 0.5% AEP event (tidal Flood Zone 3) and the 0.1% AEP event (tidal Flood Zone 2). Model runs will be undertaken for each return period with and without climate change allowances applied to determine the present day flood risk in Lowestoft and predicted future flood risk. As the development is a NSIP, the impact of and resilience to future flooding will be considered and mitigation against future flood risk elsewhere will be recommended as necessary. Climate change allowances will be applied within the FRA based on the National Policy Statement for National Networks. As the development is safety-critical, the UK Climate Projections (UKCP09) high emissions scenario for the 2080s at the 50% probability level will be used to inform the design and mitigation of the development as agreed with the EA.

5.12.9 The development will also be assessed against the H++ estimates (high risk, low probability) for sea level rise to assess a credible maximum scenario. The EA have agreed that they do not expect the design or mitigation to be provided to this level but the development should be assessed against this scenario to understand the full picture of risk.

Impact Assessment Criteria

5.12.10 Table 1 shows how a given increase in flood depth from the baseline scenario to the post-development scenario will be classified in terms of impact. A minimal increase in flood depth (<0.02m) between the two scenarios is classified as a negligible impact

because this is within the tolerance of the hydraulic model being used to predict flood risk to Lowestoft and would not significantly increase flood risk to most receptors.

Table 5.16 – Classification of magnitude of flooding impact

Magnitude of Impact	Change in depth (m)
No change	0
Negligible	>0.0 – <=0.02
Moderate	>0.1 – <=0.3
Major	0.3+ OR Flooding in areas that were previously not flooding.

5.12.11 Table 2 within the NPPF Planning Practice Guidance for flood risk and coastal change classifies receptors in terms of their flood risk vulnerability[29].

5.12.12 The need for flood mitigation is dependent on the magnitude of impact and the vulnerability of the receptor(s) that are affected by any increase in flood depth. Table 5.15 compares the magnitude of impact and receptors to demonstrate when mitigation is required and the need for flood mitigation as part of the proposed scheme will be assessed using these parameters.

5.12.13 Negative significant effects from flooding as a result of the proposed scheme are considered to be unlikely. This is because mitigation would be incorporated as an intrinsic part of the scheme should flood modelling identify that mitigation was necessary. This mitigation would need to be designed to produce a residual negligible effect.

5.12.14 to result in a residual effect of the proposed scheme following any mitigation because the mitigation would be designed to bring the scheme to a negligible impact.

[29] https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification

Table 5.17 – Significance of flood impact

	Receptor Sensitivity				
Magnitude of Impact	**Water compatible**	**Less Vulnerable**	**More Vulnerable**	**Highly Vulnerable**	**Essential infrastructure**
No Change	No Mitigation required	No Mitigation required	No Mitigation required	No Mitigation required	No Mitigation required
Negligible	No Mitigation required	No Mitigation required	No Mitigation required	Mitigation	Mitigation
Moderate	No Mitigation required	Mitigation	Mitigation	Mitigation	Mitigation
Major	No Mitigation required	Mitigation	Mitigation	Mitigation	Mitigation
All mitigation measures will be decided in consultation the EA					

5.13 Traffic and Transport

Potential Impacts

5.13.1 The proposed scheme is likely to have the following traffic and transport effects that have the potential to be significant:

- Increased traffic flows during construction: there will be an increase in traffic flows on local roads during construction, including a temporary increase in HGV movements; and
- Redistributed traffic flows post-construction: there will be a redistribution of traffic flows on the surrounding road network post-construction, and, without mitigation, an associated potential for increased pedestrian severance, driver stress and delay, and collisions on the redistribution route.

5.13.2 The introduction of the proposed scheme will not in itself generate any additional traffic although providing the bridge as an alternative route to the current crossing options, will result in a redistribution of traffic and these impacts will be assessed.

5.13.3 The potential impacts of the proposed scheme with regards to traffic are likely to be predominantly positive, with journey time savings, vehicle operating cost savings, reduced congestion, enhanced journey time reliability, collision and casualty savings, and an increase in the use of more active modes of travel.

5.13.4 One of the main aims of providing the proposed scheme is to unlock land for regeneration which is currently constrained by congestion on the local highway network. New development will lead to an increase in overall travel and trip making. More people will need to travel to work, the regenerated sites will need to be serviced and goods will have to be transported in and out.

5.13.5 Whilst the additional trips from new developments are not directly related to the development consent application for the new crossing, they are a by-product of the new crossing therefore the anticipated impact should be assessed within the ES. It is

anticipated that the new crossing and associated infrastructure improvements will meet the demand for the additional trips by all modes without putting additional pressure on the existing transport networks.

5.13.6 There will be a potential impact on the area during construction, including an increase in HGV movements for the duration of construction. This impact will be assessed within the ES.

Scope of the assessment and proposed method of assessment

5.13.7 A Transport Assessment (TA), which will assess the impact of the proposed scheme on the capacity of highway infrastructure, will be scoped with SCC and key stakeholders, and submitted in support of the DCO.

5.13.8 The ES will summarise the findings of the TA and will focus on likely significant environmental effects upon the local community, such as severance, driver delay or an increased collision rate.

5.13.9 The ES will:

- Address changes to local traffic flows during the construction phase and once the proposed scheme is completed and operational;
- Address potential disruption to local pedestrians, cyclists and road vehicle users during the construction phase; and
- Provide information on transport conditions both before and after the proposed scheme is built, including changes in relative accessibility of the local area by foot, bicycle, and public transport.

5.13.10 The ES will take account of paragraphs 32 to 36 of the NPPF (2012) and the IEMA *Guidelines for the Environmental Assessment of Road Traffic* (1993). Close consultation will be undertaken with key stakeholders, including Highways England, SCC and WDC.

5.13.11 Further desk studies and site visits will be undertaken to identify key features of the existing road and pedestrian/cycle networks in the vicinity of the proposed scheme and to obtain data on existing collision rates and identify existing public transport services.

5.13.12 Traffic surveys will be undertaken at key junctions and links surrounding the proposed scheme, if sufficient existing data is unavailable. It is anticipated that the majority of data will be available from existing survey data and the strategic model for the area, which was used to support the OBC, and was scrutinised for use by the Department for Transport (DfT) . The forecast years of assessment will be agreed with SCC when the detail of the modelling is scoped.

5.13.13 The reassignment of traffic onto the proposed scheme will be taken from the strategic SATURN model, which is a highway assignment model.

5.13.14 An assessment of the impact of the redistribution of traffic on local junctions will be completed using appropriate software (such as JUNCTIONS8 and LINSIG) at the individual junctions, to determine where any additional mitigation is required based on

capacity results (Ratio of Flow to Capacity (RFC), Degree of Saturation (DoS), Practical Reserve Capacity (PRC), as appropriate for the software type) r, delays and expected queue lengths.

5.13.15 The assessments will include forecast year scenarios for the year of opening and 15 years after opening and these scenarios will include traffic growth associated with planned / committed development.

5.13.16 The impacts on pedestrian and cycle connections, and improved public transport services/routes will also be reviewed within the ES.

Significance of effect

5.13.17 The significance of traffic and transport effects on sensitive receptors will be determined by combining the sensitivity of identified receptors with the predicted magnitude of change.

5.13.18 The IEMA Guidelines identify that the most discernible environmental impacts of traffic are noise, severance, pedestrian delay and intimidation and they provide additional information on how those impacts should be assessed:

- "At low flows, increases in traffic of around 30% can double the delay experienced by pedestrians attempting to cross a road (DOT, 1983). Whether this is significant in absolute terms requires further consideration (see 3.19). Severance and intimidation are, however, much more sensitive to traffic flow and the Department of Transport, in its MEA, has assumed that 30%, 60% and 90% changes in traffic levels should be considered as "slight", "moderate" and "substantial" impacts respectively."

5.13.19 In order to undertake a relative assessment of the increase in road traffic, the criteria outlined in Table 5.18 and Table 5.19 will be used to determine the magnitude of impact and receptor sensitivity respectively. However, consideration should also be given to the local characteristics, such as the volume of traffic, pavement widths and availability of crossing facilities.

Table 5.18 - Magnitude of Traffic Impact Criteria

Change in Traffic Flow	Magnitude of Impact
Change in total traffic or HGV flows over 90%	Major
Change in total traffic or HGV flows of 60 - 90%	Moderate
Change in total traffic or HGV flows of 30 - 60%	Minor
Change in total traffic or HGV flows of less than 30%	Negligible

Table 5.19 - Receptor Sensitivity

Receptor Sensitivity	Receptor Type
Major	Receptors of greatest sensitivity to traffic flow: schools, colleges, playgrounds, accident black spots, retirement homes, urban/residential roads without footways that are used by pedestrians.
Moderate	Traffic flow sensitive receptors including: congested junctions, doctors' surgeries, hospitals, shopping areas with roadside frontage, roads with narrow footways, unsegregated cycle ways, community centre, parks, recreational facilities.
Minor	Receptors with some sensitivity to traffic flow: places of worship, public open space, nature conservation areas, listed buildings, tourist attractions and residential areas with adequate footway provision.
Negligible	Receptors with low sensitivity to traffic flow and those with sufficient distance from affected roads and junctions.

5.13.20 The magnitude of change and sensitivity of the receptor will then be compared in order to determine the overall traffic effect significance, as shown in Table 5.20.

Table 5.20 - Determination of Significance of Traffic Effects

Sensitivity of Receptor	Magnitude of Effect			
	Negligible	Minor	Moderate	Major
Major	Minor	Moderate	Major	Major
Moderate	Negligible	Minor	Moderate	Major
Minor	Negligible	Negligible	Minor	Moderate
Negligible	Negligible	Negligible	Negligible	Minor

5.13.21 The potential effects will be considered to determine the level of significance, either major, moderate, minor or of negligible significance. Effects of major and moderate significance are considered to be significant in EIA terms.

5.14 Cumulative effects

5.14.1 In accordance with the regulations, an assessment upon cumulative effects arising from the proposed scheme in combination with near-certain development will be undertaken and presented in the ES.

5.14.2 The advice within Advice Note 17[30] identifies a four stage process to the Cumulative Effects Assessment (CEA) process and the ES will include a CEA that follows this staged approach (as

CEA Stage	Main Activities
Stage 1 – Establishing a zone of influence for the proposed scheme and identifying a long list of 'other development',	Identifying a long list of 'other development' that is proposed in the vicinity of the proposed scheme.
Stage 2 – Identify a shortlist of 'other development'.	Identifying the nature of the 'other development' and assessing whether there is the potential for significant cumulative effects.
Stage 3 – Information gathering	Collation of information on the 'other development' identified at Stage 2
Stage 4 - Assessment	Assessing

Status of the development

5.14.3 As acknowledged by PINS in their advice note on CEA the information that is available on which a robust CEA can be undertaken on future development is likely to be proportional to the status of the development.

Stage 1

5.14.4 At this Scoping Report stage the long list of 'other development' has been based upon information that is available from WDC, SCC, PINS and MMO.

5.14.5 The following schemes have been identified as being of suitable scale to be included in Stage 2 in so far that they could affect some environmental aspects cumulatively with the proposed scheme;

- Former Sanyo Site, School Road, Lowestoft (DC/15/2004/RG3);
- Brooke Peninsula And Jeld Wen mixed use development (DC/13/3482/OUT);
- Riverside Road Local Development Order (LDO);
- Lowestoft Tidal Barrier;
- East Anglia Array Windfarm; and
- Sizewell C nuclear power station.

5.14.6 Of these developments the first three listed have planning permission, as does the first phase of the East Anglia Array (East Anglia ONE) whilst the Tidal Barrier, and the remaining phases of the East Anglia Array and Sizewell C are still in the pre-consent stage.

Stage 2

[30] Advice note seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects; The Planning Inspectorate, December 2015.

5.14.7 Development identified within Stage 1 will be screened to identify whether its location and attributes is worthy of greater consideration.

Stage 3

5.14.8 Available information on the status of the Stage 2 developments will be collated and used as the basis of the Stage 4 assessment.

Stage 4

5.14.9 By their very nature, the operational air quality and noise assessments, and some aspects of the water environment assessment, will include cumulative effects in so far that the traffic data that they are based upon includes both future development and natural traffic growth. CEA for noise and air quality impacts within the ES will therefore be limited to the construction phase of the proposed scheme.

5.14.10 Similarly, the flood risk assessment for the proposed scheme will likewise adopt a worst case approach through excluding the Lowestoft Tidal Barrier from the assessment model.

5.15 Conclusions

5.15.1 The ES for the proposed scheme, in accordance with the Regulations, will present a summary of the mitigation that has been proposed to reduce any significant effects as well as any resulting residual impacts.

5.15.2 At the time of submission of the Scoping Report there are no confirmed significant effects, although conversely it has not been possible to confirm whether any of the environmental aspects discussed in this Scoping Report can be discounted as not significant.

5.15.3 Presented within Table 5.21 is our present understanding of where significant effects could be experienced, and where our knowledge to date implies that they may be avoided.

Table 5.21 – Consideration of likely significant effects given present understanding

Environmental Aspect	Discussion of present understanding
Air Quality	Impacts during the construction phase are likely to be not significant with suitable mitigation measures such that will be secured through a Construction Code of Practice. During the operational phase it is possible that the diversion of traffic away from congested areas could result in significant positive effects. The extent to which any increase in traffic results in a significant negative effect will be determined through modelling.
Cultural Heritage	Impacts upon built heritage will be considered in the scope of the assessment. Without undertaking a detailed assessment, and without an appraisal of how the proposed scheme will interact with their setting it is premature to make a determination of significance. Impacts upon buried archaeology are unlikely to be significant given present knowledge although further information will be gathered to further assess this.

Townscape and Visual Impact	The preliminary ZVI of the scheme, as shown in Figure 8, is reasonably constrained although prior to undertaking an appraisal of the proposed scheme it is premature to make a determination of significance.
Biodiversity and nature conservation	Survey data collected to date does not indicate the presence of species that are likely to be significantly affected, although additional survey data is still to be collected later in 2017.
Geology, soils and contamination	It is highly likely that contamination is present on site, although given that the proposed scheme will largely be constructed above existing ground and because of the intended use, there is unlikely to be a significant effect upon users of the proposed scheme from contamination. Greater study on impacts upon groundwater and the geology and soils is required to assess whether preferential pathways for contaminant transport could be created as a result of the proposed scheme.
Noise and vibration	Similarly to the Air Quality assessment, impacts during the construction phase are likely to be not significant with suitable mitigation measures such that will be secured through a Construction Code of Practice. During the operational phase it is possible that the diversion of traffic away from congested areas could result in significant positive effects. The extent to which any increase in traffic results in a significant negative effect will be determined through modelling.
People and Communities – Effects on all Travellers	The scheme will undoubtedly have beneficial effects upon some travellers upon the road network, although detailed study is needed to identify and ascertain whether this could be classed as significant. During construction there could be some temporary impacts, although whether it is significant will depend upon the length, nature and duration of any diversion.
People and Communities – Community and Private Assets	The loss of private assets could be deemed to be significant depending upon the nature of the operation and the extent of loss.
People and Communities – Socio-economic including recreation	The construction of the proposed scheme will bring employment opportunities although the extent to which this is significant is a factor of the existing baseline scenario.
Road drainage and the water environment	It is unlikely that the runoff from the scheme will result in a significant effect upon the receiving watercourse, although this can only be confirmed when the design and the traffic figures are assessed. With regard to the WFD, the nature of any impact upon the classification of Lake Lothing will depend upon the nature of construction.
Flood Risk	It is unlikely that a significant negative effect upon flood risk will occur as this is highly unlikely to be acceptable to the EA without suitable mitigation that reduced the nature of the effect to an acceptable level.
Traffic and Transport	The proposed scheme will divert traffic away from some congested areas of Lowestoft. The extent to which this reduction in traffic is significant will be identified as a result of the modelling and the detailed assessment.
Cumulative Effects	At stage 1 of CEA it is premature to identify likely significant effects and greater assessment of the likely effects of the proposed scheme, alongside those of other development is necessary.

6 Proposed Environmental Statement Structure

6.1.1 The nature of the likely significant environmental effects associated with the proposed scheme is such that it is considered relevant to scope into the ES all of the DMRB environmental assessment topics, with the exception of Part 6 Materials. A materials assessment has been scoped out as it is considered development of the proposed scheme is unlikely to result in significant waste streams or material usage.

6.1.2 Similarly, the requirement for a Health Impact Assessment (HIA) has not been included as part of the scope of the ES.

6.1.3 Impacts upon human health, however, are to be addressed within the relevant aspect of the Air Quality assessment. The nature of the proposed scheme and its location are such that impacts upon health are unlikely to be significant beyond that which are already to be quantified as part of the Air Quality assessment.

Format of the Environmental Statement

6.1.4 The Environmental Statement is proposed to comprise of three volumes:

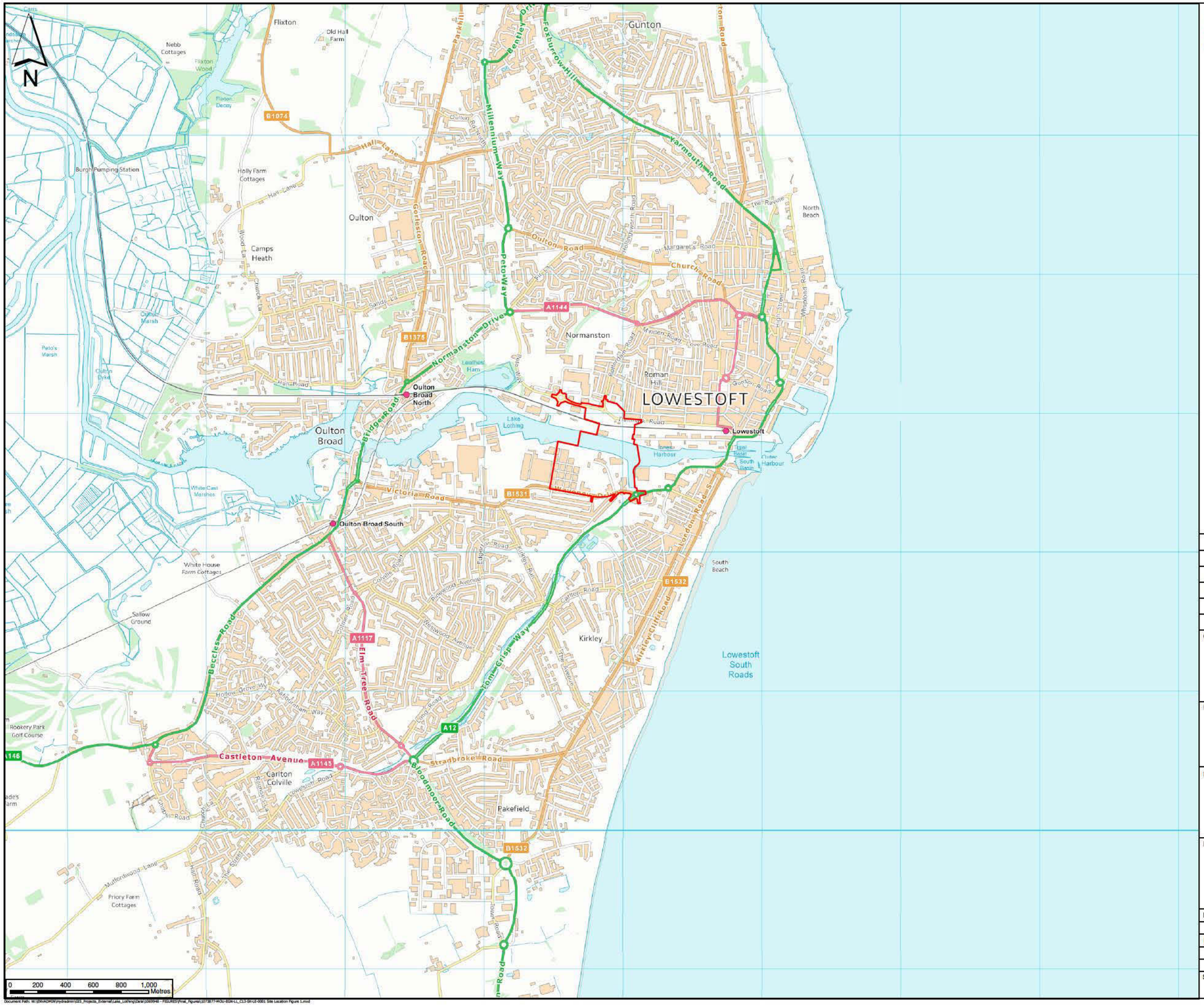
- Volume 1 will contain the main text and summary of the assessments as well as a non-technical summary;
- Volume 2 will contain figures; and
- Volume 3 will contain appendices.

6.1.5 The intended chapter format for the main text is as shown in Table 6.1:

Table 6.1 - Environmental Statement Structure

Chapter Number	Chapter Title
1	Introduction
2	Need for the Scheme
3	Consultation
4	Alternatives Considered
5	The Existing Environment
6	Description of the Proposed Scheme
7	Scoping and Introduction to Environmental Assessments
8	Air Quality
9	Cultural Heritage
10	Townscape and Visual Impact Assessment
11	Nature Conservation
12	Geology, Soils and Contamination
13	Noise and Vibration
14	People and Communities – Effects on All Travellers
15	People and Communities – Community and Private Assets

Chapter Number	Chapter Title
16	People and Communities – Socio Economics including Recreation
17	Road Drainage and the Water Environment
18	Flood Risk
19	Traffic and Transport
20	Cumulative Impacts
21	Schedule of Environmental Commitments



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Legend

Red Line Boundary/Site Location

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Red Line Boundary Revised	IW / HR
P01	19/12/2016	First Issue	IW / HR

CLIENT

Suffolk County Council

ENGINEERS

mouchel
building great relationships

PROJECT

Lake Lothing THIRD CROSSING

DRAWING TITLE

Site Location Plan

Figure 1

DESIGN BY	IW	CHECKED BY	HR
DATE	19/12/2016	DATE	19/12/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	19/12/2016	DATE	19/12/2016

DRAFT | PRELIMINARY | TENDER | CONTRACT

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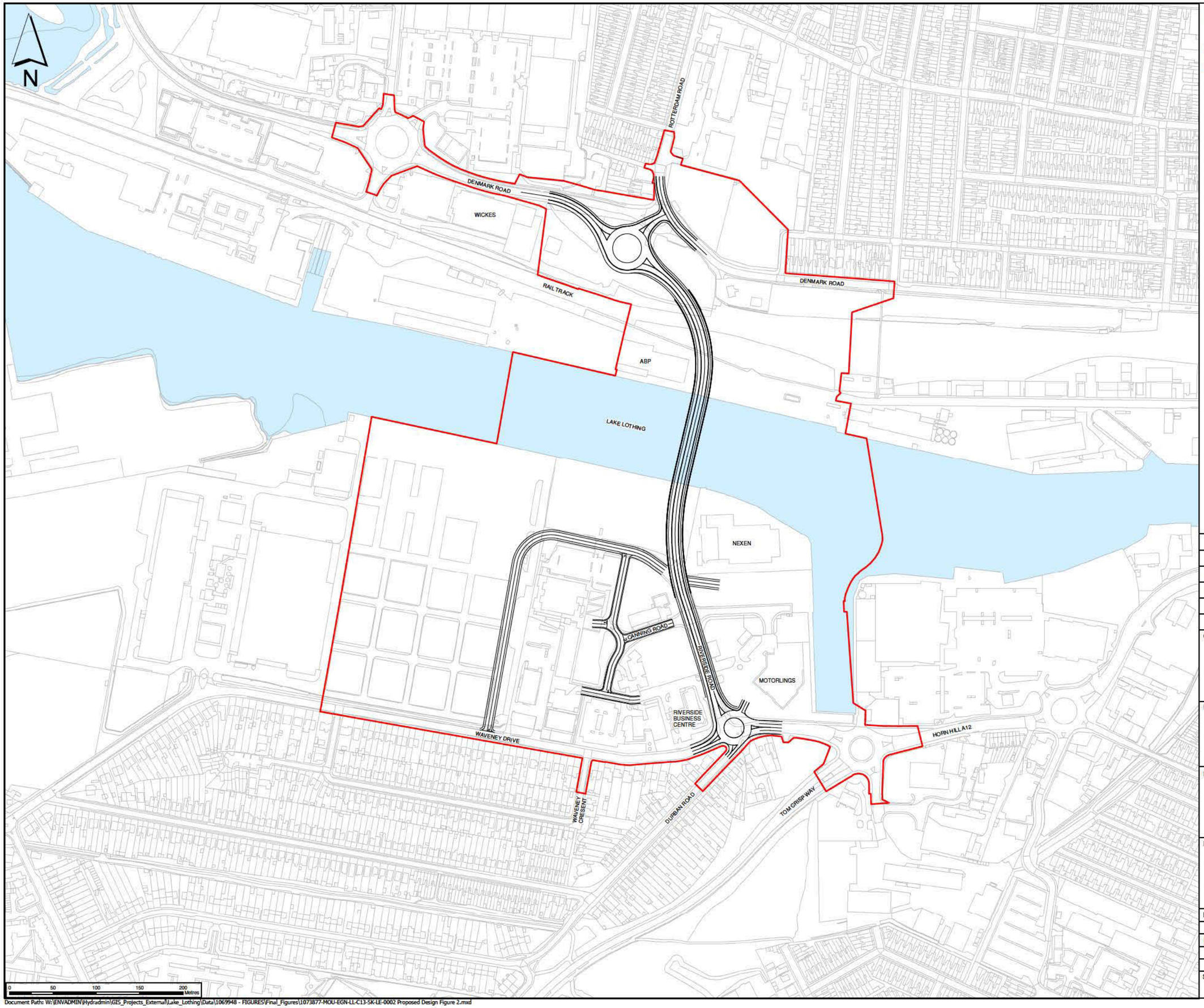

Document Path: W:\ENVADMIN\Hydradmin\GIS_Projects_External\Lake_Lothing\Data\1069948 - FIGURES\Final_Figures\1073877-MOU-EGN-LL-C13-SK-LE-0002 Proposed Design Figure 2.mxd

Legend

- The Proposed Scheme
- Red Line Boundary

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Northern Junction Layout & Red Line Boundary Revised	IW / HR
P01	19/12/2016	First Issue	IW / HR

CLIENT: Suffolk County Council

ENGINEERS: mouchel — building great relationships

PROJECT: Lake Lothing THIRD CROSSING

DRAWING TITLE

Proposed Scheme

Figure 2

DESIGN BY	IW	CHECKED BY	HR
DATE	19/12/2016	DATE	19/12/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	19/12/2016	DATE	19/12/2016

DRAFT | PRELIMINARY | TENDER | CONTRACT

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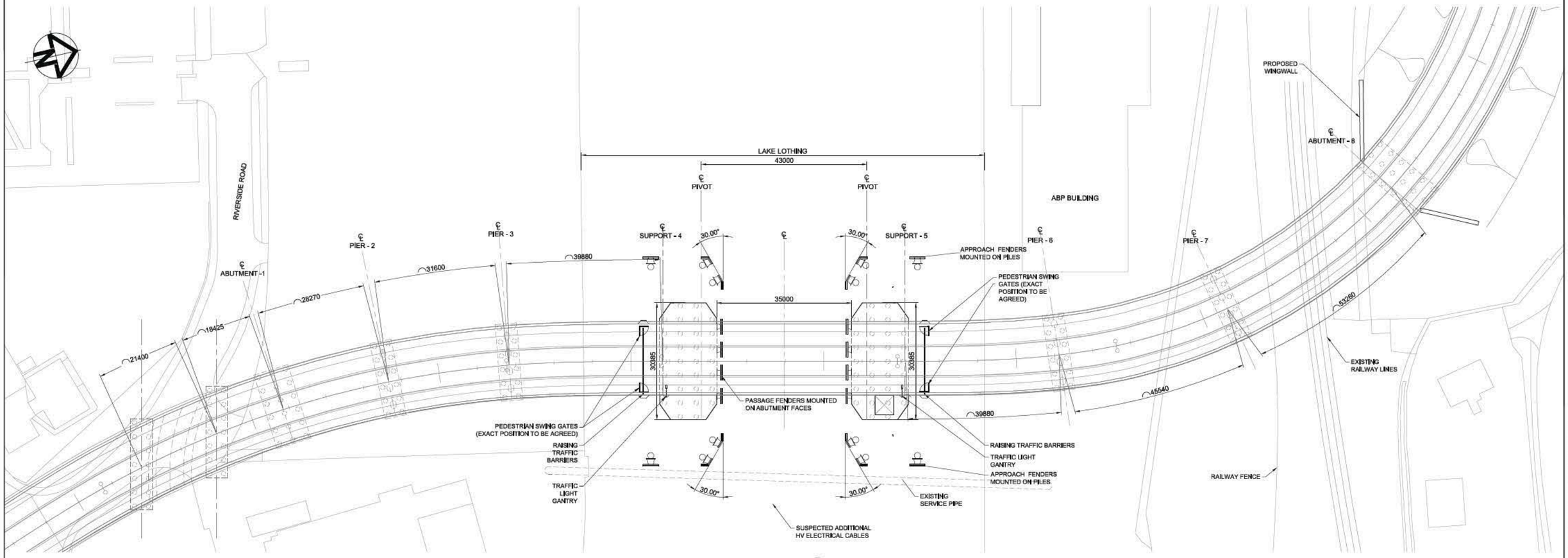

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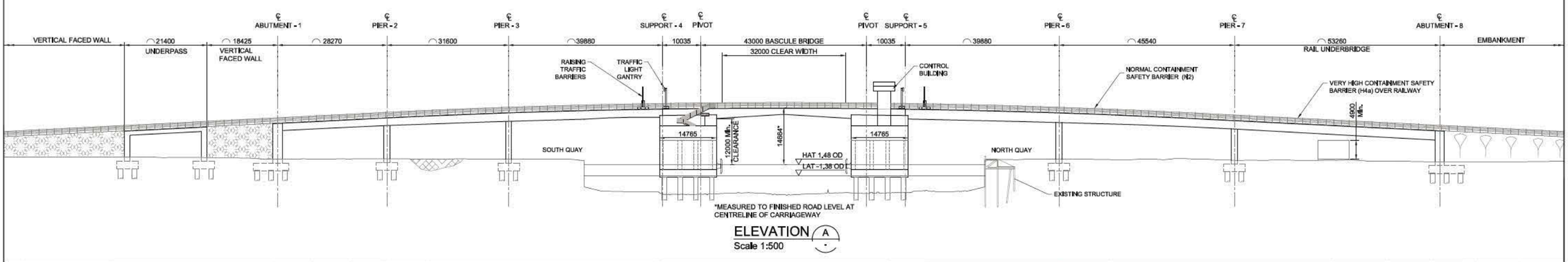

ELEVATION
Scale 1:500

Revision	Amendment	Drawn/Designed	Checked	Approved	Date

Project: LAKE LOTHING THIRD CROSSING

Drawing Title: FIGURE 3 - STRUCTURES PLAN AND ELEVATION 2 PIER

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Scale	Designed / Drawn	Checked	Approved	Authorised
As shown	OW	MC	MN	MN
Original Size: A1	Date 20/12/16	Date 20/12/16	Date 20/12/16	Date 20/12/16

Status: FOR INFORMATION

Drawing No Project	Originator	Volume	Location	Type	Role	Number	Suitability	Revision
1069948	MOU		SGN				S3	
LL_C13	DR		CB			0008		P01

Legend

- Connection to existing road network

Proposed bridge alignment colours corresponds to connection options

- W1
- W2
- W3
- C1
- C3
- C4
- E1
- E4
- E3
- Proposed tunnel alignment
- New roundabout junction

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Drawing Number Amended	IW / HR
P01	12/12/2016	First Issue	NE / HR

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Lake Lothing THIRD CROSSING

DRAWING TITLE

Alternatives Considered

Figure 4

DESIGN BY	NE	CHECKED BY	LW
DATE	12/12/16	DATE	12/12/16
DRAWN BY	NE	APPROVED BY	
DATE	12/12/16	DATE	12/12/16

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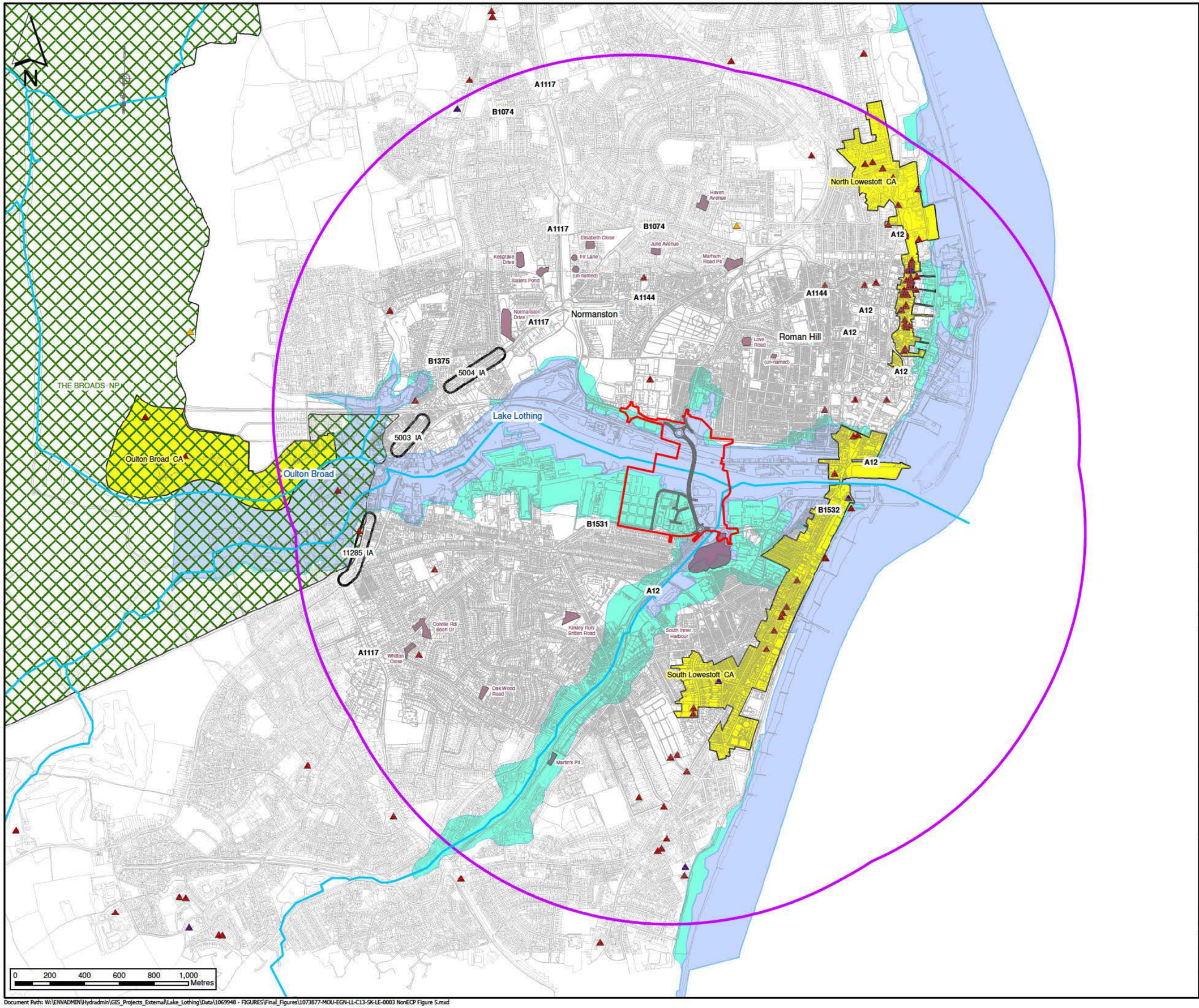
SCALE - A3	DRAWING NO	REV
NTS	1073877-MOU-EGN-LL_C13-SK-LE-0005	P02



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Legend

- Red Line Boundary
- 2KM Buffer
- The Proposed Scheme
- Watercourse
- National Park
- Historic Landfill
- Conservation Area
- Defra Noise Important Area (IA)
- Floodzone 3
- Floodzone 2

Listed Building

GRADE

- I
- II
- II*

REV.	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Northern Junction Layout & Red Line Boundary Revised	IW / HR
P01	08/12/2016	First Issue	IW / HR

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ENGINEERS: mouchel — building great relationships

PROJECT: Lake Lothing THIRD CROSSING

DRAWING TITLE

Non-ecological Environmental Constraints Plan

Figure 5

DESIGN BY	IW	CHECKED BY	HR
DATE	08/12/2016	DATE	08/12/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	08/12/2016	DATE	08/12/2016

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SCALE - A3	DRAWING NO	REV
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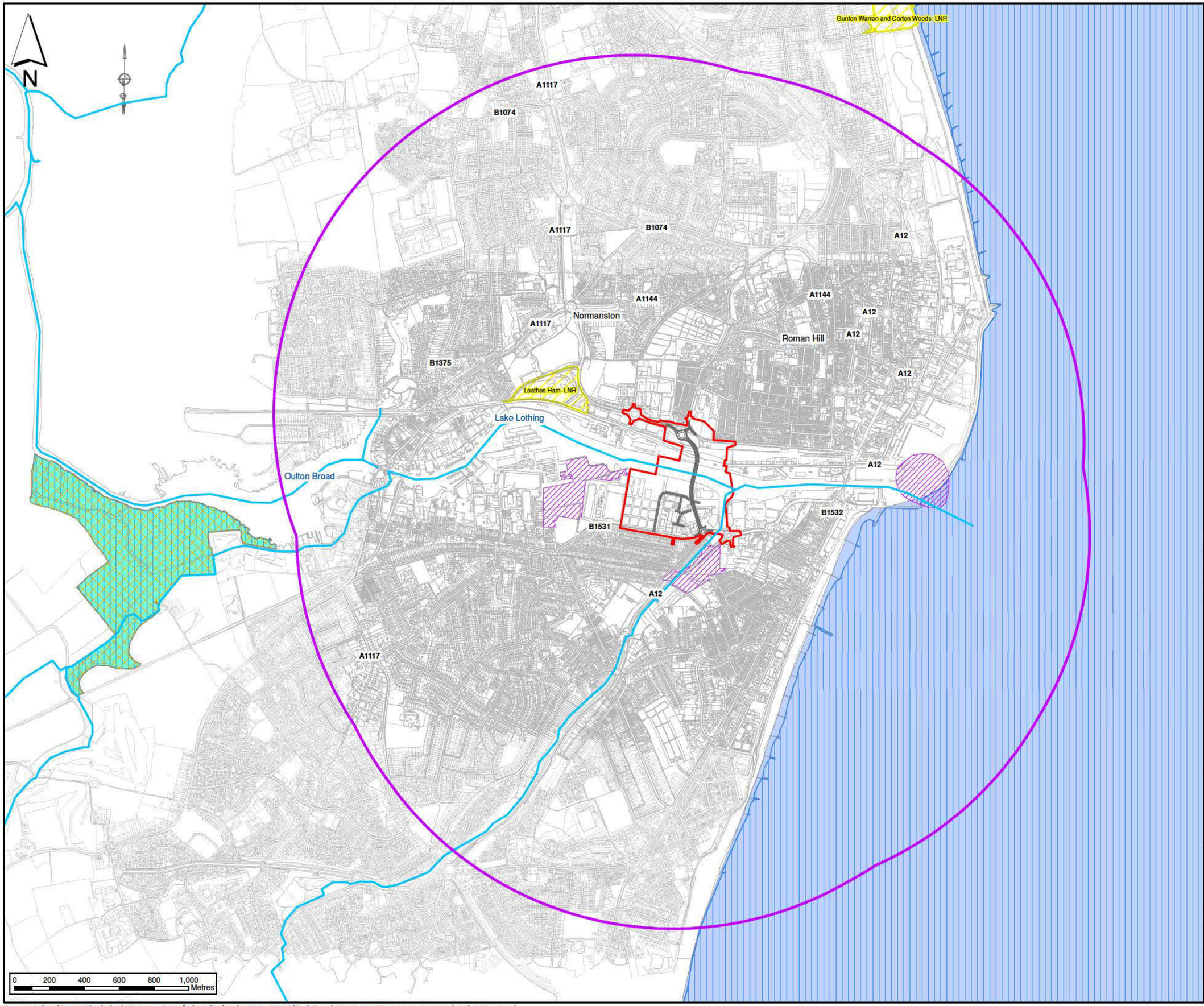

Legend

- Red Line Boundary
- 2KM Buffer
- The Proposed Scheme
- Watercourse
- Ramsar
- Special Areas of Conservation
- Special Protection Areas
- Southern North Sea Possible SAC
- Local Nature Reserve (LNR)
- County Wildlife Site

REV.	DATE	AMENDMENT	INITIALS
P03	09/02/2017	Northern Junction Layout & Red Line Boundary Revised	IW / HR
P02	20/01/2017	2 County Wildlife Sites added	IW / HR
P01	19/12/2016	First Issue	IW / HR

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Lake Lothing THIRD CROSSING

DRAWING TITLE

Ecological Constraints Plan

Figure 6

DESIGN BY	IW	CHECKED BY	HR
DATE	19/12/2016	DATE	19/12/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	19/12/2016	DATE	19/12/2016

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M45 M36 M44 M34 M35 M37 M43 M33 M38 M41 M40 M39 M32 M42 M31 M30 M29 M28 M27 M26 M20 M19 M21 M22 M23 M24 M25 M18 M17 M16 M15 M14 M11 M13 M10 M12 M9 M8 M6 M7 M5 M2 M4 M1 M3

LOWESTOFT

0 500 1,000 1,500 2,000 2,500 Metres

Legend

- Proposed Mouchel Monitoring Sites
- Local Authority Monitoring Sites

Air Quality Affected Links

- Increasing Affected Link
- Not Affected Link
- Decreasing Affected Link

OVERVIEW PLAN

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Drawing Number Amended	IW / HR
P01	19/12/2016	First Issue	IW / HR

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Co-location

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Lake Lothing THIRD CROSSING

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Air Quality Monitoring Sites & Affected Network

Figure 7

DESIGN BY	IW	CHECKED BY	AC
DATE	19/12/2016	DATE	19/12/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	19/12/2016	DATE	19/12/2016

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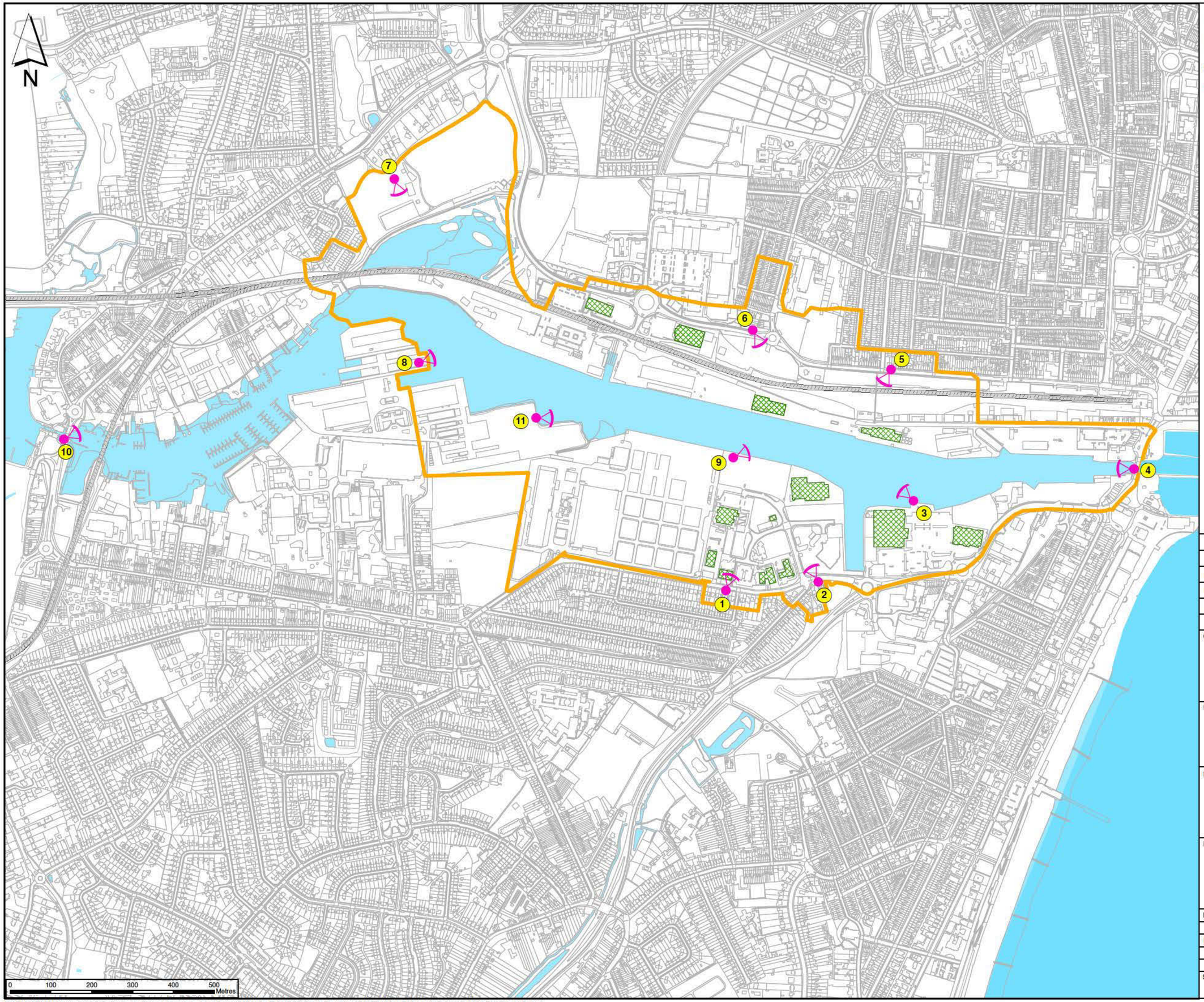

Legend

- Significant buildings
- Preliminary Mapping & ZVI (Zone of Visual Influence)
- Proposed Viewpoint - Location and Direction of View

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Drawing Number Amended	IW / HR
P01	20/12/2016	First Issue	IW / HR

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Zone of Visual Influence

Figure 8

DESIGN BY	IW	CHECKED BY	AW
DATE	20/12/2016	DATE	20/12/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	20/12/2016	DATE	20/12/2016

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SCALE - A3	DRAWING NO	REV
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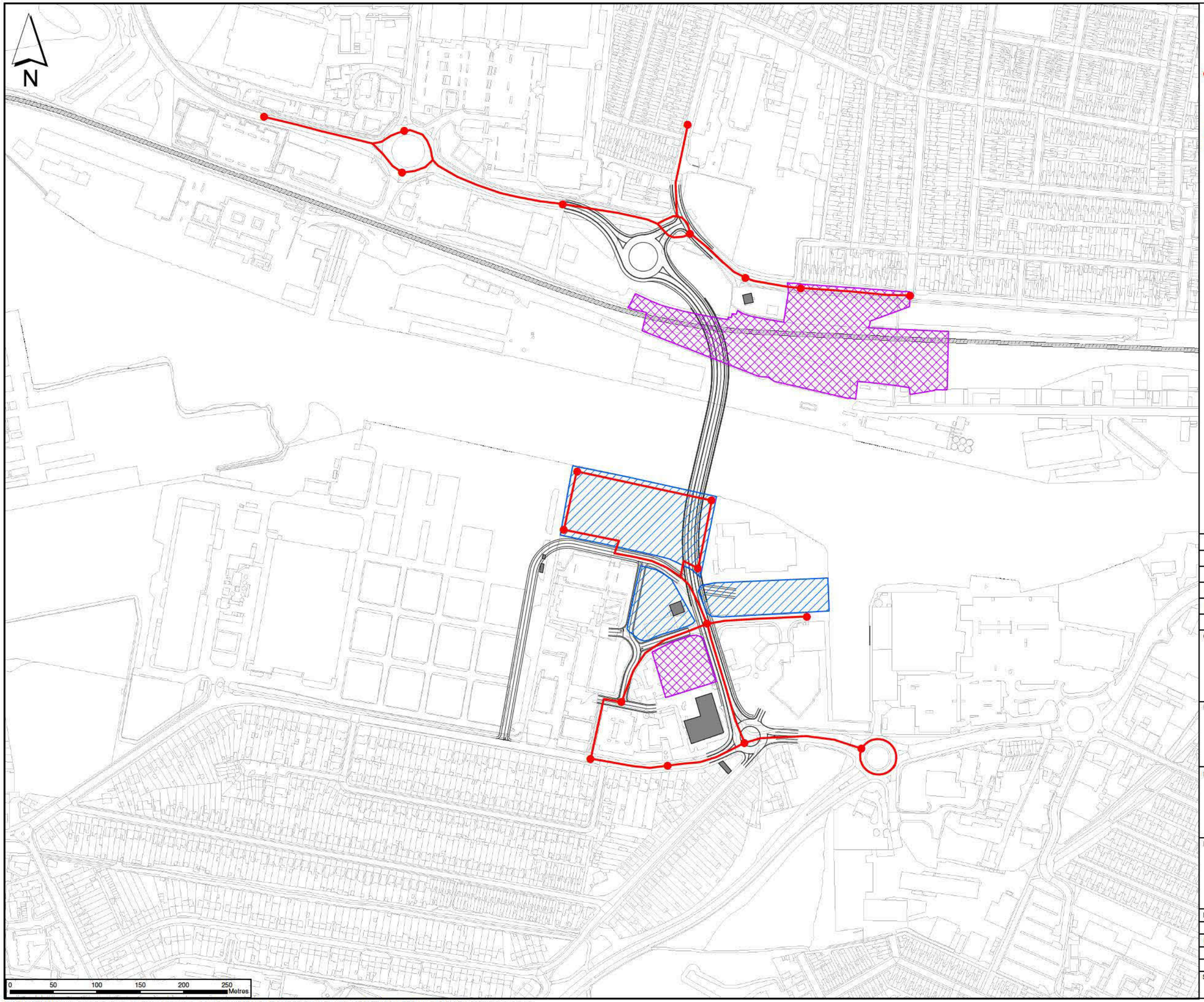

Legend

- The Proposed Scheme
- Bat Transect
- Bat Potential
- Reptiles 2016
- Reptiles 2017

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Northern Junction Layout Revised	IW / HR
P01	11/10/2016	First Issue	IW / HR

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DRAWING TITLE

Bat Potential, Bat Transect & Reptiles 2016/2017

Figure 9

DESIGN BY	IW	CHECKED BY	HR
DATE	11/10/2016	DATE	11/10/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	11/10/2016	DATE	11/10/2016

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SCALE - A3	DRAWING NO	REV
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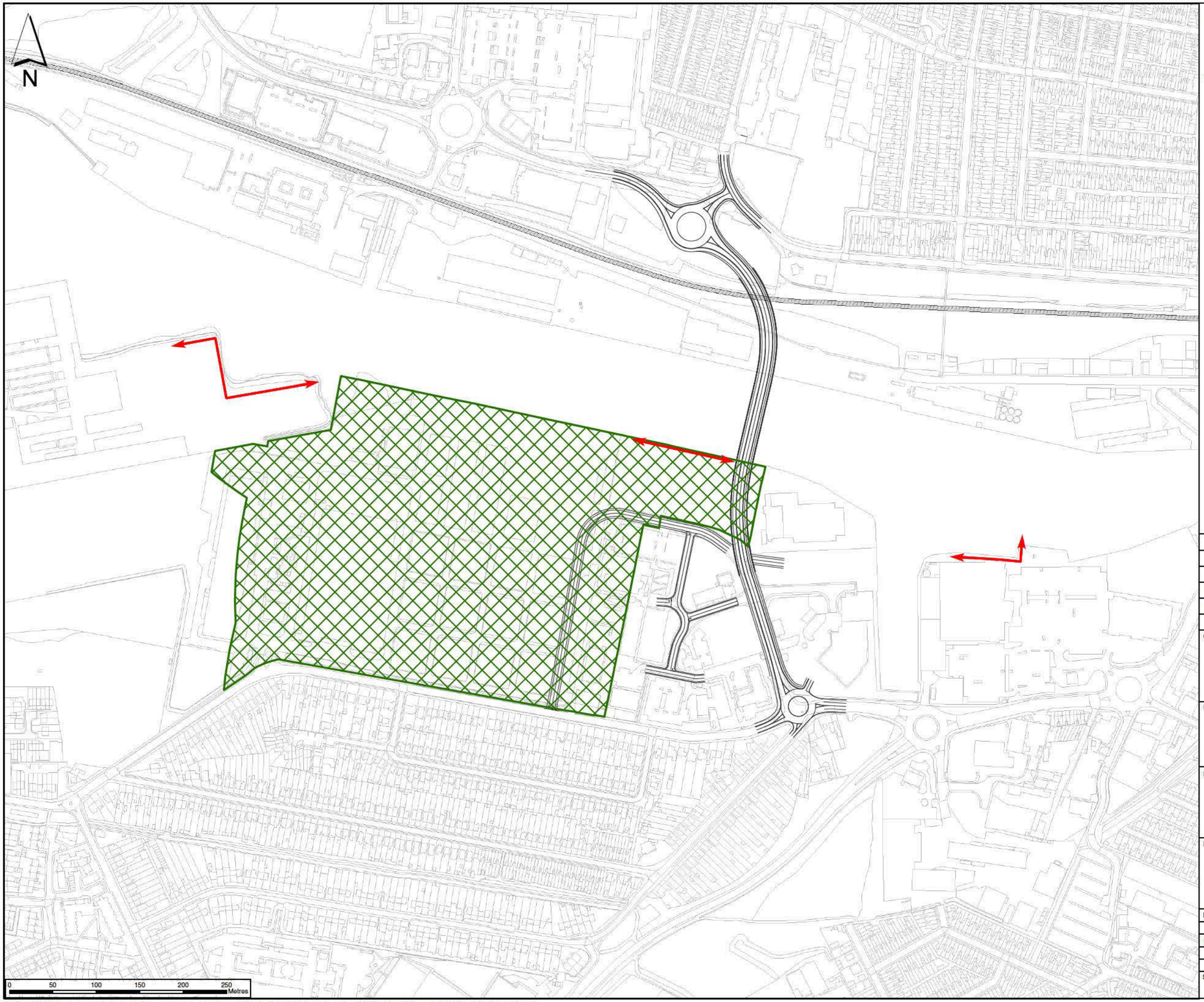

Legend

- Black Redstart
- Area of Wintering Bird Survey (Nov16-Mar 17)
- The Proposed Scheme

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Northern Junction Layout Revised	IW / HR
P01	11/10/2016	First Issue	IW / HR

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DRAWING TITLE

Birds Surveys

Figure 10

DESIGN BY	IW	CHECKED BY	HR
DATE	11/10/2016	DATE	11/10/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	11/10/2016	DATE	11/10/2016

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N

0 50 100 150 200 250 Metres

Legend

- Proposed Noise Monitoring Locations
- The Proposed Scheme

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Northern Junction Layout Revised & Two Monitoring Locations added	IW / HR
P01	30/11/2016	First Issue	IW / HR

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DRAWING TITLE

Proposed Noise Monitoring Locations Plan

Figure 11

DESIGN BY	IW	CHECKED BY	RB
DATE	30/11/2016	DATE	30/11/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	30/11/2016	DATE	30/11/2016

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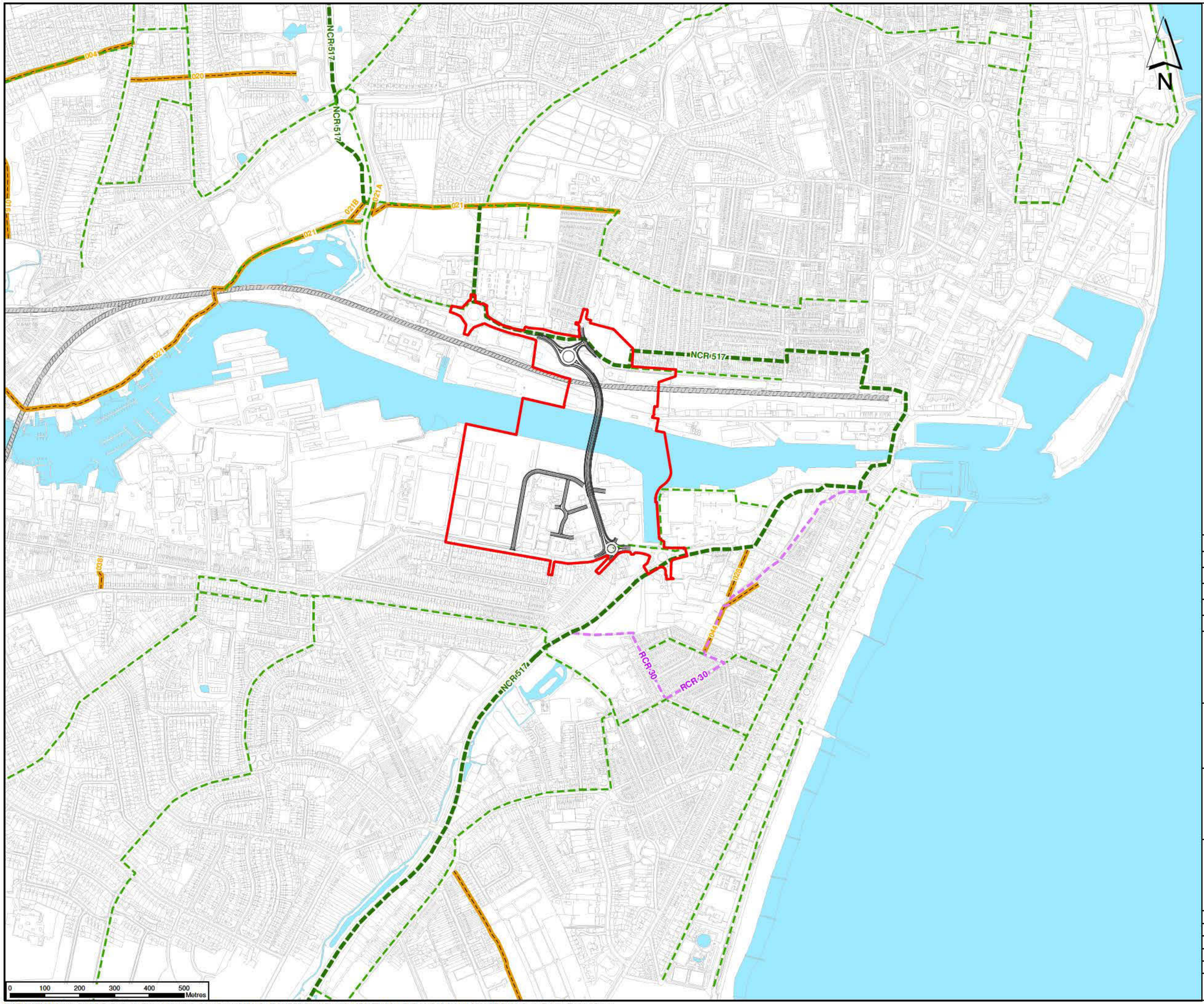

Legend

- Red Line Boundary
- The Proposed Scheme
- National Cycle Route (NCR)
- Regional Cycle Route (RCR)
- Cycle Route (Local)
- Public Rights of Way

REV	DATE	AMENDMENT	INITIALS
P02	09/02/2017	Northern Junction Layout & Red Line Boundary Revised	IW / HR
P01	02/12/2016	First Issue	IW / HR

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PROJECT

Lake Lothing THIRD CROSSING

DRAWING TITLE

Public Rights of Way and Cycle Routes

Figure 12

DESIGN BY	IW	CHECKED BY	HR
DATE	02/12/2016	DATE	02/12/2016
DRAWN BY	IW	APPROVED BY	HR
DATE	02/12/2016	DATE	02/12/2016

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SCALE - A3	DRAWING NO	REV
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Appendix A – Secretary of State Direction

Department for Transport

DIRECTION BY THE SECRETARY OF STATE UNDER SECTION 35 OF THE PLANNING ACT 2OO8 RELATING TO THE LAKE LOTHING THIRD CROSSING, LOWESTOFT.

By letter to the Secretary of State received on 24th February 2016, Suffolk County Council formally requested that the Secretary of State exercise the power vested in the Secretary of State under section 35 of the Planning Act 2008 ("the Act") to direct that the proposed scheme set out in the Suffolk County Council's letter and known as the Lake Lothing Third Crossing, as well as any associated matters, be treated as development for which development consent is required.

The Secretary of State is satisfied that:

- the development does not currently fall within the definition of a "nationally significant infrastructure project" and therefore it is appropriate to consider use of the power in section 35; and
- Suffolk County Council's request constitutes a "qualifying request" in accordance with section 35(10) of the Act.

The Secretary of State has made a decision within the primary deadline set out in section 35A(2) and wishes to convey that decision.

Having considered the details of the Lake Lothing Third Crossing set out in the request, the Secretary of State is of the view that this development by itself is nationally significant, for the reasons set out in the Annex below.

Accordingly, as the Secretary of State is satisfied that the proposed Lake Lothing Third Crossing is nationally significant, THE SECRETARY OF STATE DIRECTS that development, together with any matters associated with it, is to be treated as development for which development consent is required.

In addition, the Secretary of State further directs that any proposed application in relation to the Lake Lothing Third Crossing is to be treated as a proposed application for which development consent is required.

This direction is given without prejudice to the Secretary of State's consideration of any application for development consent which is made in relation to the Lake Lothing Third Crossing.

Signed by

Maureen Pullen
A Senior Civil Servant in the Department for Transport
For and On Behalf of the Secretary of State

22rd March 2016

ANNEX

REASONS FOR THE DECISION TO ISSUE THE DIRECTION

The Secretary of State is of the opinion that the Lake Lothing Third Crossing is of national significance for the following reasons:

- it provides a connection to/from Trans European Network–Transport (TEN-T) and the Strategic Road Network. The TEN-T link is to the A12/A47, one of only a limited number of routes in the East of England which is recognised as such; and
- would act as a tactical diversion route for the strategic road network, the A12/A47 when the Bascule Bridge, a nationally recognised pinch point, is closed thereby reducing delays and congestion on the SRN; and
- In addition, the scheme
    - supports national growth potential by directly delivering over 9000 jobs with a further 3,500 indirect jobs thus supporting the proposed employment growth; and
    - improves connection to/from the Great Yarmouth and Lowestoft Enterprise Zone; and
    - Delivers the Port of Lowestoft's role in being the hub for the off-shore wind farms that are part of the East Anglia Array, a major energy supplier for the UK.

Appendix B – Cultural Heritage Desk Based Assessment

Lake Lothing, Lowestoft: Third Crossing

Cultural Heritage Assessment

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Document Control Sheet

Project Title	Lake Lothing, Lowestoft: Third Crossing
Report Title	Cultural Heritage Assessment
Report ref no.	10699948/Heritage
Version	0.3
Status	Final
Report Date	15th December 2015

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
0.1	Draft	A Hancock	03/12/2015	M Roberts	03/12/2015		
0.2	Draft	A Hancock	10/12/2015	S Hales	10/12/2015		
0.3	Final	A Hancock	11/12/2015	S Hales	15/12/2015	S Hales	15/12/2015

Distribution

Date	Organisation	Contact	Format	Copies

Limitations

This report is presented to Suffolk County Council in respect of the options appraisal for the proposed Lake Lothing Third Crossing and may not be used or relied on by any other person. It may not be used by Suffolk County Council in relation to any other matters not covered specifically by the agreed scope of this Report.

Notwithstanding anything to the contrary contained in the report, Mouchel Consulting is obliged to exercise reasonable skill, care and diligence in the performance of the services required by Suffolk County Council and Mouchel Consulting shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This report has been prepared by Mouchel Consulting. No individual is personally liable in connection with the preparation of this report. By receiving this report and acting on it, the client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

Contents

1 Introduction

1.1 Project background

1.1.1 The third crossing of Lake Lothing ('the Proposed Scheme') comprises construction of a new road crossing at Lake Lothing, a large saltwater lake which opens into the North Sea. The lake measures c.180m at its widest point, and forms the inner harbour of the Port of Lowestoft. Three option alignments for the new crossing have been identified, they are described in Section 7 of this document and are referred to as options C11, W4 and T3.

1.1.2 The project is at early stages of development and detail of the design and construction methods of the proposed crossings is not currently available.

1.1.3 In recent years the area bordering Lake Lothing has suffered greatly from the decline of shipbuilding and other heavy industry, and it has been identified as a key area for regeneration. The Proposed Scheme would support this regeneration by improving access between the south and north of the town and by relieving congestion in, and around the town centre.

1.2 Site location

1.2.1 Lake Lothing separates the north and south of Lowestoft. The A12 forms a north-south route on the eastern (seaward) side, crossing Lake Lothing by means of a bascule bridge. Another north-south route is provided by the A146 and A1177, which crosses Lake Lothing to the west near Oulton Broad by means of a lifting bridge at Mutford Lock.

1.2.2 The two north-south routes are linked by the A1144 and Denmark Road (north of Lake Lothing) and a section of the A146 (south of Lake Lothing).

1.3 Topography and Geology

1.3.1 Lake Lothing is an artificial channel which connects the River Waveney to the North Sea; it is located at the base of a broad, shallow, east-west aligned valley.

1.3.2 The area of the Proposed Scheme lies broadly level at c.3.6m AOD. However, this height is largely artificial, resulting from reclamation and levelling which was completed in the 19th and 20th centuries to form dockside. The levelling deposits overlie deep deposits of Holocene alluvium, including remnants of peat, which was laid down over Pleistocene river sands and gravels.

1.3.3 The solid geology of the Lowestoft area is Jurassic Chalk. A thick deposit of Tertiary London Clay lies above the chalk, the clay is capped by Pliocene and Early Pleistocene sands of the Crag Group, which is capped in turn by a succession of glacigenic tills comprising the Happisburgh Formation (formerly Corton Formation) and the Lowestoft Formation. In the immediate environs of Lake Lothing the till is overlain by marine deposits, river sands and gravels, and peat of Holocene age.

2 Aims and Objectives

2.1 The principal aims and objectives of this report are to:

- Establish the historical and archaeological background of the study area as far as possible through desk based research;
- Map any previously unrecorded features and areas of archaeological potential which may be identified through desk based research or site walkover;
- Assess the archaeological significance of the site, where possible;
- Understand the impact of the proposed scheme upon heritage assets;
- Make recommendations for further archaeological mitigation, where necessary.

2.2 The cultural heritage assessment forms the first stage of an iterative process, which will consider cultural heritage alongside wider scheme issues during development of the Proposed Scheme design. As part of the detailed design process, further archaeological investigations may be required to assess the extent, character and significance of buried remains.

3 Legislative Context

3.1 National and Regional Planning Policy

3.1.1 The requirement for an assessment of heritage is outlined in Policy 128 of the National Planning Policy Framework (NPPF) which outlines the need to identify and assess all heritage assets, their significance and the impact the proposals may have upon them (where possible). The following national and regional legislation, policies, plans and guidelines have been taken into account as part of this study.

Ancient Monuments and Archaeological Areas Act, 1979

3.1.2 This legislation sets out guidance and policy for protecting nationally important monuments through scheduled status. Consent must be obtained from English Heritage for all works on Scheduled Ancient Monuments.

Planning (Listed Building and Conservation Areas) Act 1990

3.1.3 This Act makes provision for the protection and conservation of historic buildings and areas by way of a process of listing and designation. Identified buildings are classified as being Grade I, Grade II* or Grade II by English Heritage and historic areas are designated Conservation Areas by the Secretary of State upon recommendation from the local authority. Once listed, Listed Building consent must be obtained from the local planning authority before works to demolish, alter or extend a Listed Building can be carried out. Similarly, consent must be obtained for the demolition of buildings in a Conservation Area. New developments in a Conservation Area are also expected to adhere to strict design criteria to ensure the character of the area is maintained or enhanced. Developments within proximity of a Conservation Area should also reflect the character of the area.

National Planning Policy Framework (NPPF) 2012

3.1.4 Section 12 of the NPPF sets out policies relating to the conservation and enhancement of the historic environment. Policies include the requirement to assess heritage assets as part of development schemes and to record assets that cannot be conserved as part of the works. This includes both designated and undesignated assets.

Suffolk County Council Environment Policy

3.1.5 Suffolk County Council is committed to the sustainable management of the local and global environment to support Suffolk's communities and growth in the local economy. The Council will strive to achieve the ambition to create the greenest county by tackling the issue of a changing climate, reducing our carbon emissions, and protecting and enhancing the natural and historic environment. In delivering services, the Council is committed to meeting all relevant regulatory, legislative and other requirements, and to the continual improvement of environmental performance

3.2 Local Planning Policy

Waveney Local Development Framework

3.2.1 Waveney District Council adopted the Waveney Local Development Framework in 2009; the framework contains the following policies which address cultural heritage assets:

Core Strategy: Built and Historic Environment. Policy CS 17

3.2.2 The District Council will work with partners and the community to protect and enhance the built and historic environment in the District. Proposals for development are expected to conserve or enhance the character and setting of the following:

- Conservation Areas:- Lowestoft (North and South), Beccles, Bungay, Halesworth, Southwold, Southwold Harbour, Holton, Homersfield, Somerleyton, Wangford, Wissett, Wrentham, and Walberswick (part);
- Listed buildings and locally listed buildings;
- Scheduled ancient monuments;
- Sites of archaeological interest and their settings; and
- The local distinctiveness of existing non-designated built environments.

3.2.3 In particular, proposals in conservation areas will be assessed against the relevant Conservation Area Appraisals and Management Plans.

Lowestoft Lake Lothing and Outer Harbour Action Plan: Heritage Assets. Policy EHC2

3.2.4 New development will reflect, protect and enhance the historic character of Lowestoft as illustrated in Figure

3.2.5 Development within the Lowestoft North and South Conservation Areas will be required to be of high standards of urban design that is complementary to the heritage environment. The character and setting of listed buildings within the Area Action Plan (AAP) will be enhanced and protected by development.

3.2.6 Development proposals should seek to retain and re-use existing listed or locally listed buildings unless it can be demonstrated that demolition would produce substantial benefits for the community in accordance with policy guidance set out in Planning Policy Statement 5 (PPS5: since superseded by the National Planning Policy Framework, NPPF). A historic building appraisal conducted by an individual with appropriate expertise should inform development proposals which potentially affect the setting or appearance of heritage assets.

3.2.7 Proposals involving the demolition of non-listed buildings within the Conservation Areas will be considered if proposals will enhance the overall quality of the Conservation Areas and bring about positive socio-economic benefits.

3.2.8 The redevelopment of the Strategic Sites identified within the Action Plan will require archaeological desk-based assessment, trial trenching and palaeo-environmental assessment, in order to establish the full archaeological implications of any proposals prior to the determination of planning applications. The results of this work will enable the archaeological resource (both in quality and extent) to be accurately quantified.

3.3 Standards and Guidance

3.3.1 The archaeological assessment has been undertaken in accordance with the Standards and Guidance for Historic Environment Desk Based Assessments set by the Chartered Institute for Archaeologists (CIfA) (rev 2014).

3.3.2 The assessment has been undertaken using appropriate methods and practices to satisfy the stated aims of the project, which comply with the Code of Conduct, Code of Approved Practice for the Regulation of Contractual Arrangements in Field Archaeology, and other relevant by-laws of the CIfA.

4 Methodology

4.1 The desk-based study was undertaken to investigate, as far as is reasonable and practical, the nature and extent of any known or potential archaeological and historical assets within a study area encompassing a 500m buffer from the Proposed Scheme alignments. For designated assets, such as Listed Buildings, the study area was also 500m.

4.2 The following were consulted during preparation of this document:

- Historic England (Inspector of Historic Buildings and Areas);
- Suffolk County Council (Senior Archaeological Officer); and
- Waveney District Council (Design and Conservation Officer).

4.3 The assessment has been informed by a review of all available archaeological records; historical documentary evidence; cartographic evidence and photographic material. This has involved a consultation of the following sources:

- Suffolk Historic Environment Record (HER) – for all records relating to known heritage assets and secondary source material including archaeological reports;
- Suffolk Record Office – for all historic maps, and other documentary evidence; and
- Historic England Archive.

4.4 Ordnance Survey (OS) maps from the 1st edition to the present, and any additional relevant historic maps such as tithe and enclosure maps have been examined.

4.5 The solid and drift geology for the site has been identified based on that recorded by the British Geological Survey/Geological Survey of Great Britain Maps.

4.6 A site walkover was conducted, where access and health and safety allowed, to allow for a consideration of the study area, the possible identification of landscape and archaeological features and factors that may have had an impact on buried remains. The site walkover was undertaken on 20th November 2015. Photographs were taken using a digital camera.

4.7 A brief appraisal of designated built heritage assets present within the study area was also undertaken. This involved a visual inspection of the exterior of the buildings.

4.8 All features identified through the research have been located on a site plan in GIS (Figure 1, Appendix B). The site numbers shown on the plan correspond with the reference numbers allocated in the gazetteer (Appendix A).

4.9 An Online Access to Index of Archaeological Investigations (OASIS) project record will be composed following approval of the final report.

5 Historical and Archaeological Background

5.1 Introduction

5.1.1 The study area examines Heritage Assets recorded by the Suffolk Historic Environment Record (HER) within 500m of the Proposed Scheme alignments and designated assets recorded by the Historic England Archive (HEA) within a 500m radius of the Proposed Scheme alignments. A small number of designated and undesignated heritage assets outside the study area have been included in the following sections if they enable better understanding of the heritage context.

5.1.2 The heritage asset data is supplemented with information derived from the Lowestoft URC Area, Cultural Heritage Assessment (Scott Wilson, 2006), the South Lowestoft Conservation Area Character Appraisal (Waveney District Council 2007) and other readily available documentary sources.

5.1.3 A total of 55 heritage assets and 9 previous archaeological investigations have been identified within the study area. Numbers in bold within the report text refer to the heritage assets and events. The assets and events are tabulated in a gazetteer presented in Appendix A and shown on Figure 1 (Appendix B).

5.2 Designated Heritage Assets

5.2.1 There are no World Heritage Sites, Scheduled Monuments, Registered Battlefields or Registered Park and Gardens within the study area.

5.2.2 There is one Listed Building within the study area

- The Beeches: Grade II

5.2.3 One Conservation Areas area is located within the study area:

- Lowestoft South.

5.2.4 Two other Conservation Areas are located in relatively close proximity to the study area:

- Lowestoft North, c.600m northeast;
- Oulton Broad, c.850m west.

Both of the above conservation areas are screened from the Proposed Scheme by the existing built environment and topography and neither is considered in this report.

5.3 Historic Landscape Characterisation

5.3.1 Historic Landscape Characterisation (HLC) has been completed for Suffolk (Suffolk County Council, 2008 V3).

5.3.2 The broad character immediately adjacent to Lake Lothing is current industrial.

5.3.3 Areas of modern leisure and a small parcel of unimproved land are located at the west of the study area. The remaining character comprises the built up area of the post medieval and modern town.

5.4 History and Archaeology

5.4.1 Heritage assets within the study area are described in the context of a timeline of archaeological periods from prehistoric through to modern.

The time periods discussed can be broadly divided as follows:

- Prehistoric:
    - Palaeolithic c.800,000 – 10,000 BC
    - Mesolithic 10,000 – 4,000 BC
    - Neolithic 4,000 – 2,500 BC
    - Bronze Age 2,500 – 700 BC
    - Iron Age 800 BC – AD 43
- Roman AD 43 – 410
- Early Medieval AD 410 – 1066
- Medieval AD 1066 – 1540
- Post-Medieval AD 1540 – 1900
- Modern AD 1900 – present

Palaeolithic

5.4.2 The Palaeolithic era was a period of cold glaciations interspersed with warm interstadials and interglacials. The successive glaciations have removed all archaeological evidence of this period in many parts of Britain, but rare scatters of flint tools and isolated finds of the early part of the period (Lower Palaeolithic) have been discovered in East Anglia.

5.4.3 Investigations of the Cromer Forest Bed Formation (part of the Crag Group) at Pakefield, c.2.5km to the south of the centre of Lowestoft, recovered Lower Palaeolithic worked flints, associated palaeoenvironmental material and animal bone, dated to c.700,000 years BP (Parfitt et al.2005). Other significant sites in East Anglia include Hoxne (c.400,000BP; Stringer et al. 1993), High Lodge, Mildenhall (c. 500,000 years BP; Ashton et al. 1992) and c.800,000 BP human footprints discovered in 2013 at Happisburgh Beach, Norfolk.

5.4.4 One Lower Palaeolithic findspot is recorded in the study area; in the 19th century five early Palaeolithic flints, including one possible handaxe (**63**), were recovered from 'Cannon-shot' gravels at Normanston.

5.5.5 Britain was connected to the rest of Europe by a land bridge in the latter part of this period. Relatively few Upper Palaeolithic sites have been identified in Suffolk although Late Upper Palaeolithic artefacts dated to between c.8,800 and 8,300 BC have been found at Sproughton near Ipswich, (Wymer and Rose 1976)

5.4.6 There is no recorded Upper Palaeolithic evidence within the study area.

Mesolithic

5.4.7 Temperature increased after the end of the last glaciation and the environment gradually changed from tundra to temperate grassland, then open woodland and finally mixed deciduous oak forest. Mesolithic people had a hunting, gathering and fishing economy; their former presence is usually evidenced by scatters of flint tools. The remains of the ephemeral types of structure used by Mesolithic hunter-gatherers are very rarely discovered.

5.4.8 The Mesolithic landscape of the study area is poorly understood, but much of it may have been fen or marshland, an environment suitable for wildfowling and seasonal gathering of other resources. The study area was subject to two episodes of marine transgression during later periods and evidence of transient Mesolithic activity may have been preserved

within or under marine, alluvial and peat deposits, which lie at c.3m-15m below ground level.

5.4.9 However, the study area was subject to extensive medieval and post medieval peat cutting and this may have removed any Mesolithic evidence that was present in the vicinity of Lake Lothing. No evidence of this period is recorded within the study area.

Neolithic

5.4.10 The Neolithic saw the development of agriculture and a more sedentary society. Areas of woodland were cleared for growing crops, animals were domesticated, pottery began to be used, ceremonial and communal funerary monuments were constructed.

5.4.11 Evidence for human activity remains relatively sparse, often comprising scatters of flint tools, such as those found within the study area at Victoria Road, Lowestoft (**2**) and Heath Road, Oulton (**55**). Isolated pits are sometimes found, such as an example found at Walton Road, Lowestoft (**11**), and evidence of small scale burning and woodland clearance is sometimes identified during palaeoenvironmental studies.

5.4.12 The study area saw an episode of marine transgression during the latter part of this period and any early Neolithic evidence located at the lower lying areas will have been buried by marine, alluvial and peat deposits.

5.4.13 Neolithic activity during the marine transgression may have been limited to exploitation of marine and wetland resources at the majority of the study area, This activity may have involved the construction of wooden trackways, use of dugout canoes and fish traps, but medieval and post medieval peat cutting and recent land reclamation may have adversely affected the survival of remains of this period at the majority of the study area.

Bronze Age

5.4.14 The Bronze Age marks the beginning of metallurgy in Britain. Woodland clearance intensified while pastoral and arable farming became the mainstay of the economy. A hierarchical society developed and this is reflected in the construction of individual funerary monuments such as round barrows and cairns. Many lowland barrows have been ploughed out, but they remain the most visible monument of this period.

5.4.15 Bronze Age human activity is often represented by isolated worked flints or flint scatters, but none has been discovered in the study area. Settlement evidence remains relatively rare nationally, but undated cropmarks which may locate Bronze Age features have been identified at slightly higher ground within the study area to the north of Lake Lothing (**38**) and immediately to the south (**45**) of the study area. The southern area of cropmarks includes a possible ring ditch of a Bronze Age burial mound and Bronze Age worked flint has been recovered at this location.

5.4.16 A marine transgression continued to affect the study area during the earlier part of the Bronze Age and human activity at much of the study area was probably limited to exploitation of marine, estuarine and subsequent wetland resources.

5.4.17 A marine transgression during the late Iron Age and Roman periods may have buried and preserved any Bronze Age evidence located at lower lying parts of the study area, but extensive medieval and later peat cutting will have adversely affected its survival.

Iron Age

5.4.18 The study area lay within the tribal territory of the Iceni during the Iron Age. Prevalent monument types include small, sometimes enclosed farmsteads and large hillforts.

5.4.19 A few small towns or "Oppida" developed in the latter part of the period and East Anglian examples are present at Saham Toney, Thetford and Caistor St Edmund.

5.4.20 The majority of the study area probably remained as wet, marginal land until the end of this period when a second marine transgression began. The use of the majority of the study area was probably limited to exploitation of wetland, estuarine and marine resources.

5.4.21 Archaeological remains of the period could be preserved under and within marine and alluvial deposits, but extensive medieval and post medieval peat cutting will have adversely impacted their survival.

5.4.22 No Iron Age features or find spots are recorded at the study area.

Roman

5.4.23 The Romano-British era began with the invasion of the south east of Britain in AD 43. The following four centuries saw the establishment of roads, forts, villa estates, and towns, all supporting a central administration which cemented the Roman occupation of Britain.

5.4.24 A marine transgression affected the study area throughout this period and activity at the majority of the study area may have been limited to exploitation of marine and estuarine resources with some use of marginal drier land at the north and south.

5.4.25 The River Waveney is known to have been used as a communication and trade route, but it is unclear whether the river could be reached from the study area during this period. A possible Roman road from Colchester to Burgh Castle is said to have passed through Lowestoft and archaeological remains tentatively interpreted as part of this road, or an associated bridge, were found during 19th century excavation of peat in the vicinity of the current Bascule Bridge. The evidence comprised several large tree trunks, 10-12 feet in length, laid out parallel and approximately two feet apart.

5.4.26 Five find spots of coins (**1**, **3**, **4**, **53**, **64**) are recorded within or very close to the study area. A coin hoard, a possible cremation urn and the skeletons of a number of horses was found during the 19th century c.200m north east of the study area, at a part of Lowestoft now known as "Roman Hill".

Early Medieval

5.4.27 The Early Medieval period began as the Romans left Britain in AD 410. The early part of the period is often difficult to detect as the prevailing Anglo Saxon settlement pattern was dispersed, short-lived and unenclosed farmsteads, which often focussed on river valleys.

5.4.28 The middle part of the period saw the establishment of longer lived settlements and the latter part saw the establishment of many historic English villages. The majority of the villages surrounding the study area, including Lowestoft and Kirkley, are recorded in the Domesday survey of 1086 (Williams and Martin 2003) and will have been founded by the latter part of this period.

5.4.29 The early focus of Lowestoft is thought to have been located some distance away from the present town centre, perhaps c.900m north of the study area in the vicinity of St Margaret's church. Limited agricultural activity may have been carried out at the north and south of the study area but it is probable that the majority will have remained as marginal land exploited for estuarine and wetland resources

5.4.30 No archaeological evidence of this period is recorded in the study area.

Medieval

5.4.31 Until the latter part of this period the core of Lowestoft may have retained its focus around St Margaret's church, approximately 900m north of the study area. The Domesday Survey of 1086 records rent for land being paid in herrings, which suggests that fishing already formed a significant part of the village economy.

5.4.32 Lowestoft was granted markets in 1308 and 1445 and by the end of the medieval period Lowestoft was a significant fishing port and the most important settlement in the area. The core of the town had moved east by this time to the area of the modern High Street. The southern edge of the medieval town (**5**) was located c.700m to the northeast of the study area.

5.4.33 Lake Lothing is a remnant of a turbary (**13**) - an extensive area of medieval peat cuttings. The speed of the peat cutting and the development of Lake Lothing is currently uncertain, but the eastern end of Lake Lothing including Kirkley Ham inlet was open to the sea by the 14th century (Oppenheim 1907). The northern side of this end of Lake Lothing was known as the Inner Harbour by this time and ships were being constructed on the southern side to the east of Kirkley Ham inlet.

5.4.34 Kirkley Ham inlet and its immediate environs may have been the most important harbour at this part of the coast for a brief part of the 14th century, but the inlet began to silt during the 15th century and by the end of the medieval period the importance of the port at Kirkley had been superseded by that of Lowestoft (Morely 1928).

5.4.35 Archaeological investigations at land located in the vicinity of Kirkley Ham inlet (**12, 15, 16, 57, 59**) have not revealed evidence of medieval activity in the study area and medieval evidence has not been discovered elsewhere.

Post-Medieval

5.4.36 In the post medieval period the port and town of Lowestoft continued to expand and in 1679 the town was granted Port Status, with certain specified rights of export and import. By the beginning of the 18th century up to 25% of men were involved in the fishing industry. The main catch of the fishing fleet comprised herring.

5.4.37 At the end of the 18th century Lowestoft was a moderately sized market town and fishing port with a population of about 2,300. Lowestoft had doubled in size by 1841 and by 1871 the population was over 13,000.

5.4.38 The focus of the port moved to the seaward beaches from 1712 when the mouth of Lake Lothing was closed to the sea by drifting sand. Occasional flood tides broke through the sand bar until 1717, but the lake then remained separated from the sea until harbour works including construction of a customs office known as The Port House (**60**) were completed in 1832.

5.4.39 The government forced the sale of the harbour in 1842 after the harbour works proved ineffective and a loan could not be repaid. The harbour was eventually sold to Sir Samuel Morton Peto in 1844 after which further harbour works were carried out. Mooring for 1000 boats was provided at the outer harbour and permanent access to the Inner Harbour at Lake Lothing was established.

5.4.40 In the latter half of the 19th century Sir Samuel Morton Peto played a leading role in the expansion of the town. He opened a rail link between Lowestoft and Norwich in 1847, with the station located just to the north of the Bascule Bridge. He subsequently built several other railways linking Norwich and Lowestoft to Ipswich and is credited with establishing

Lowestoft as a holiday resort. The investment in the town stimulated the expansion of the town to the south of Lake Lothing and the construction of many grand Victorian buildings including the Grade II* listed Royal Norfolk and Suffolk Yacht Club (**61**).

5.4.41 The study area contained dispersed farms and remained agricultural land until the latter part of the 19th century when the expanding town, port, industry and infrastructure of Lowestoft began to encroach. A manorial survey of 1618 (Butcher 1997) illustrates that the majority of the arable, meadow and heathland had been enclosed by the early 17th century.

5.4.42 A great house surrounded by parkland (**54**) was built at Normanston during this period. It is first shown on 18th century mapping and is named "Normanston Court" on 19th century Ordnance Survey maps. The house and surrounding parkland appear to have remained intact during the first half of the 20th century, but the area of its grounds fronting Normanston Drive began to be developed after the Second World War and the parkland was put to recreational use. The great house may have survived until the late 1960s or early 1970s when it was demolished to make way for housing development.

Modern

5.4.42 Lowestoft continued to see success and expansion into the early part of the 20th century with the fishing fleet, boat building and associated trades being the mainstay of its economy. By 1911 the population had reached 37,886, which reflects the peak in production for the British fishing industry.

5.4.43 Three bulwarks equipped with batteries of cannon had been constructed along the coastline to defend Lowestoft in the early 16th century, but it was 20th century which saw the zenith of military activity at the town.

5.4.44 The First World War saw some of the more capable local boats requisitioned by the Admiralty for patrolling and minesweeping. The town was bombed on a number of occasions, and on 25th April 1916, the German High Sea Fleet shelled the town and harbour leaving forty houses destroyed, two hundred damaged and four people killed.

5.4.45 During the inter war period the fishing industry and the town suffered a decline, but the start of the Second World War saw the town transformed into an important naval base with an all-round defensive perimeter of trenches, pillboxes and dense belts of barbed wire (e.g. **6-10, 18-37, 48**). None of the defences now survive but many of their locations have been recorded by the HER and the Defence of Britain project.

5.4.46 Lowestoft was extensively bombed during the Second World War and much redevelopment was necessary during the post war period.

5.4.47 During the latter part of the 20th century the port remained a focus of shipbuilding and developed as a focal point for operations of the oil and gas industries in the southern North Sea.

6 Archaeological Potential

6.1 Palaeoenvironmental

6.1.1 Very little palaeoenvironmental work has been undertaken within the study area, but limited evidence (GgMS 2013) suggests that peat deposits may survive at either side of Lake Lothing.

6.1.2 Any surviving areas of peat may have been truncated by medieval peat cutting and where preserved it will be located beneath levelling and alluvial deposits at depths of between 3m and 15m below ground level. The peat is likely to preserve evidence of the environment, and could preserve archaeological remains, of the later prehistoric periods.

6.2 Palaeolithic

6.2.1 There is limited evidence of Palaeolithic activity within the study area. However, well preserved evidence of the period (c.700,000 BP) has been discovered at Pakefield c.2.5km to the south within the Cromer Forest Bed Formation. This formation is likely to be present beneath the study area, but will be deeply buried beneath alluvial, marine and glacial deposits.

6.2.2 The proposed development could impact Palaeolithic archaeological remains at spatially constrained areas where deep excavations would be necessary, e.g. where bridge piers would be constructed, but this is unclear with the current level of geological information. The potential for the presence of archaeological remains of this period is **uncertain**.

6.3 Mesolithic to Iron Age

6.3.1 The only definitive evidence for the Mesolithic, Neolithic, Bronze Age or Iron Age periods within the study area are two find spots of Neolithic worked flint and one Neolithic pit. However, activity associated with the exploitation of marine, estuarine and marginal drier environments is likely to have occurred within the study area during all of these periods.

6.3.2 Any evidence may have been destroyed by subsequent extensive medieval peat cutting, or by recent construction of quay sides, industrial buildings and infrastructure. The potential for the presence of archaeological remains of the prehistoric periods is **low**.

6.4 Roman

6.4.1 Roman settlement activity is evident in the wider area and it has been suggested that a Roman Road crossed the eastern end of Lake Lothing in the vicinity of the current Bascule bridge. The River Waveney is known to have been used as a communication and trade route, but it is uncertain if the river could be reached from the vicinity of Lowestoft. Three find spots of Roman coins are recorded within the study area, but other types of evidence have not been identified.

6.4.2 The area was subject to a marine incursion during this period and activity in the vicinity of the alignment options may have been limited to exploitation of marine, estuarine and marginal drier environments. Any such evidence may have been destroyed by medieval peat cutting; recent construction of quay sides, industrial buildings and infrastructure. The potential for the presence of archaeological remains of the Roman period is **low**.

6.5 Early Medieval

6.5.1 Archaeological remains of this period have not been identified within the study area, but the villages of Lowestoft and Kirkley are mentioned in the Domesday Book and evidence

associated with exploitation of marine, estuarine and marginal drier environments could survive at the proposed crossing alignments.

6.5.2 However, any such evidence may have been destroyed by medieval peat cutting, by construction of quay sides, modern industrial buildings and infrastructure. The potential for the presence of archaeological remains of the early medieval period is **low**.

6.6 Medieval

6.6.1 The evidence for this period is limited. The eastern end of Lake Lothing was in use as a harbour by the end of the period, in particular the area near Kirkley Ham may have been the focus of a port and settlement during the 14th century. The majority of the study area was agricultural land and the central part of the study area was subject to extensive peat cutting. The lower lying land is also likely to have been exploited for freshwater fish, shellfish, wildfowl, reeds and pasture / water meadow.

6.6.2 The construction of quay sides, modern industrial buildings, infrastructure and housing will have adversely impacted archaeological remains of this period, and the potential for the survival of medieval remains in the vicinity of the proposed crossing alignments is **low**.

6.7 Post-medieval

6.7.1 The town and port of Lowestoft saw significant growth during the 19th century and the conurbation eventually expanded to the south of Lake Lothing. The eastern end of the lake was used as a harbour, with boat and ship building yards, fish processing, ancillary and manufacturing industries located along each side.

6.7.2 The majority of the study area remained agricultural land, although the great house, “Normanston Court” was built c.250m to the north west of the area where alignments W4 and T3 tie in to Peto Way. The historic parkland and agricultural character of the study area suggests that the potential for the presence of post medieval remains is **low**.

6.8 Modern

6.8.1 Interest in this period relates mainly to the Second World War when Lowestoft was transformed into a naval base with a surrounding defensive perimeter. The above ground evidence for the defences has been removed, but truncated subsurface remnants may survive. The proposed alignments avoid the majority of recorded defences and the potential for the discovery of Second World War archaeological remains is **moderate**.

7 Site Visit

7.1 Introduction

The following is a description of the areas of the alignment options as determined from a site walkover.

7.2 Option C11

7.3.1 The option ties into an existing roundabout on Waveney Drive then extends northward to cross modern commercial and industrial development located to the south of Lake Lothing. At the northern side of the lake it traverses dockside, a railway line and a modern commercial area before tying in to a new roundabout at Denmark Road. Short sections of new road are proposed within the modern development to the south of the lake and upgrades to existing sections of road would also occur.

7.3.2 The area of this option is predominantly industrial, transport and commercial in character (Plate 1, Appendix C) although limited residential buildings are located to the north and south.

7.4 Option W4

7.4.1 The option ties into the existing road network to the south of Lake Lothing at Waveney Drive. From here it traverses land located between a large industrial development and a playing field, then crosses an area of undeveloped reclaimed ground (Plate 2, Appendix C) situated at the southern side of Lake Lothing.

7.4.2 To the north of Lake Lothing it crosses an area of dockside containing late 20th century office and industrial buildings (Plate 3, Appendix C), the railway line, and then enters an area of undeveloped land located at the side of an artificial lake known as Leathes' Ham before tying in to Peto Way at a new roundabout located partly on Normanston Park Sports Ground (Plate 4, Appendix C: formerly parkland of Normanston Court).

7.5 Option T3

7.5.1 The option has a very similar alignment to W4. It ties into the existing road network to the south of Lake Lothing at Waveney Drive. From here it traverses land located between a large industrial development and a playing field, then crosses an area of undeveloped reclaimed ground at the southern side of Lake Lothing.

7.5.2 To the north of Lake Lothing it crosses an area of dockside containing late 20th century office and industrial buildings, the railway line, and then enters an area of undeveloped land before crossing the north east side of an artificial lake known as Leathes' Ham, and subsequently tying in to Peto Way at a new roundabout located on Normanston Park Sports Ground (formerly parkland of Normanston Court)..

8 Cartographic Evidence

8.1 Early Mapping

Early mapping of the Lowestoft area such as Hodskinson's Map of 1783 and Robert Barnes Map of 1830 (Figure 2, Appendix B) show the focus of the town located to the north of the study area and provide some detail of the road layout and villages surrounding Lowestoft. With the exception of the presence of the great house and parkland at Normanston Court, little detail is illustrated at the study area, which suggests that it was undeveloped agricultural, common or marginal land. The Lowestoft (1841), Carlton Colville (1842) and Kirkley Ham (1841) tithe maps show much of the study area as enclosed agricultural fields bisected by two railway lines.

8.2 1885 Ordnance Survey map

The town expanded slightly to the west and to the south across Lake Lothing during the early - mid 19th century. However the study area remained mostly agricultural land; the central option (C11) is situated at an area of enclosed fields located slightly to the west of industrial development at the edge of the town. The eastern options (W4 and T3) are located in the agricultural hinterland of the town except at the north where they are located in the parkland of "Normanston Court" (Figure 3, Appendix B).

8.3 1886 - 1960 Ordnance Survey maps

An additional railway line was constructed to the west of Lowestoft during the late 19th century. The northern part of Lowestoft remained little changed, but Normanston, Mutford Lock and the southern half of the town saw housing and industrial development during the first half of the 20th century (Figure 4, Appendix B). The area of the alignment options remained mostly agricultural land.

8.4 1961 - Modern Ordnance Survey maps

The 1960s mapping (Figure 5, Appendix B) shows that the area between Lowestoft and Normanston had almost completely infilled with housing. Industrial development had also expanded along the southern side of Lake Lothing. "Normanston Court" had been demolished and Lowestoft had reached its modern size by the mid-1970s although limited infill development and regeneration has subsequently occurred.

9 Built Heritage

9.1 Introduction

The following sections use Historic England list entry information, observations made during the site visit, and the South Lowestoft Conservation Area character appraisal (Waveney District Council 2007) to summarise the built heritage situated in proximity to the alignment options and to enable assessment of setting.

9.2 South Lowestoft Conservation Area

The south east of the study area includes a part of the South Lowestoft Conservation Area which encompasses the part of the town which was constructed during its 19th century expansion. The area developed following the establishment of a harbour and river access through Lake Lothing in the early 19th century and grew into a pleasure resort from the mid-19th century onwards. The buildings of the conservation area comprise commercial premises which are focussed at the north around Lake Lothing, large townhouses and villas to the south along the seafront, with areas of lower status terraced housing to the west. The area has a largely linear street plan, laid out parallel to the shore.

9.3 Listed Buildings

9.3.1 There is one Listed Building within the study area:

- The Beeches: Grade II (Plate 5, Appendix C)

It is screened from the alignment options by the existing built environment.

9.3.2 The setting of two other listed buildings would be affected by alignment option C11 and these are:

- The Royal Norfolk and Suffolk Yacht Club: Grade II* (Plate 6, Appendix C); and
- The Port House: Grade II (Plate 7, Appendix C).

9.3.3 The Royal Norfolk and Suffolk Yacht Club was built in 1903 by G & F Skipper, influenced by the arts and crafts style, with rendered and asymmetrical elevations, establishing a high level of architectural quality to the open space (Royal Plain) to its south. The views of the option alignments from the Yacht Club would be limited by the three storey Pier Terrace located slightly to its west, but it is probable that alignment C11 would be clearly visible from its upper floors.

9.3.3 The Port House was constructed in 1831 as the port customs house. Built in gault brick, with slate roofs. It comprises a long south facing two storey range containing sash windows, with a central transept.

9.4 Undesignated Buildings

9.4.1 The setting of a small number of historic buildings of local interest located on the northern side of Lake Lothing would be affected by alignment option C11:

- 3 – 11 Station Square (Plate 8, Appendix C);
- Terraced Houses fronting the north side of Commercial Road from its junction with Station Square (Plate 9, Appendix C);
- A two storey brick built 20th century industrial building located on the north side of Commercial Road (Plate 10, Appendix C); and

- A one storey brick built 20th century industrial building and an iron railway footbridge located on the north side of Commercial Road at the entrance to Associated British Ports land (Plate 11, Appendix C).

9.4.2 The setting of one historic building of local interest located south of the bascule bridge and to the west of the Royal Norfolk and Suffolk Yacht Club would be affected by alignment option C11:

- Pier Terrace (Plate 12, Appendix C).

10 Statement of Significance

10.1 Palaeoenvironmental

There has been limited work on palaeoenvironmental deposits in the study area, which has suggested that there is potential for encountering palaeoenvironmental deposits beneath or within estuarine, marine sands, alluvial or reclamation deposits. The ability to determine the formation processes, sequence and date of such deposits would be of **local** or **regional** importance. Palaeoenvironmental deposits associated with occupation sites would be of particular significance.

10.2 Early Prehistoric

The geology of East Anglia favours the presence and survival of in situ early prehistoric archaeology. Any deposits associated with the Palaeolithic period could be of national or international significance.

10.3 Later Prehistoric

There is limited evidence for the prehistoric periods in the study area. However, peat, marine and alluvial sediments may cover well preserved prehistoric sites. The remains of wooden trackways, platforms, and inter-tidal sites and features, such as boats, fish-traps and salterns could be present. Sites or finds of this nature are likely to be of regional significance.

10.4 Roman

Limited evidence for Roman activity has been discovered within the study area. The discovery of settlement evidence of this period would be of **local** or **regional** significance. The River Waveney was used for river transport in the Roman period and it is possible that evidence for Roman river and sea trade, or military naval activity may be located within the study area. The discovery of such remains would be of **regional** or **national** significance.

10.5 Early Medieval

Lowestoft is mentioned in the Domesday Book but there is no archaeological evidence of this period within the study area. Discovery of remains of this period would be of **local** or **regional** significance.

10.6 Medieval

Evidence related to medieval port activity would be of **regional** or **national** significance, and answer key questions within the regional research agenda regarding the chronological development of the medieval ports of Lowestoft and Kirkley Ham. Recovery of significant assemblages of pottery would contribute to the development of a regional pottery typology (Brown and Glazebrook 2000, 27-29).

10.6 Post-medieval

Evidence related to river and sea transport, the port and railways and discovery of industrial archaeological deposits within the study area would be of **local** or **regional** significance. Archaeological evidence for the chronological development and expansion of the town and agrarian practice would be of **local** significance.

10.7 Modern

Evidence relating to defences of the two World Wars would be of **regional** significance according to the regional research agenda (Brown and Glazebrook 2000, 34).

11 Statement of Impact

11.1 Introduction

The assessment has identified a number of heritage assets close to the alignment options including scattered Neolithic and Roman find spots, commercial and industrial buildings of the late post medieval period and demolished defensive structures of Second World War date. The examination of impact in the following sections is based on the known cultural heritage of the study area.

11.2 Early Prehistoric

There is remote potential for the presence of Lower Palaeolithic evidence. The evidence would be deeply buried and the majority of groundwork during construction of the Proposed Scheme would have no impact on remains of this period. However, areas of deep excavation into or through the Cromer Forest Bed Formation, which may lie above the London Clay, could have a major adverse impact on remains of this period.

11.3 Later Prehistoric

The later prehistoric periods are poorly represented at the study area with only two find spots of Neolithic worked flint and discovery of one Neolithic pit recorded. Remnants of peat containing palaeoenvironmental evidence and archaeological remains of the periods may be present, but is likely to have been removed or have been heavily truncated across much of the area during the medieval period. The limited later prehistoric evidence suggests that the options are unlikely to cause significant adverse impact to sub-surface heritage assets of this period.

11.4 Roman

Known evidence is restricted to a few find spots of coins, which suggests that the options are unlikely to cause significant adverse impact to sub-surface heritage assets of this period.

11.5 Early Medieval

There is no evidence for the early medieval period in the study area. The options are unlikely to cause significant adverse impact to sub-surface heritage assets of this period.

11.6 Medieval

There is no securely dated evidence of this period in the study area and the options are unlikely to cause significant adverse impact to sub-surface heritage assets of this period.

11.7 Post-medieval

Little post medieval evidence has been discovered in the study area and the options are unlikely to cause significant adverse impact to heritage assets of this period.

11.8 Modern

Significant evidence of the modern period would be restricted to the structural remains of Second World War defences and naval bases. The majority of the defensive positions and structures were demolished during the second half of the twentieth century. Any truncated remnants of these features would probably be relatively shallow and groundwork which encountered such remains would have a major adverse impact.

11.9 Built Heritage

Option C11 would impact the setting of The Royal Norfolk and Suffolk Yacht Club (Grade II*), The Port House (Grade II) and a small number of historic buildings of local interest

focussed along Commercial Road and around the bascule bridge. A moderate adverse impact would occur to the setting of the Port House and minor adverse impact to the setting of the Yacht Club. The impact on the setting of some buildings of local interest would be minor adverse although slight beneficial impact could occur where traffic would be diverted away from the eastern end of Commercial Road and the current bascule bridge.

12 Recommendations

12.1 A geoarchaeological deposit model should be compiled to determine the presence or absence and depth of any surviving Cromer Forest Bed Formation deposits, and of peat, marine and alluvial sediments at the option alignments. The results of the deposit modelling should inform the selection of a preferred option

12.2 The impact of the options on the setting of designated and undesignated built heritage should be considered during the option selection and design process.

12.3 Mitigation of the impact of the proposed development would be required in advance of and during construction of a selected option. The scope of the mitigation should be informed by the geoarchaeological deposit model and consideration of the impact on setting and significance of designated and undesignated built heritage.

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Appendix A - Gazetteer of Cultural Heritage Assets

The following table lists the sites and monuments listed in the Suffolk Historic Environment Record and the National Monuments Record as identified through historical references, archaeological investigation, cartographic evidence and aerial photographs. The gazetteer includes all designated and undesignated sites within 500m buffer around the proposed alignments.

* Primary Record Number (PRN) – Suffolk Historic Environment Record

** NMR Reference – National Monuments Record Reference

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
1.	Roman Coin. The Fairfield. Roman Hill	LWT007		TM 5415 9335	Findspot		Third brass of Constantine I (AD307-337)	Low
2.	Neolithic flint. Victoria Road.	LWT016		TM 5285 9225	Findspot		Scatter of small flakes, scrapers and flake from chipped axe	Low
3.	Roman Coins. 108 Bevan Street.	LWT024		TM 5475 9305	Findspot		Four Roman Coins	Low
4.	Roman Coins. Roman Road	LWT027		TM 5450 9327	Findspot		Roman coins found 1877	Low
5.	Lowestoft Medieval Town Core	LWT040		TM 5515 9375	Settlement		Area of archaeological importance defining area of medieval and post medieval town core	High
6.	WWII Anti tank Defences	LWT045		TM 5214 94	Military		The site of an extensive World War Two anti-tank defensive system, consisting of anti-tank	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							cubes, barbed wire obstructions and scaffolding, is visible on aerial photographs surrounding the northern perimeter of Lowestoft, from the Lowestoft Denes to Lake Lothing and Oulton Broad. Now demolished.	
7.	Three WWII road blocks	LWT103		TM 5447 9294	Military		Three World War II road blocks to the north of Lowestoft Docks	Low
8.	WWII road block	LWT104		TM 5400 9296	Military		A road block of World War II date is visible in Hervey Street, Lowestoft on aerial photographs from 1944 (S1). The roadblock is visible as 2 rows of 'dots' which represent the caps covering holes/slots into which posts were slotted to block	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
9.	WWII air raid shelter	LWT105		TM 5403 9293	Civil Defence		Air raid shelter of World War II date, south of Denmark Road, near Lowestoft Docks	Low
10.	WWII air raid shelter	LWT106		TM 5440 9290	Civil Defence		Air raid shelters of World War II date,located south of Denmark Road, close to Lowestoft Docks	Low
11.	Walton Road Neolithic pit	LWT137		TM 5451 9321	Ritual / domestic		Neolithic pit revealed in evaluation in 2002	Low
12.	Former Crown Works shipbuilding and engineering site	LWT151		TM 5424 9254	Event		Photographic survey of extant structures undertaken of the former Crown Works shipbuilding and engineering site in Lowestoft, followed by monitoring, no significant archaeological remains	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							were revealed.	
13.	Lake Lothing	LWT154		TM 5272 9296	Turbary		Lake Lothing, possible remnant of Medieval turbary.	Low
14.	Barnard's Meadow eval	LWT166		TM 5344 9329	Event		Negative evaluation trenching	Low
15.	Land off Clifton Road, Lowestoft; St Matthews Church	LWT176		TM 5436 9216	Event		Site of windmill, buildings and large Mission church (St Matthew's). Evaluation revealed three early modern ditches, one undated ditch associated with site drainage, area of desiccated peat and several large modern pits.	Low
16.	Horn Hill, Lowestoft/Kirkley Drive	LWT180		TM 5429 9238	Event		Negative evaluation trenching	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
17.	St Mary's Water treatment works evaluation	LWT190		TM 5384 9249	Event		Negative evaluation trenching	Low
18.	Site of WWII barrage balloon, air raid shelters and a possible operational building	LWT210		TM 5445 9303	Military		The site of World War Two barrage balloon, earthen-covered air raid shelters and a possible operational building are visible on aerial photographs.	Low
19.	Site of WWII emergency water tank and air raid shelter	LWT211		TM 5414 9297	Military		The site of World War Two emergency water tank and an earthen-covered air raid shelter are visible on aerial photographs.	Low
20.	WWII emergency water tank and road blocks	LWT214		TM 5397 9325	Military		The site of World War Two emergency water tank and road block	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
21.	WWII military buildings and shelters	LWT220		TM 5422 9336	Military		The site of a group of World War Two military buildings, possibly largely accommodation, but potentially also operational buildings are visible on aerial photographs. Large numbers of entrances to sub-surface air raid shelters are also visible.	Low
22.	WWII barrage balloon site	LWT230		TM 5396 9266	Military		The site of World War Two barrage balloon mooring and associated structures is visible on aerial photographs.	Low
23.	WWII barrage balloon site and public air raid shelters	LWT231		TM 5342 9206	Military		The site of a World War Two barrage balloon mooring and public air raid shelters in the grounds of Kirkley High School is visible on	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							aerial photographs	
24.	WWII emergency water tank	LWT232		TM 5336 9222	Civil Defence		The site of a World War Two emergency water tank is visible on aerial photographs	Low
25.	WWII civil defence	LWT233		TM 5309 9231	Civil Defence		The site of a possible World War Two ARP warden's post	Low
26.	WWII pillbox	LWT234		TM 5350 9270	Military		The site of a World War Two a type 22 MSX27408 pillbox is visible on aerial photographs.	Low
27.	WWII defended fuel store	LWT235		TM 5361 9255	Military		The site of a probable fuel storage tank, surrounded by World War Two structures and barbed wire defences, is visible on aerial photographs from 1944-45. Earlier wartime	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							photography indicates that a pillbox and/or gun emplacement stood on this site and a number of slit trenches were visible within this area.	
28.	WWII pillbox	LWT236		TM 5289 9301	Military		The site of a World War Two a type 22 pillbox is visible on aerial photographs.	Low
29.	WWII pillbox and slit trench	LWT237		TM 5308 9284	Military		The site of a World War Two a type 22 pillbox and slit trench is visible on aerial photographs	Low
30.	WWII gun battery	LWT245		TM 5272 9326	Military		The site of World War Two gun battery is visible on aerial photographs camouflaged within a quarry. The rear two gun houses are disguised as huts in 1945. The site	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							consists of four angular 'lozenge' shaped gun emplacements that may have contained field guns. Alongside the battery is large range of buildings, which appear to be largely pre-World War Two in date, with some military structures in amongst them, suggesting that the site is being used for wartime purposes. A raised platform of land, in front of the main building range, has either a trench shelter or an entrance to a sub-surface shelter leading into it. See LWT 280 and LWT 306-307 for similar arrangements of guns protecting Lowestoft.	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
31.	WWII air raid shelters	LWT246		TM 5346 9315	Civil Defence		The site two World War Two earthen covered air raid shelters, partially camouflaged within allotments, is visible on aerial photographs	Low
32.	WWII barrage balloon site, camouflaged factories and air raid shelters	LWT247		TM 5369 9327	Military		The site of a World War Two barrage balloon mooring, substantial earthen covered communal air raid shelters and an extensive area of camouflaged factories at the Nobel Chemical Finishes Eastern Coach Works are visible on aerial photographs on the site of the North Quay retail park. An unusually long curved profile hut is located along the western side of the factory complex. It	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							is assumed that this has a specialised function, potentially to do with the manufacturing and finishing items or equipment associated with the war effort.	
33.	Probable WWII gun emplacements alongside railway	LWT248		TM 5361 9347	Military		The site of probable World War Two gun emplacements or similar features are visible on aerial photographs alongside railway line.	Low
34.	WWII pillbox and other defensive structures	LWT249		TM 5358 9362	Military		The site of a former World War Two type 22 pillbox and other defensive structures and temporary training activity are on aerial photographs. These formed part ofthe wider system of defences recorded under LWT	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							045.	
35.	WWII pillbox	LWT250		TM 5345 9355	Military		The site of a former World War Two a type 22 pillbox is visible on aerial photographs. The pillbox is located near to the barbed wire system to the north of Lowestoft (LWT 045) and forms part of this defensive system (LWT 309	Low
36.	WWII huts and camouflaged buildings	LWT252		TM 5268 9307	Military		The site of an area of World War Two huts, potentially nissen huts, and camouflaged buildings are visible on aerial photographs near the slipways and quayside alongside Lake Lothing. Although the camouflaged buildings may be industrial or associated	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							with the workings of the port and shipping, it is possible that they be serving a military or naval function.	
37.	Possible WWII pillbox	LWT255		TM 5394 9338	Military		The site of a World War Two a type 22 pillbox is visible on aerial photographs	Low
38.	Cropmarks of multi-phase ditches and boundaries	LWT285		TM 5342 9340	Cropmarks		The cropmarks of a fragmentary and multiphase ditches and boundaries of unknown date, but potentially including elements of late prehistoric, Roman and medieval to post medieval date, are visible on aerial photographs. Although it must be noted that some of the cropmarks could feasibly relate to	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							non-archaeological subsurface features such as geology and/or drainage	
39.	WWII bomb craters	LWT292		TM 5315 9322	Military		The site of a pair of probable World War Two bomb craters are visible on aerial photographs within Leathes' Ham	Low
40.	WWII Naval Base, HMS Myloden	LWT297		TM 5289 9265	Military		The site of World War Two Naval Base, HMS Myloden, to the south of Lake Lothing Lowestoft, is visible on aerial photographs. The base, which undertook Landing Craft Training for RM Commandos and Combined Operations, was located within the site of the old Silk Factory which is located	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							alongside the waterfront. Practical training was carried out at sea with craft regularly in transit on exercise between the base, Great Yarmouth and HMS Wolverstone, another landing craft training establishment on the Orwell	
41.	WWII bomb craters	LWT298		TM 5305 9267	Military		The site of a probable World War Two bomb craters is visible on aerial photographs. These may relate to aerial bombardment of the docks or the Naval site to the immediate west (LWT 297).	Low
42.	WWII bomb craters	LWT299		TM 5357 9184	Military		A line of World War Two bomb craters is visible on aerial photographs.	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
43.	World War Two pillbox and possible civil defence site	LWT300		TM 5394 9243	Military		The site of a World War Two type 22 pillbox and another structure is visible on aerial photographs. The second structure is square with a possible associated blast wall and may have been in use as a defensive structure or a check point. It is however visible on an oblique aerial photograph taken in 1928, indicating that it pre-dates the Second World War, but may have been added to during this period.	Low
44.	World War Two air raid shelters and other possible military/civil	LWT301		TM 5398 9195	Military		The site of a World War Two air raid shelters, and other possible military/civil defence structures, is visible on	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
	defence structures						aerial photographs	
45.	Cropmarks of multi phase ditches	LWT304		TM 5280 9176	Cropmarks		The cropmarks of a dispersed group of multiphase ditches and field boundaries are visible on aerial photographs. The date of these features could potentially range from the later prehistoric to medieval to post medieval period. See LWT 308 for possible Bronze Age round barrow within area of the site.	Low
46.	WWII gun battery	LWT306		TM 5282 9217	Military		The site of World War Two gun battery is visible on aerial photographs, partially camouflaged within a quarry and area of	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							rough ground. The site consists of two angular 'lozenge' shaped gun emplacements that are likely to have contained field guns. Similar sites in other parts of the country were constructed out of sandbags filled with concrete and with a concrete roof placed on the top). It is impossible to tell from the aerial photographs whether these are of a comparable construction. This site, along with the nearby LWT 307, formed a line of defence on the south side of Lowestoft. Another two arrangements of guns (LWT 245, LWT 280)	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							protect the north.	
47.	WWII gun battery	LWT307		TM 5303 9191	Military		The site of World War Two gun battery is visible on aerial photographs, partially camouflaged within areas of rough ground, cultivation and extraction. The site consists of at least two angular 'lozenge' shaped gun emplacements that are likely to have contained field guns. An additional three rectangular structures are suggested by the aerial photographs, although they are not as conclusive, as the more characteristic gun houses, and may be temporary shelters.	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							Similar batteries in other parts of the country were constructed out of sandbags filled with concrete and with a concrete roof placed on the top. It is impossible to tell from the aerial photographs whether these are of a comparable construction, although they do appear to be of fairly temporary construction, judging by the appearance of the site immediately post-war. This site, along with the nearby LWT 306, formed a line of defence on the south side of Lowestoft. Another two arrangements of guns (LWT 245, LWT 280) protect the north.	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
48.	WWII defensive system	LWT309		TM 5278 9295	Military		A major World War Two defensive system, consisting of anti-tank ditch system, barbed wire obstructions, antitank scaffolding and lines of anti-tank cubes, and associated defences, including pillboxes, gun emplacements, slit trenches and weapons pits, is visible on aerial photographs encircling Lowestoft and running along this section of the East Coast from Corton to Pakefield. The defence is split into two sections, with Lake Lothing and Oulton Broad forming a natural break in the defensive line. The northern section surrounds the	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							northern perimeter of Lowestoft, from the Lowestoft Denes to Lake Lothing and Oulton Broad (LWT 045) and then runs south from Oulton Broad Lowestoft to Pakefield (LWT 284).	
49.	Possible post medieval remains	LWT318		TM 5356 9307	Settlement		The slight earthworks and possibly low structural remains and/ or exposed foundations of probable post medieval date may be visible on aerial photographs. The Ordnance Survey First Edition map indicates possible structures in this vicinity and it was therefore decided that these features probably related to ephemeral post medieval	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							structures, perhaps relating to industrial or horticultural activity and were therefore not mapped	
50.	WWII bunker	LWT319		TM 5386 9304	Military		The site of a World War two structure surrounded by a substantial blast wall, and some other structures and trenches, are visible on aerial photographs to the north of North Quay. Although it is possible that this is a large, well protected air raid shelter, it seems more likely that this represented an important operational building for either military or civil defence.	Low
51.	Land at the	LWT330		TM 5280 9260	Event		Negative evaluation	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
	former Sanyo site, School Road						trenching	
52.	Polished flint axe	LWT333		TM 5296 9245	Findspot		-	Low
53.	Roman coins	LWT334		TM 5442 9312	Findspot		-	Low
54.	Normanston	LWTMisc		TM 5315 9355	Domestic: Manor House		Great House shown on Bowen's 1755 (S1) and Hodskinson's 1783 maps (S2)	Low
55.	Heath Road, Oulton	OUL013		TM 5296 9245	Findspot		Probably related to Mouchel Ref No: 52. Drawing of butt half of a Neolithic polished axehead with description. Found in 1996. (S1).	Low
56.	Former Brook Marine Site	ESF21504		TM 5304 9288	Event		Desk based assessment	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
57.	Marstons Pub, Horn Hill	ESF21518		TM 5428 9238	Event		Negative monitoring	Low
58.	Land off Canning Road	ESF22240		TM 5376 9257	Event		Negative evaluation	Low
59.	Southern Relief Road. SCCAS Monitoring	ESF19727		TM 533 914	Event		Negative monitoring of southern relief road	Low
60.	Port House, North Quay		1292511	TM 5472 9275		Grade II	Offices, formerly Customs house. 1831. Gault brick. Slate roofs. 2 storeys. Long range facing south with a central transept. Transept lit through one 6/6 sash each floor to south and similar fenestration to east and west returns. Hipped roof. To right of transept are 5 ground-floor 6/6 sashes, two C20 ones in blocked doorways.	Medium

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							Three 6/6 sashes to first floor. All sashes have gauged skewback arches. Three 6/6 sashes to first floor left of transept, some replaced. Central doorway flanked by one 6/6 sash either side to ground floor. Shallow hipped roof with 5 stacks, all set to the left. The east return forms the entrance: 4 bays. Late C20 gabled porch in second bay (from left), with a pediment. One 6/6 sash left, 2 right, all with gauged skewback arches. 4 identical first-floor sashes. INTERIOR. Open well staircase at the west end: 2 turned balusters to each tread,	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							moulded handrail and heavy turned newels with ball finials. Interior otherwise modernised for office use.	
61.	Royal Norfolk And Suffolk Yacht Club, Royal Plain		1207043	TM 5480 9261		Grade II*	Purpose-built yacht club. 1902-3 by G & F Skipper of Norwich. Rendered and whitewashed brick under plaintile roofs. Very advanced design for its date. L-shaped, with an engaged tower in the inner angle opposing a square observation room at the top of the outer angle. 2-3 storeys. The south front is composed of a 3-storey, 3-bay square block with the observation room at the top. In the centre is a	High

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							low entrance porch with a panelled and glazed door flanked by a 3-light semi-circular window with glazing bars either side. The windows above are casements of varying design. At the first floor is a moulded brick panel with a sailing ship moulded in high relief brick. The observation room is glazed all round under a copper dome. To the right is a 2-storey wing under a half-hipped roof with a further semi-circular-headed casement to the ground floor and three windows to the first floor: 2 round-headed casements with balconies and, to the left, a canted bay	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							window. The east elevation is lit through a large segmental sash with 18/18 glazing bars, and the upper storey through 3 circular windows with casements. The hip of the roof is pierced by a triangular sash with glazing bars. The north side has, between the arms of the L, a curved and glazed single-storey bow. Behind it rises the 3-storey engaged round tower illuminated through casements to the first floor and a band of brick-dressed lights at the second floor. The hipped northern arm of the L has casements with glazing bars. INTERIOR. The	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							entrance leads into a square central hall partly top-lit from an open ceiling well into the first floor. A concave wall separates the hall from the bar to the north-east, which is entered through bowed double doors with glazing. The restaurant in the north-west corner has double muntin doors with leaded and glazed upper panels and a segmental overlight. The closed-string staircase has tall square newels tapering above the handrail and terminating in saucer finials, in a style being developed by Voysey. Reeded balusters. The first floor has an octagonal open	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							well looking into the ground-floor hall and protected by a reeded balustrade. The doors to the 2 principal rooms are of muntin type with stained glass panels. The north room also has a fireplace with a 3-panel overmantel. (Goodey C: 120 Years of Sailing: Beccles: 1980-: P.12).	
62.	The Beeches, 16 High Beech		1207021	TM 5362 9388		Grade II	Formerly known as: The Beccles Normanston Drive. House, now flats. Early C19. Gault brick, rendered to returns and rear. Double-depth plan with slate to the front range and pantiles to the rear. Facade is to the south. 2 storeys in 3 bays. Central full-height	Medium

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							bow opened to the ground floor to form a porch defined by a pair of fluted Greek Doric columns. The door is C20 half-glazed under a rectangular overlight. Above the door is a 6/6 curved sash under a gauged skewback arch. One similar, though flat, sash to each floor either side of the bow. Projecting eaves. Gabled roof over which shows a pair of gault-brick stacks set in the valley between the 2 piles. The left-hand (west) stack reduced in height following gale damage 1987. Against the east and west returns are C20 single-storey extensions. The	

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							rear elevation is irregular: C20 glazed door right of centre, one early C19 6/6 sash ground-floor left, another first-floor right, remainder are C20 sashes or casements. Dentil eaves cornice. INTERIOR. Open string stick-baluster staircase with a ramped and wreathed handrail. The rear section has chamfered bridging beams.	
63.	Palaeolithic handaxes from Cannon Shot gravels	MSF15299		TM 53 93	FIndspot		Normanston: In his review of Palaeolithic implements of East Suffolk, W A Dutt (1908) illustrates five flints from `Cannon-shot' gravels at 27m OD, found in a pit a few 100m north of the	Low

Mouchel Reference Number	Site Name	PRN*	NMR Reference**	Grid Reference	Site Type	Designation	Description	Value
							main road from Lowestoft to Oulton Broad. These have not been traced, but form the drawing they appear genuine, one possibly a hand-axe. Some were rejected, but others were accepted by W G Clarke and A S Kennard	
64.	Roman coin found at Normanston Park	-	-	-	Findspot	-	Findspot of Roman coin recorded in Proceedings of the Suffolk Institute of Archaeology 1975 (33)	Low

Appendix B – Figures

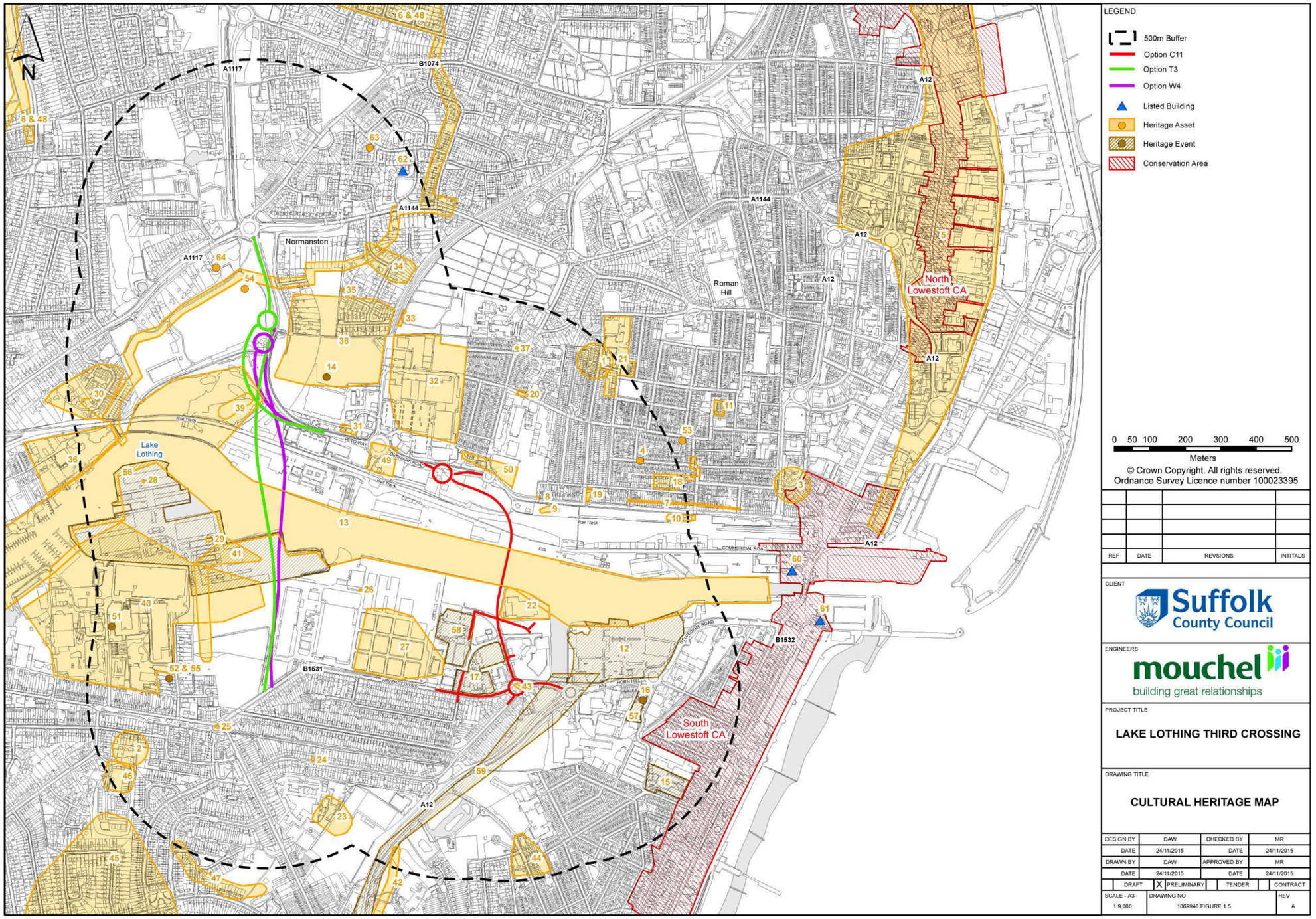

Figure 1: Location of heritage assets and events

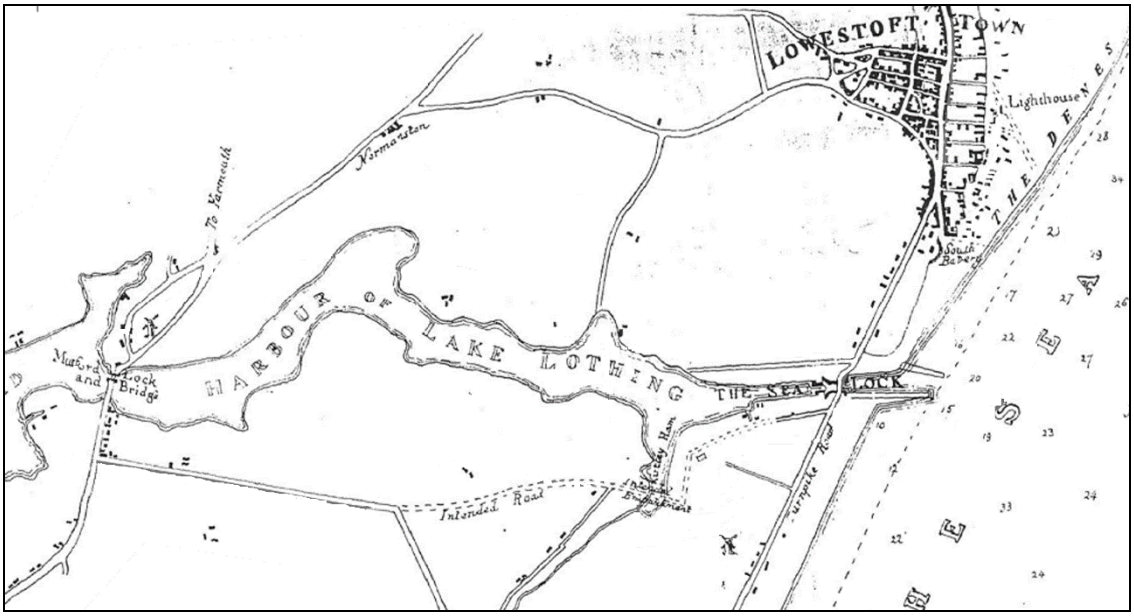

Figure 2: Extract from Map of 1830 by Robert Barnes

Figure 3: Extract from 1885 Ordnance Survey Map

Figure 4: Extract from 1906 Ordnance Survey map

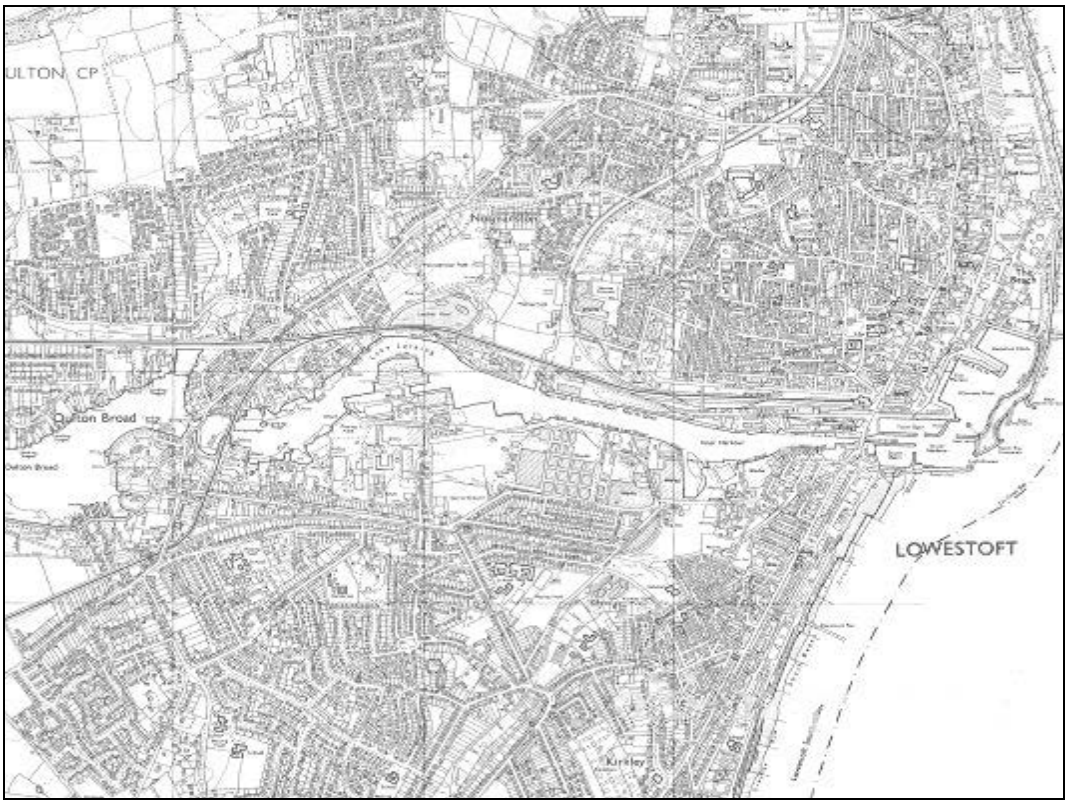

Figure 5: Extract from 1964 Ordnance Survey map

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Appendix C – Deposit Model

Lake Lothing Third Crossing, Lowestoft, Suffolk

Deposit Model

Lake Lothing THIRD CROSSING

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Document Control Sheet

Project Title	Lake Lothing Third Crossing
Report Title	Deposit Model
Revision	2.0
Status	Final
Control Date	6th February 2017

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
0.1	Draft	A. Hancock	12.01.17	H Roberts	12.01.17		
1.0	Draft	A. Hancock	13.01.17	H Roberts			
2.0	Final	A. Hancock	06.02.17	H Roberts	8.02.17	S Hales	8.02.17

Distribution

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1 Introduction

1.1 Background

Suffolk County Council (SCC) will implement a programme of ground investigations during 2017 to supplement existing borehole information, and determine ground conditions underlying the location of the proposed Lake Lothing Third Crossing (LLTC).

This document uses the existing borehole information to produce a deposit model to assess the potential for survival of deposits with high palaeoenvironmental and archaeological potential in the vicinity of the proposed location of the LLTC in advance of the forthcoming ground investigation.

The deposit model will inform implementation of a programme of geoarchaeological work co-ordinated with the ground investigation to assess and analyse high potential deposits, should the deposit model show that such deposits survive. The scope of any geoarchaeological work will be agreed with Suffolk County Council Archaeological Service (SCCAS) and Historic England (HE).

1.2 Site location

The LLTC will comprise the construction of a new road crossing at Lake Lothing, a large saltwater lake which forms the inner harbour of the Port of Lowestoft. Lake Lothing separates the north and south of Lowestoft, measuring c.180m at its widest point.

The proposed scheme (Figure 1) consists of a new single carriageway road across Lake Lothing linking the B1531 Waveney Drive on the south side to the C971 Peto Way on the north side and will include the provision of a new bascule bridge in Lake Lothing, a new rail bridge on the north side and a new road bridge on the south side as well as associated changes to the local highway network and landscaping.

1.3 Geology and Topography

The solid geology of the Lowestoft area is Cretaceous Chalk. A thick deposit of Tertiary London Clay lies above the chalk, the clay is capped by Pliocene and Early Pleistocene marine sands of the Crag Group. At higher ground the Crag Group is overlain by a succession of glacigenic tills comprising the Happisburgh Formation (formerly Corton Formation) and the Lowestoft Formation. In the lower lying area of Lake Lothing the Crag Group is overlain by Pleistocene glaciofluvial sands and gravels, which are covered by Holocene alluvium and peat.

Lake Lothing is an artificial channel which connects the River Waveney to the North Sea; it is located at the base of a broad, shallow, east-west aligned valley.

The land based area of the LLTC lies broadly level at c.3.0m AOD. However, this height is largely artificial, resulting from land reclamation and levelling completed to form dockside in the 19th and 20th centuries.

2 Archaeological Background

2.1 General

This section provides a brief outline of the archaeological and historic background of the area of the LLTC, which was prepared during Options Appraisal (Mouchel 2016a). Information on heritage assets is derived from records held by the Suffolk Historic Environment Record (HER) and the National Heritage List for England (NHLE). The heritage asset data is supplemented with information collated for the Lowestoft Urban Regeneration Company (URC) Area, Cultural Heritage Assessment (Scott Wilson, 2006) and other readily available documentary sources. A more detailed archaeological and historical background will be produced as part of forthcoming Environmental Impact Assessment.

2.2 History and Archaeology

Heritage assets are described in the context of a timeline of archaeological periods from prehistoric through to modern. The time periods discussed can be broadly divided as follows:

- Prehistoric:
    - Palaeolithic c.800,000 – 10,000 BC
    - Mesolithic 10,000 – 4,000 BC
    - Neolithic 4,000 – 2,500 BC
    - Bronze Age 2,500 – 700 BC
    - Iron Age 800 BC – AD 43
- Roman AD 43 – 410
- Early Medieval AD 410 – 1066
- Medieval AD 1066 – 1540
- Post-Medieval AD 1540 – 1900
- Modern AD 1900 – present

Palaeolithic

There is limited evidence of Palaeolithic activity in the vicinity of the LLTC; in the 19th century five early Palaeolithic flints, including one possible handaxe, were recovered from ‘Cannon-shot’ gravels at Normanston. However, well preserved evidence, comprising Lower Palaeolithic worked flints, associated palaeoenvironmental material and animal bone dated to c.700,000 BP, has been discovered within the Cromer Forest Bed Formation at Pakefield, c.2.5km to the south. This geological formation includes evidence of the earliest known presence of pre-modern humans in northern Europe, comprising footprints dated to c.800,000 BP, which were discovered in 2013 at Happisburgh Beach, Norfolk. The Cromer Forest Bed Formation may be present at Lowestoft, but will be deeply buried beneath alluvial, marine and glacial deposits.

Mesolithic to Iron Age

Evidence for activity of the Mesolithic, Neolithic, Bronze Age or Iron Age periods is restricted to an isolated Neolithic pit found at Walton Road, Lowestoft and scatters of Neolithic flint tools found at Victoria Road, Lowestoft and Heath Road, Oulton.

Episodes of marine transgression affected the area during the latter part of the Neolithic, the early part of the Bronze Age and the late Iron Age. Any evidence of these periods situated at lower lying areas may have been buried by marine, alluvial and peat deposits.

Roman

It has been suggested that a Roman road from Colchester to Burgh Castle passed through Lowestoft. Archaeological remains tentatively interpreted as part of this road, or an associated bridge, were found during 19th century excavation of peat in the vicinity of the current Bascule Bridge. The evidence comprised several large tree trunks, 10-12 feet in length, laid out parallel and approximately two feet apart.

The closest settlement evidence, including a coin hoard, a possible cremation urn and the skeletons of a number of horses was found approximately 700m to the north east of the LLTC during the 19th century at a part of Lowestoft now known as “Roman Hill”. The HER also records five isolated findspots of Roman coins.

The lower lying parts of the area continued to be affected by a marine transgression and its use may have been limited to exploitation of marine and estuarine resources.

Early Medieval

The villages of Lowestoft and Kirkley are mentioned in the Domesday Book and consequently had been founded by the latter part of this period. The early focus of Lowestoft is thought to have been located some distance away from the present town centre, perhaps in the vicinity of St Margaret’s church. It is probable that the area of the LLTC was marginal land exploited for estuarine and wetland resources

Medieval

Lowestoft was granted markets in 1308 and 1445 and by the end of the medieval period it was a significant fishing port and the most important settlement in the area. Until the latter part of this period the core of Lowestoft may have retained its focus around St Margaret’s church.

Lake Lothing is a remnant of a turbary, an extensive area of medieval peat cutting. The speed of the peat cutting is currently uncertain, but the eastern end of Lake Lothing including Kirkley Ham inlet was open to the sea by the 14th century when the northern side was known as the Inner Harbour and ships were being constructed on the southern side to the east of Kirkley Ham inlet.

Post-medieval

The town and port of Lowestoft saw significant growth during the 19th century and the conurbation eventually expanded to the south of Lake Lothing. The eastern end of the Lake was used as a harbour, with quayside, boat and ship building yards, fish processing, ancillary marine and manufacturing industries constructed along each side. The higher ground in proximity to the LLTC remained agricultural land for the majority of this period.

Modern

Lowestoft continued to expand into the early part of the 20th century with the fishing fleet, boat building and associated trades being the mainstay of its economy. By 1911 the population had reached 37,886, which reflects the peak in production for the British fishing industry.

The First World War saw some of the more capable local boats requisitioned by the Admiralty for patrolling and minesweeping. The town was bombed on a number of occasions, and on 25th April 1916, the German High Seas Fleet shelled the town and harbour leaving forty houses destroyed, two hundred damaged and four people killed.

During the inter war period the fishing industry and the town suffered a decline, but the start of the Second World War saw the town transformed into an important naval base with an all-round defensive perimeter of trenches, pillboxes and dense belts of barbed wire. None of the defences now survive but many of their locations have been recorded by the HER and the Defence of Britain project. The town was extensively bombed during the Second World War and much redevelopment was necessary during the post war period.

During the latter part of the 20th century the port remained a focus of shipbuilding and developed as a focal point for operations of the oil and gas industries in the southern North Sea.

3 Aims, Objectives and Standards

3.1 Aims

The principal aims of the deposit model are to:

- Establish the presence or absence of deposits with high palaeoenvironmental or archaeological potential at the proposed location of the LLTC through desk based research;
- Establish the extent and depth of any high potential deposits;
- Establish any variability in extent and depth of high potential deposits which may suggest the presence of localised geomorphological features, such as infilled palaeochannels;
- Assess the palaeoenvironmental and archaeological significance of any high potential deposits, where possible; and
- Understand the impact of the LLTC upon any high potential deposits.

3.2 Objectives

The principal objective of the deposit model is:

- To use the results to inform the scope of any necessary mitigation strategy.

3.3 Standards

The deposit model was completed with reference to *Requirements for Palaeoenvironmental Assessment (*SCCAS 2011), *Research and Archaeology Revisited: A Revised Framework for the East of England* (Medlycott 2011), the Chartered Institute for Archaeologists (CIfA) Code of Conduct and other relevant CIfA Standards and Guidance documents.

4 Methodology

4.1 General

The deposit model has been produced after review of relevant geotechnical reports and available borehole logs situated in close proximity to the LLTC. Archaeological reports detailing results of investigations located within 500m of the LLTC have also been examined.

4.2 Sources

Information from the following sources has been reviewed:

- British Geological Survey (BGS) online borehole record viewer;
- Lake Lothing Third Crossing: Geotechnical Feasibility Report (Mouchel 2016b);
- Suffolk Historic Environment Record (HER);
- Suffolk Record Office; and
- National Heritage List for England.

4.3 Consultees

The following were consulted during preparation of this document:

- Suffolk County Council Archaeological Service; and
- Historic England.

5 Results

5.1 Previous Deposit Model

An attempt was made to produce a deposit model during cultural heritage assessment of the Lowestoft Urban Regeneration Company (URC) Area (Scott Wilson 2006). The URC area covered approximately 250 ha of the town, including part of Lowestoft's High Street, the Beach Industrial Estate, the inner and outer docks, and land surrounding Lake Lothing.

The deposit model was derived from the results of eighteen widely dispersed geotechnical boreholes and five archaeological investigations. The small number of sources meant that it was not possible to provide detail of archaeological deposits or horizons, the level of ground disturbance or depth of reclamation deposits. Nonetheless, a considerable depth of marine sands was noted overlying the natural glacial deposits at the area surrounding the High Street, the outer docks and Beach Industrial Estate (URC Cultural Heritage Assessment Zones 1 and 2), and a considerable depth of alluvium was noted at the inner docks and land surrounding Lake Lothing (URC Cultural Heritage Assessment Zones 3 and 4).

Made ground deposits appeared to be thicker at the base of a cliff situated to the east of the High Street (Zone 1), and around Lake Lothing (Zones 3 and 4). Whilst archaeological evidence suggested that deposits at parts of the sloping topography of Zone 1 had been modified by post medieval terracing.

5.3 Archaeological Evidence

The HER includes a total of eight archaeological investigations situated within 500m of the LLTC (Figure 1). The investigations comprised a trial trench evaluation at an undeveloped area (Barnard's Meadow) situated c.450m to the north west of the LLTC (**1**); a desk based assessment examining a site (Brooke Peninsula) located on the southern side of Lake Lothing c.400m to the west of the LLTC (**2**); two trial trench evaluations, respectively located c.300m east and c.450m south east (**3** and **4**); and the remaining four were trial trench evaluations or programmes of archaeological monitoring located around the southern end of the LLTC (**5** to **8**).

The trial trench investigations usually examined a relatively shallow depth, although a small number of deeper trial pits were occasionally completed to examine the extent of made ground. Results have illustrated that deep deposits of relatively recent levelling material / made ground are widespread, but have often failed to examine areas for the presence or absence of underlying Holocene deposits which may have high archaeological or palaeoenvironmental potential. A single exception is provided by results of trial trenching carried out c.450m to the south east near Clifton Road (4: Archaeological Solutions 2011). Made ground was relatively shallow in this location and an underlying layer of desiccated peat (max 0.25m deep), plus evidence of podsolization, including "iron panning", was observed at the eastern half of the site.

The desk based assessment of the Brooke Peninsula (**2:** CgMS 2013) included an examination of a geotechnical investigation of the undeveloped eastern part of this area. The results of thirteen trial pits and three boreholes showed that c.1.5m to c.2.8m of made ground was present. The made ground overlay alluvial deposits which were

c.1.0m to 1.5m deep, except at the southern edge of the site where alluvium was absent. In addition two test pits located at the western edge of the investigated area contained localised peat deposits up to c.0.4m thick, which were situated beneath, or toward the base of the alluvium at a depth of c.2.9m to c.3.5m bgl (approx. 0.5m to 0.2m OD). The alluvium and peat overlay glaciofluvial river sands and gravels laid down on earlier sands interpreted as belonging to the “Corton Sands” (now part of the Happisburgh Formation).

5.3 Geotechnical Evidence

General

A geotechnical feasibility report (Mouchel 2016b) produced during the LLTC Options Appraisal examined available ground investigation data from 62 exploratory boreholes and seven trial pits located close to, or on the footprint of the LLTC (Figure 1). Results were used to produce a geological cross section across the LLTC (Figure 2).

The earliest of the ground investigations was completed on the southern side of Lake Lothing by the East Anglian Ice Company in 1909. A small number of other ground investigations date from the 1960s through to the 1980s, but the majority of borehole logs containing sufficient detail to enable preparation of the deposit model were completed during the 1990s in advance of southern relief road (A12) improvements.

The southern relief road information was presented in two documents:

- BH32 to BH55, BH56A and BH57A, BH58 to BH71, 40 No., Ground Engineering Ltd 1992, Factual Report. Additional boreholes are included within this report but lie outside of the subject area. Supplementary to Acer Consultants Interpretive Report (1994).
- BH35, BH38 to BH42, BH53, BH55, BH56A, BH57A, BH60, BH62, BH76 to BH78: A12 Kessingland to Pleasurewood Improvement, Acer Consultants 1994.

The borehole and trial pit logs generally extend to depths of between approximately 2.0m bgl to 40m bgl, although the record dating to 1909 extends to approximately 558m bgl. Inferred sub-surface conditions are summarised in the following sections and the location of boreholes which have encountered deposits with high archaeological and palaeoenvironmental potential (alluvium and peat) are shown on Figure 2.

Made Ground

Made ground is widespread on each side of Lake Lothing and the borehole logs indicate that there is a general trend for thickening of the made ground toward the existing quay walls. However, the depth of made ground is variable locally (this is most evident on the north side of the Lake), which suggests the presence of topographic high and low points in the underlying deposits, perhaps resulting from the presence of partly infilled geomorphological features.

The made ground extends from the current ground surface to depths of between 1.4m bgl and 5.0m bgl. It is dominated by redeposited silty sand with varied flint gravel and clay content, although localised ash, construction rubble comprising brick, concrete and wood as well organic material are occasionally recorded as minor constituents.

Contamination, in the form of oily odours, was recorded at various depths in a number of boreholes located near the quay walls.

Alluvium and Peat

Alluvium, generally comprising a soft grey silty sand or dark grey clayey silt with variable organic and gravel content, is recorded in numerous boreholes located on the northern side of Lake Lothing, although the depth to the surface of the alluvium varies locally, i.e. at some areas alluvium is first encountered at c.2m bgl, but at other areas it is recorded at c.5m bgl. However, the alluvial deposits show an overall trend to thicken as they near Lake Lothing, with a maximum depth of c.6m of alluvium recorded adjacent to the existing north quay wall.

At the south of Lake Lothing alluvium was only encountered in three boreholes, located c. 30m west of Kirkley Ham (BH01), c.10m south of Waveney Drive (BH33**),** and c.60m north of Waveney Drive (BH56A) where the alluvium extended from 3.2m bgl to 5.7m bgl (-0.16m to -2.66m OD).

Alluvial deposits are also present within Lake Lothing, extending from the lake bed to a maximum thickness of c.2.5m. The lake bed alluvial deposits are generally described as a silt with variable sand content, also containing occasional gravel clasts and plant remains. The Lake is regularly dredged to 4.7m CD (-6.2m OD) to reduce the thickness of the river bed deposits in order to maintain sufficient water depth for commercial shipping requirements.

A number of the boreholes situated at the northern side of Lake Lothing have recorded the presence of thin lenses of peat within the alluvium, but only two of the boreholes examined for the deposit model have encountered deep deposits of peat.

- At the north side of Lake Lothing BH57A (offset c.10m west of the LLTC) encountered c.1.3m of fibrous sandy peat situated beneath the alluvium and above the glaciofluvial deposits, between -1.76m and -3.06m OD; and
- At the southern side of Lake Lothing BH56A (offset c.20m west of the LLTC) recorded c.0.4m of peat situated immediately below made ground and above alluvial deposits, between 0.24m to -0.16m OD.

Glaciofluvial Deposits

The glaciofluvial deposits underlie the alluvium and peat and result from channel infill, they are generally granular in nature and are dominated by layers of medium dense to dense sands, flint gravels and gravelly sand.

To the south of Lake Lothing the surface of the glaciofluvial deposits may rise slightly from c.1.0m OD near Waveney Drive to c.2.0m OD near the junction of Riverside Road and Canning Road, but then exhibits an overall south to north downward trend to -1.5m OD (c.4.0m bgl) at the quay wall.

A general south – north upward trend is evident to the north of Lake Lothing, where the surface of the glaciofluvial deposits is recorded at c.8.0m bgl near the north quay wall, then at c.1.5m bgl near Denmark Road. However, intermediate boreholes show much greater local variability in surface height than is evident to the south.

The maximum and minimum thicknesses of glaciofluvial deposits were recorded in BH56A and BH46, respectively 18.8m (between -2.6m to -21.4m OD) and 12.6m (between -8.2m to -20.8m OD). A basal layer of clay is often noted as forming the boundary with the underlying Crag Group. The clay layer generally comprises a grey thinly to thickly laminated silty clay with interlaminations of fine to coarse sand.

Lowestoft Till and Corton Formation

BGS Sheet 176 shows that the Lowestoft Till and underlying Corton Formation (now part of the Happisburgh Formation) are present at higher ground to the north and south of Lake Lothing. Neither formation was recorded in examined boreholes.

Crag Group

The full depth of the Crag Group (mostly formed of marine sands and gravels) has only been proven in a single borehole which was completed in 1909 at the southern side of Lake Lothing. The surface of the Crag Group was poorly defined in this borehole, but the Craq was observed to extend to a depth of approximately 67m bgl (-60m OD). Recent boreholes (BH55, BH56A and BH67) located in close proximity to the 1909 borehole have recorded the surface of the Crag Group at between 21.5m bgl (-19.0m OD) and 26.5m bgl (-23.5m OD) and an approximate total thickness of 42m is inferred.

The Crag Group is described as a medium dense to very dense fine to coarse grained sand with shells and occasional gravel clasts and clay pockets. Overbank deposits of the Cromer Forest Bed Formation, which sometimes form the upper part of Crag Group, do not appear to have been encountered and may be absent, perhaps as a consequence of erosion prior to deposition of the overlying glaciofluvial deposits.

Palaeogene and Cretaceous Deposits

The exploratory borehole undertaken by the East Anglian Ice Company in 1909 shows that the Thames and Lambeth Groups, and the Ormsby Clay Formation of Paleogene age underlie the Crag Group, extending from about -72m to -160m OD. Cretaceous deposits of the Chalk Group underlie the Paleogene deposits.

6 Conclusions

6.1 General

Overall, the archaeological evidence has limited applicability to the deposit model and to the definition of human activity pre-dating the late post medieval period. In part because the available evidence has a restricted distribution as a result of the focus of recent development, with the majority of work situated at the southern side of Lake Lothing. Additionally, the full depth of archaeological deposits has not been examined by the majority of investigations and the interpretation of “made ground” and ‘natural’ layers appears variable.

The quality, distribution and terminology of the geotechnical investigations often makes direct comparisons with the archaeological evidence difficult. Examination of the wider distribution of geotechnical work in the Lowestoft area shows dispersed clusters centred on proposed new development, similar to the distribution of the archaeological evidence. Fortunately, the proposed location of the LLTC was subject to relatively comprehensive geotechnical investigation during the 1990s and this has enabled production of a reasonably robust deposit model.

The deposit model shows that localised areas of peat deposits survive at both sides of Lake Lothing (further discussed in sections 6.2 and 6.3). The peat illustrates semi terrestrial episodes when the surrounding land may have been more readily exploited by prehistoric people in comparison to episodes when the area was inundated and alluvium was being deposited. The intercalated sequence of Holocene alluvium and peat is of archaeological and palaeoenvironmental significance as it will enable better understanding of the local and regional Holocene environments at the time of peat formation / alluvial deposition and may preserve evidence of prehistoric human activity.

It has not been possible to determine if the Cromer Forest Bed Formation (with potential to contain Lower Palaeolithic archaeological evidence) is present or absent at the upper part of the Crag Group. It is tentatively suggested that it may be absent, perhaps eroded prior to deposition of the overlying glaciofluvial deposits, however, the level of detail presented in the existing geotechnical records is insufficient to enable secure interpretation.

6.2 South of Lake Lothing

The deposit model suggests that archaeological evidence pre-dating the post medieval period may be absent from much of the area located adjacent to the southern side of Lake Lothing. The bulk of made ground here is recorded as sterile redeposited silty sand with varied amounts of flint gravel and clay which directly overlies glaciofluvial deposits. The absence of Holocene alluvium or peat suggests that extensive truncation has occurred, which will have removed any archaeological evidence pre-dating the post medieval period. Deposits of alluvium and peat are recorded toward the southern end of the LLTC scheme, and archaeological evidence pre-dating the post medieval period may survive here.

Palaeoenvironmental potential appears to be restricted at the southern side of the Lake as alluvium and peat is absent from many of the geotechnical records, with made

ground directly overlying glaciofluvial deposits. However, three exceptions are recorded:

- borehole BH01, located c.30m west of Kirkley Ham, encountered alluvium from a depth of 1,8m bgl;
- borehole BH56A, located c.60m north of Waveney Drive, encountered c.0.4m of peat overlying c.2.5m of alluvium; and
- borehole BH33, located c.10m south of Waveney Drive, encountered c.0.7m of alluvium.

The recorded distribution of the alluvium and peat makes the origin and extent of these deposits difficult to interpret, although the alluvium in BH01 may be associated with Kirkley Ham, and deposits at BH33 and BH56A perhaps infill a palaeochannel, or other body of water, which drained north east into Kirkley Ham.

6.3 North of Lake Lothing

Extensive deposits of made ground are present to the north of Lake Lothing. The bulk of the made ground is recorded (as to the south) as sterile redeposited silty sand with varied amounts of flint gravel and clay and is likely to possess little archaeological potential. It generally shallows to the north, from c.5.0m deep near the quay wall to c.1.4m deep near Denmark Road, although much greater localised variability in the depth of made ground is evident than was observed to the south. The variation in depth suggests the presence of topographic low points, perhaps resulting from truncation of the underlying alluvial deposits or the presence of partly infilled drainage features such as palaeochannels.

Deep alluvial deposits survive beneath the made ground at the north side of Lake Lothing. The depth to the surface of the alluvium varies locally, i.e. it is first encountered at c.2m bgl at some areas, but at c.5m bgl elsewhere. However, the alluvial deposits show an overall trend to thicken as they near Lake Lothing, with a depth of c.6m of alluvium recorded adjacent to the existing north quay wall. The alluvium is generally described as soft grey silty sand or dark grey clayey silt containing variable organic material, with occasional lenses of gravel and peat.

Only one borehole (BH57A) situated to the north of Lake Lothing (located c. 8m south of the railway and offset c.7m west of the LLTC) encountered a deep deposit of peat, recorded as c.1.3m of fibrous sandy peat situated beneath the alluvium and above glaciofluvial deposits, between -1.76m and -3.06m OD. The presence of the peat immediately above the glaciofluvial sediments suggests that this perhaps localised organic deposit may have formed during the early part of the Holocene.

7 Recommendations

The borehole logs from the forthcoming ground investigation will be provided to Mouchel Heritage Consultants within 24 hours of their completion. Mouchel Heritage Consultants will review the logs to identify areas of high palaeoenvironmental / archaeological potential for targeted retrieval of an undisturbed core through surviving deposits of Holocene alluvium and peat. The deepest sequences of alluvium and peat (if encountered) will be prioritised for retrieval of the undisturbed core.

The undisturbed core will be completed by the geotechnical contractor during the time allowed for the programme of ground investigation and the undisturbed core will be collected solely for assessment and analysis by a fully qualified geoarchaeological contractor. The geotechnical contractor will offset the undisturbed core a maximum of 5m from the position of the ground investigation core which recorded high potential deposits. The location (NGR co-ordinates) and ground level height (m OD) of the retrieved undisturbed core will be recorded with GPS survey equipment.

If necessary, the geotechnical contractor will retain the undisturbed core at an off-site sample store until collection by the geoarchaeological contractor. The geoarchaeological contractor will ensure that the core is collected from the sample store a maximum of five working days after being deposited.

The scope of geoarchaeological assessment and analysis of the undisturbed core will be set out in a Written Scheme of Investigation to be agreed in consultation with Suffolk County Council Archaeological Service and Historic England.

As part of their assessment the geoarchaeological contractor will review all forthcoming geotechnical borehole logs to assess whether the Cromer Forest Bed Formation is present at the interface between the glaciofluvial deposits and the Crag Group. Results of this assessment would be used to enhance understanding of the distribution of this deposit, which contains evidence of the earliest pre-modern human presence known in northern Europe.

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(Numbers in bold are the Mouchel reference for archaeological investigations discusssed in the deposit model text and shown on Figure 1)

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Figures

1

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Legend

LLTC AND 500M BUFFER

ARCHAEOLOGICAL INVESTIGATIONS

GEOTECHNICAL BOREHOLES
(AND SAME SYMBOL IN OTHER COLOURS)

REF	DATE	REVISIONS	INITIALS

Client:
Suffolk County Council

Produced by:
mouchel
building great relationships

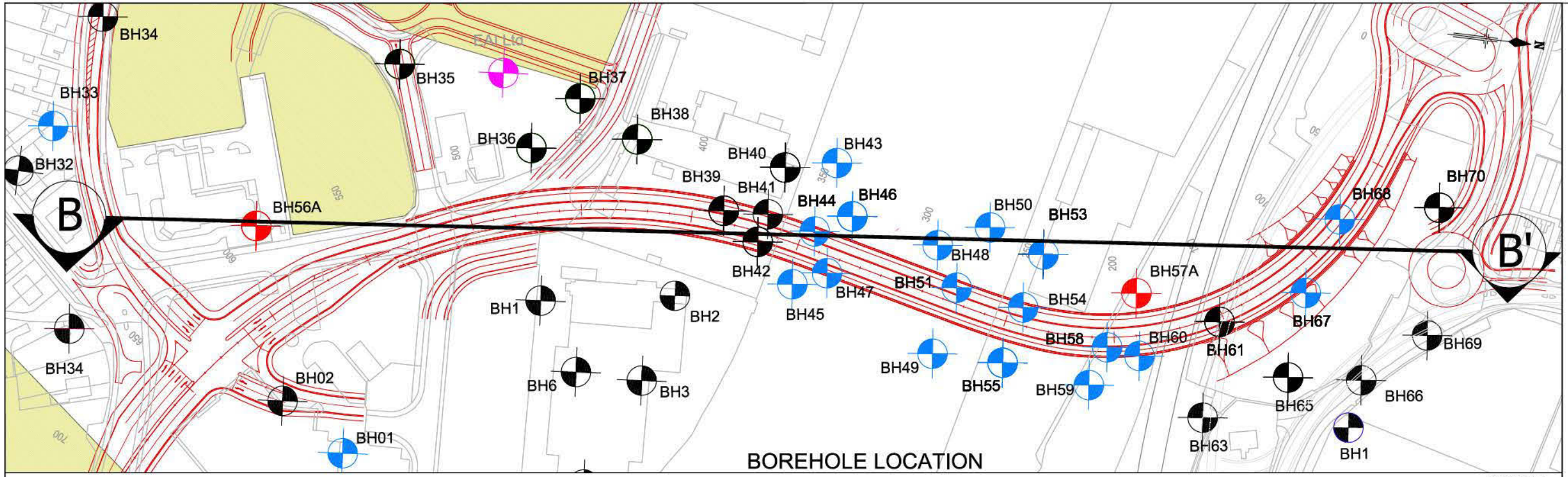
Project:
LAKE LOTHING THIRD CROSSING

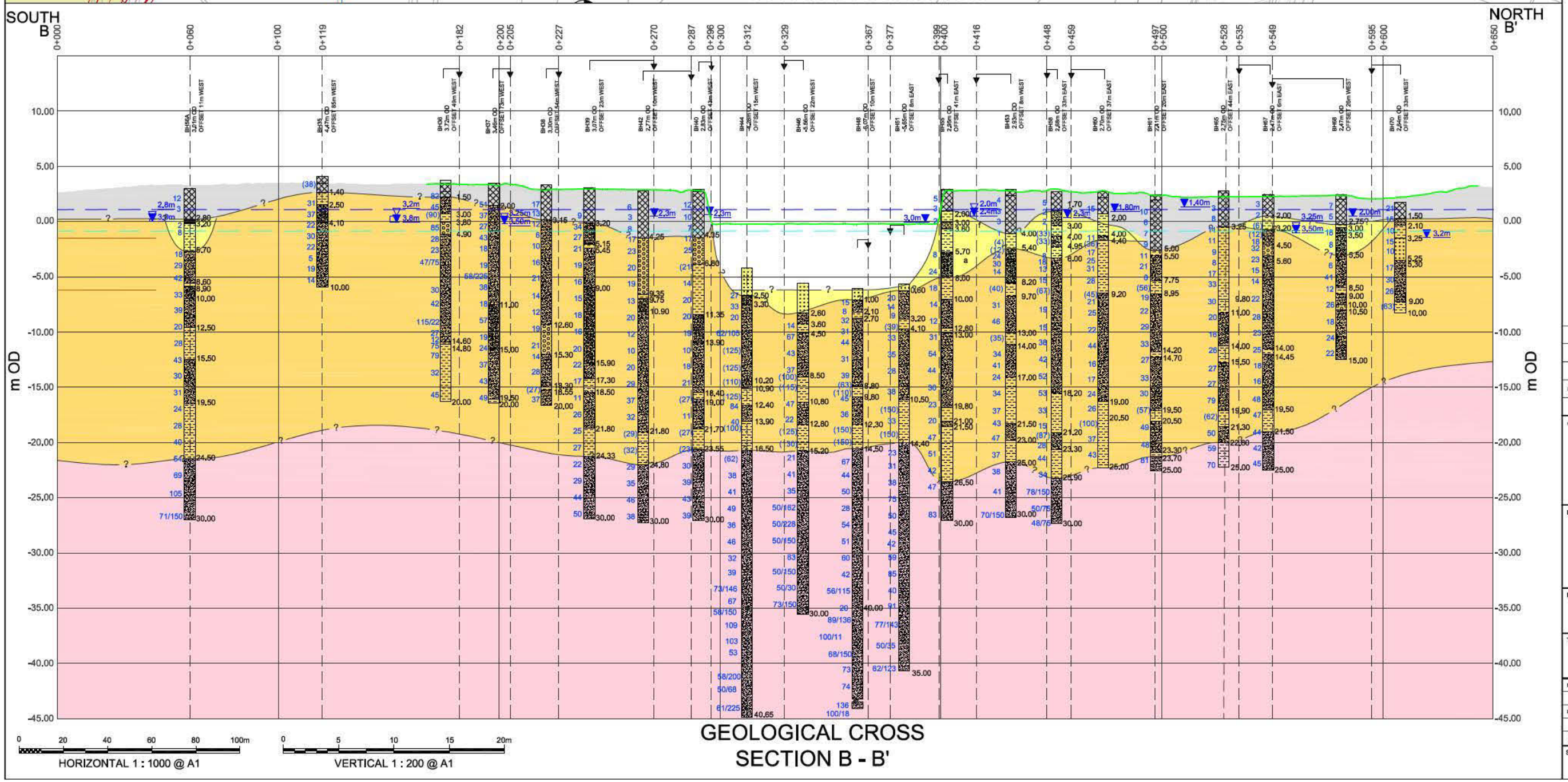
Title:
LOCATION OF LLTC, BOREHOLES AND ARCHAEOLOGICAL INVESTIGATIONS

DESIGN BY		CHECKED BY	
DATE		DATE	
DRAWN BY		APPROVED BY	
DATE		DATE	

X	DRAFT		PRELIMINARY		TENDER		CONTRACT	

SCALE – A3	DRAWING NO.	REV.
1:7500	1073877 FIGURE 1	A





Legend

BOREHOLES RECORDING:

- PALAEOGENE AND CRETACEOUS DEPOSITS (COMPLETED IN 1909)
- GLACIOFLUVIAL DEPOSITS
- ALLUVIAL DEPOSITS
- DEEP ORGANIC (PEAT) DEPOSITS

GEOLOGICAL CROSS SECTION DEPOSITS:

- MADE GROUND
- ALLUVIUM
- GLACIOFLUVIAL DEPOSITS
- CRAG GROUP

REF	DATE	REVISIONS	INITIALS

Client: Suffolk County Council

Produced by: mouchel — building great relationships

Project: LAKE LOTHING THIRD CROSSING

Title: DEPOSIT MODEL BOREHOLE LOCATION AND GEOLOGICAL CROSS SECTION

DESIGN BY		CHECKED BY	
DATE		DATE	
DRAWN BY		APPROVED BY	
DATE		DATE	

X DRAFT | PRELIMINARY | TENDER | CONTRACT

SCALE - A3	DRAWING NO.	REV.
1:1000	1073877 FIGURE 2	A

Appendix D – Ecology Phase 1

Lake Lothing Third Crossing

Phase I Survey Report

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Document Control Sheet

Project Title:	Lake Lothing Third Crossing
Report Title:	Phase I Survey Report
Document No:	1069948/ENV/02
Revision:	2
Status:	FINAL
Control Date:	December 2015

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
1	Draft	D. Weaver	26/10/15	A. Bascombe	3/11/15	P. Joyce	16/11/15
2	Final	D. Weaver	16/10/15	H. Roberts	17/11/15	A.Bascombe	2/12/15

Distribution

Organisation	Contact	Copies

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Contents

Appendices

Executive summary

As part of a project to alleviate traffic congestion through Lowestoft a third crossing over Lake Lothing has been proposed. Traffic travelling through Lowestoft on the A12 between Ipswich and Great Yarmouth can often cause congestion at peak times and alternative routes through residential roads can cause problems for the local residence. Therefore in 2009 a feasibility study for a third crossing was undertaken, it concluded that there was a potential four routes the new road could take, crossing Lake Lothing at two potential locations; the western (Grid Ref: TM532929), and the central (Grid Ref: TM538927).

The current study aims to assess potential ecological constraints that may affect the proposed routes, and offer recommendations for further study and potential mitigation.

The desk study showed that there was a total of one statutory protected area and 4 non-statutory protected sites, offering a constraint to works. There was also suitable habitat for breeding birds, reptiles and bats found within the study area.

Recommendation to avoid offences being committed were:

- Avoiding works during the breeding bird season, or the presence of a qualified ecologist during works to advise if active bird nests are encountered;
- Reptile survey to inform potential mitigation; and
- Bat roost surveys to inform potential mitigation.

1 Introduction

1.1 Background

1.1.1 in order to alleviate traffic congestion through Lowestoft, a third crossing over Lake Lothing has been proposed. Traffic travelling through Lowestoft on the A12 between Ipswich and Great Yarmouth can often cause congestion at peak times and alternative routes through residential roads can cause problems for local residents. It is also intended that a third crossing will provide better access to the lake area, support regeneration and provide an improved environment in Lowestoft, as well as remove through traffic from the currently congested Bascule bridge. This makes it possible to improve the pedestrian environment in the town centre, and meet expectations for ease of movement and journey reliability against a background of increasing traffic levels.

1.1.2 In 2009 a feasibility study for a third crossing was commissioned. This concluded that the new road could take one of four routes, with two possible crossing points of Lake Lothing: west (Grid Ref: TM532929), and the central (Grid Ref: TM538927).

1.2 Site location

1.2.1 Lake Lothing is situated in the centre of Lowestoft, Suffolk (Grid Ref: TM540927). It once housed a thriving boat building and repair industry which has declined in use over recent decades. It is classed as a salt water lake and lies east of the Broads National Park, opening into the North Sea at its eastern end.

1.3 Study rationale and objectives

1.3.1 The aim of the study was to appraise the ecological value of the study area, identify habitats and their likelihood of supporting protected species.

2 Methods

2.1 Desk Study

2.1.1 Information about the locations of any protected species records, and statutory protected nature conservation sites (e.g. Natura 2000 sites and Sites of Special Scientific Interest - SSSI) and non-statutory nature conservation sites (e.g. county wildlife sites including Sites of Nature Conservation Importance - SINCs) within a radius of 2 km of the proposed route were sought from the following sources.

- Multi Agency Geographic Information Centre website (www.magic.gov.uk).
- Suffolk Biological Records Centre (SBRC).
- Ordnance Survey Maps.

2.1.2 The desk study set out to identify any statutory or non-statutory designated sites, priority species and habitats or other ecological receptors.

2.2 Field Survey

2.2.1 A field survey of the site and its immediate environs was undertaken to:

- Appraise the ecological value of the Main Study Area, identify habitats and their suitability to support protected species.
- Map habitat types within the Main Study Area and provide a baseline assessment of the ecological value of these habitats in accordance with CIEEM (2006) “Guidelines for ecological impact assessments in the United Kingdom”;
- Identify habitat types which are suitable to support species that are protected by law or otherwise of particular nature conservation importance and review existing information regarding the likely presence of such species within the Broad Study Area;
- Determine whether ecological features are likely to constrain the proposed works; and
- Make recommendations for further work to progress the scheme, including further surveys, mitigation measures or ecological enhancements.

2.2.2 The map of habitat types is provided in Appendix 1.

2.3 Field Survey Limitations

2.3.1 The survey was completed in early October, therefore species of plants flowering earlier in the season may have been undetected. At the time of survey no access was available to private property; however, habitat areas were generally small and identification of species was possible from the boundaries. We were also unable to gain access to an industrial area with woodland scrub behind it (Grid Ref: TM 53023 92859), therefore no assessment was made of this area. The desk study identified that this area of scrub woodland is a County Wildlife Site and that ecological reports for it are available.

2.4 Assessment Methodology

2.4.1 The assessment methodology used to evaluate possible ecological receptors within the site follows published guidance CIEEM (2006). Ecological receptors have been evaluated based on specific criteria, which include:

- Habitat size, shape, diversity (e.g. mosaics, mono-cultures) and connectivity;
- Physical conditions (e.g. natural, semi-natural, buildings/hard standing);
- Biodiversity, including species richness, range and populations of plant and animals communities;
- Rarity and typicalness of plant and animal communities;
- Stage/stability of ecological succession and habitat development trajectory;
- Typicalness of the physical environment;
- Position in an ecological or geographical unit; and
- Potential and intrinsic value, ease of re-creation.

2.4.2 In addition, consideration has also been given to the possible occurrence of S41 species and habitats (referring to priority species and habitats listed under section 41 of the Natural Environment and Rural Communities Act 2006 (as amended)), inclusion on national or county Red Data Books, and to conservation status (such as nationally notable/scarce species, etc.). However, the inclusion within a priority species or habitat reflects the fact that the population of the habitat concerned is in a sub-optimal state (and hence that conservation action is required) and does not necessarily imply any specific level of value.

3 Results and Evaluation

3.1 Desk Study Results

Statutory protected sites

3.1.1 1.8 km west of the site is The Broads Special Area of Conservation (SAC) (Grid Ref: TM 51270 92474) which is also designated as a Ramsar site (Broadland Ramsar Site), and Site of Special Scientific Interest (Sprat's Water and Marshes, Carlton Coville SSSI). The significant barriers between the site and this area, including numerous residential areas, the A1117 and a train line, mean that adverse effects would not occur, and therefore Appropriate Assessment under the Habitats Regulations is not required.

3.1.2 Leathes Ham is a Local Nature Reserve (LNR) and County Wildlife Site adjacent to Peto Way (Grid Ref: TM 53011 93232). This site comprises a large water body with fringing reedbeds, wet woodland and rough grassland. The site supports a diversity of habitats and is important for breeding birds.

Non-statutory protected sites

3.1.3 There are twelve County Wildlife Sites within 2km of the proposed site. Of these, four are located within areas where the proposed works might affect them.

3.1.4 Brooke Yachts and Jeld-Wen Mosaic (Grid Ref: TM532962) is situated on the southern bank of Lake Lothing. It has an open mosaic of habitats on previously developed land and a small area of intertidal mudflat. This site supports a large population of common lizards and a diverse assemblage of breeding birds.

3.1.5 Kirkley Ham (Grid Ref: TM539922) lies adjacent to the A12 south of Lake Lothing. It comprises two distinct habitat types dissected by disused railway lines. The southern part contains two areas of reedbed fringed by willow scrub. These are drying out in places with encroachment of scrub and willowherb. They are fed by surrounding run-off and water from ponds in the adjacent Kirkley Fen Park. The site forms part of the flood control system. There are small areas of open water. The higher northern part consists of dry neutral and acidic grassland with gorse and scattered hawthorn scrub. A dyke running along the north western edge contains a few specimens of greater spearwort which is a nationally rare plant. Common lizard have been recently recorded at this site and it contains habitats suitable to support breeding birds.

3.1.6 Harbour Kittiwake Colony (Grid Ref: TM552927) is an important sea bird colony present near the Outer Lowestoft Harbour. This site contains an artificial cliff built on the north pier extension which was provided to replace an original nest site.

3.1.7 A plan showing the statutory and non-statutory sites that could be affected by the proposed scheme is provided in Appendix 2.

Protected species

3.1.8 Records of brown long-eared bat *Plecotus auritus*, pipistrelle *Pipistrellus sp*., water

vole *Arvicola amphibious*, grey seal *Halichoerus grypus* and common lizard *Zootoca vivipara* exist within 2km of the final alignments. Approximately 150 species of birds have been recorded within 2km of the site, including notable species such as barn owl Tyto alba, black redstart *Phoenicurus ochruros*, green sandpiper *Tringa ochropus*, hen harrier *Circus cyaneus*, kingfisher *Alcedo atthis*, little tern *Sternula albifrons*, peregrine *Falco peregrinus* and red throated diver *Gavia stellate*. A full list of all bird species recorded within 2km of the site is provided in Appendix 3.

Priority species

3.1.9 Biological records show several priority species (S41 NERC Act as amended) that have been recorded within 2km. Species recorded include hedgehog *Erinaceus europaeus*, common toad *Bufo bufo*, common frog *Rana temporatia* and smooth newt *Lissotriton vulgaris*. These species are afforded no formal protection within the UK, but must be taken into consideration during the planning phase.

3.2 Field survey results

3.2.1 The area surveyed was an urban landscape with a mixture of new retail and leisure developments, abandoned industrial units, and active industrial units. There are small remnant patches of woodland, scrub and tall ruderal around the industrial areas, with Leathes Ham LNR to the west of the site.

Habitats

3.2.2 **Semi-natural broadleaved woodland** – this is a small area situated either side of Peto Way. On the east side of the road the habitat contains a mixture of mature species with a complex scrub like understorey. Mature species include English oak *Quercus robur*, elm *Ulmus minor*, sycamore *Acer pseudoplatanus*, ash *Fraxinus excelsior*, maple *Acer campestre*, willow sp. *Salix sp.,* silver birch *Betula pendula*, horse chestnut *Aesculus hippocastanum*, elder *Sambucus nigra*, holly *Ilex aquifolium* and hawthorn Crataegus monogyna. The understorey consisted of bramble Robus fruticosus, common nettle *Urtica dioica*, gorse *Ulex euroaeus*, male fern *Dryopteris filix-mas* and ground ivy *Hedera helix*.

3.2.3 To the west of Peto Way the woodland is dominated by willow sp. with poplar *Populus tremula*, alder *Alnus glutinosa* and silver birch. The understorey has common reed *Phragmites australis*, ladies mantle *Alchemilla mollis* and rosebay willowherb *Chamerion angustifolium*. The dominances of willow trees and close proximity of this habitat to a lake mean that this is wet woodland. Wet woodland is a nationally important habitat type that has been in decline in the UK over recent decades, however, this habitat is locally abundant in East Anglia because of the abundance of wetlands within the area.

3.2.4 **Tall ruderal** – Small isolated areas of this habitat were present to the north of the railway line adjacent to Denmark Road. These areas were dominated by bramble, with willow herb, common nettle, ragwort *Jacobaea vulgaris*, common hogweed *Heracleum sphondylium*, ivy, bindweed Convolvulus arvensis, broom *Cytisus*

scoparius and dog rose *Rosa canina*.

3.2.5 Small areas of grasses were interspersed within the tall ruderal, and these consisted of perennial rye grass *Lolium perenne*, timothy-grass *Phleum pratense*, false oat grass *Arrthenatherum elatius* and willow herb. There were also some woody species within the tall ruderal, including elm, hawthorn and sycamore. This habitat is found throughout the UK and is not an ecological constraint to the works.

3.2.6 **Unimproved neutral grassland** –areas of this habitat type were present south of Lake Lothing in former industrial areas which have been left unmanaged. Species present included soft rush *Juncus effusus*, bramble, greater plantain *Plantaga major*, yarrow *Achillea millefolium*, broom, gorse, silverweed Argentina *anserina*, willowherb and ragwort. These areas if left unmanaged can be expected to succeed to tall ruderal within the next few years. Unimproved neutral grassland is widespread throughout the UK and is not an ecological constraint to the works.

3.2.7 **Amenity grassland** – there are two large areas of amenity grassland north of the lake, east and west of Peto Way, both of which are playing fields and recreational areas. This habitat is of low ecological value and is not an ecological constraint to the proposed works.

3.2.8 **Freshwater lake** – This is an LNR and is a large fresh water lake surrounded by reedbeds composed of common reed and bull rush *Typha latifolia*, adjacent to wet woodland. Several bird species were seen to be using the lake, including cormorant *Phalacrocorax carbo*, herring gull *Larus argentatus*, mallard duck *Anas platyrhynchos* and American Pekin duck *Anas pltyrhynchos domestica*. This is a UK statutory protected site and will need to be taken into consideration during the planning stage.

3.2.9 **Hard Standing** – several areas of old hard standing are present, containing numerous cracks within which vegetation has become established. Species present include buddleia *Buddleja globose*, gorse, willow herb and several species of grasses. This habitat is of little ecological value and is not a constraint to the proposed works.

Protected and priority species

3.2.10 **Breeding birds** – Many habitats present are suitable to support breeding birds, in particular, woodland and tall ruderal habitats. All UK birds are protected by law when breeding.

3.2.11 The breeding bird season typically occurs between mid-March and mid-August and therefore measures should be put in place to minimise the risk of adverse effects occurring on breeding birds at this time.

3.2.12 **Reptiles** – The site contains habitat suitable for use by reptiles, and records of reptiles exist for the wider area. Consequently, it is possible that reptiles may be present within the final alignment routes. Further investigation of reptiles is therefore recommended to inform the scheme design and assessment.

3.2.13 **Bats** – Records exist of bats west of the proposed site within the Broads National

Park. Buildings within the Main Study Area may be suitable to support roosting bats. Further investigation of bats is therefore recommended to inform the scheme design and assessment.

4 Discussion

4.1 Description of baseline ecology and constraints

4.1.1 The proposed alignments of the third crossing of Lake Lothing will pass through an urban landscape with interspersed pockets of semi-natural landscape and industrial buildings.

4.1.2 Leathes Ham LNR and the Brooke Yachts and Jeld-Wen Mosaic CWS support populations of common lizards, breeding birds, and contain valuable habitats including wet woodland and mudflats.

4.1.3 The natural and semi-natural habitats listed in the results section are relatively widespread in the UK (although some may be locally rare), however, due to their proximity to the two aforementioned sites, may also hold ecological value. The area holds suitable habitat for both reptiles and breeding birds. These species will inhabit woodland, tall ruderal, grassland and use decaying hardstanding making these habitats significant ecological receptors.

4.1.4 The large number of old industrial buildings offer suitable roosting sites for bats. Two species of bat have been recorded in the area therefore further surveys are recommended to establish if bats are using these buildings to roost and associated natural habitats for foraging and commuting.

4.2 Recommendations for further work

4.2.1 The following surveys are recommended to further investigate the likely effects of the proposals on ecological resources, and advise the need for and extent of any mitigation.

4.2.2 **Reptile Surveys** –surveys should be carried out within areas of suitable habitat. Surveys should seek to confirm presence/absence, identify species present and estimate population sizes. The survey findings will inform the scheme assessment and the need for and extent of any mitigation.

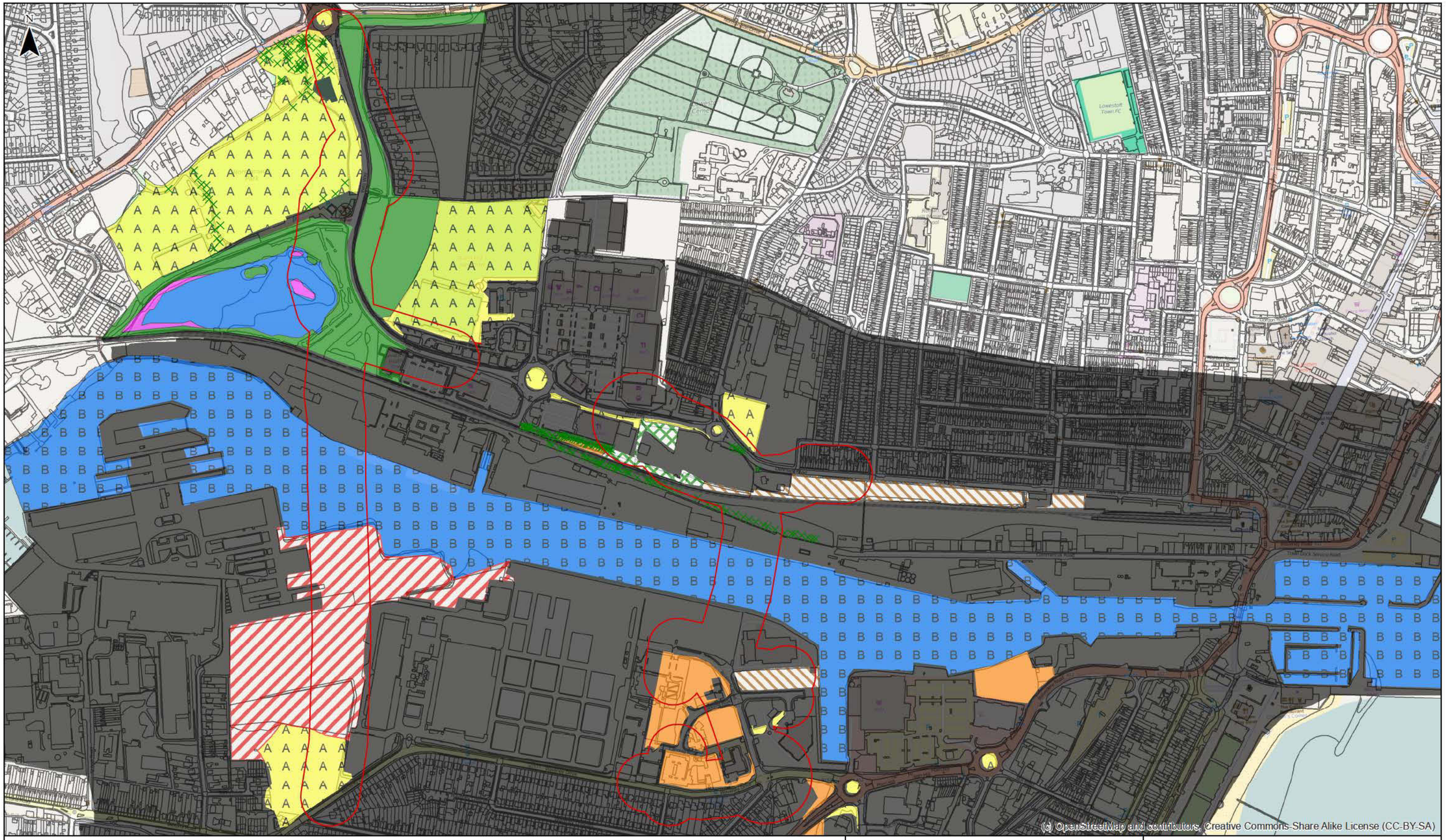
4.2.3 **Bat surveys** – surveys are recommended to identify possible roost sites within 50m of the proposed routes. Any possible roosts should be subject to emergence surveys to confirm whether roosting bats are present. The findings of these surveys would inform the scheme assessment and design, and the need for and extent of mitigation, as well as providing information that may be necessary should a protected species licence application need to be made.

4.2.4 **Breeding birds** - It is recommended that vegetation clearance takes place outside of the typical bird breeding season of mid-March to mid-August. If this is not possible then a suitably experienced ecologist should supervise vegetation clearance works, advising as appropriate should breeding birds be present.

4.2.5 We have used our reasonable endeavours to provide information that is correct and accurate and have discussed above the reasonable conclusions that can be reached on the basis of the information available. We would recommend that in order to obtain more secure results, the additional work outlined above should be commissioned.

Appendices

Appendix A Phase I Habitat Map



Legend

- Proposed Route
- Standing Tree
- Amenity Grassland J1.2
- Brackish Water
- Buildings and Hardstanding J3.6
- Dense and Continuous Scrub A2.1
- Inundation Vegetation F2.2
- No Access
- Scattered Scrub A2.2
- Semi-natural Broadleaved Woodland A1.1.1
- Standing Water G1
- Tall Ruderal C3.1
- Unimproved Neutral Grassland B2.1

Version	Amendment	Drawing Date	Review Date	Approved Date
A	First Issue	03/12/15 DW	03/12/15 PJ	03/12/15 AB

Client: Suffolk County Council

Project: Lowestoft Third Crossing

Drawing Title: Phase 1 Survey

mouchel
building great relationships

Office: Blackfriars

Tel: 020 7822 2497

Scale (at A3 size): 1:6,000

Purpose of Issue: Information

Drawing Number:

Appendix B Constraints Map

Leathes Ham

Brooke Yachts and Jeld-Wan Mosaic

Kirkley Ham

Harbour Kittiwake colony

Legend

- Proposed Routes
- County Wildlife Site
- Local Nature Reserve
- Standing Tree
- Amenity Grassland J1.2
- Brackish Water
- Buildings and Hardstanding J3.6
- Dense and Continuous Scrub A2.1
- Inundation Vegetation F2.2
- No Access
- Scattered Scrub A2.2
- Semi-natural Broadleaved Woodland A1.1.1
- Standing Water G1
- Tall Ruderal C3.1
- Unimproved Neutral Grassland B2.1

Version	Amendment	Drawing Date	Review Date	Approved Date
A	First Issue	03/12/15 DW	03/12/15 PJ	03/12/15 AB

Client: Suffolk County Council

Project: Lowestoft Third Crossing

Drawing Title: Local Protected Sites - Constraints

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Tel: 020 7822 2497

Scale (at A3 size): 1:7,000

Purpose of Issue: Information

Drawing Number:

Appendix C Bird Records

Common Name	Latin Name
Alpine Swift	*Apus melba*
Arctic Tern	*Sterna paradisaea*
Ardea alba subsp. alba	*Ardea alba subsp. alba*
Avocet	*Recurvirostra avosetta*
Balearic Shearwater	*Puffinus mauretanicus*
Barn Owl	*Tyto alba*
Barnacle Goose	*Branta bernicla*
Bearded Tit	*Panurus biarmicus*
Bewick's Swan	*Cygnus columbianus*
Bittern	*Botaurus stellaris*
Black Redstart	*Phoenicurus ochruros*
Black Tern	*Chlidonias niger*
Black-necked Grebe	*Podiceps nigricollis*
Black-tailed Godwit	*Limosa limosa*
Black-throated Diver	*Gavia arctica*
Blue Tit	*Cyanistes caeruleus*
Brambling	*Fringilla montifringilla*
Brent Goose	*Branta bernicla*
Bullfinch	*Pyrrhula pyrrhula*
Cetti's Warbler	*Cettia cetti*
Coal Tit	*Periparus ater*
Common (Mealy) Redpoll	*Acanthis flammea*
Common Crossbill	*Loxia curvirostra*
Common Scoter	*Melanitta nigra*
Common Tern	*Sterna hirundo*
Crane	*Grus grus*
Cuckoo	*Cuculus canorus*
Curlew	*Numenius arquata*
Dark-bellied Brent Goose	*Branta bernicla subsp. bernicla*
Dartford Warbler	*Sylvia undata*
Dunlin	*Calidris alpina*
Dunnock	*Prunella modularis*
Fieldfare	*Turdus pilaris*
Firecrest	*Regulus ignicapilla*
Garganey	*Anas querquedula*
Goldcrest	*Regulus regulus*
Goldeneye	*Bucephala clangula*
Goldfinch	*Carduelis carduelis*
Goshawk	*Accipiter gentilis*
Grasshopper Warbler	*Locustella naevia*

Common Name	Latin Name
Great Grey Shrike	*Lanius excubitor*
Great Northern Diver	*Gavia immer*
Great Spotted Woodpecker	*Dendrocopos major*
Great Tit	*Parus major*
Great White Egret	*Ardea alba*
Green Sandpiper	*Tringa ochropus*
Green Woodpecker	*Picus viridis*
Greenfinch	*Carduelis chloris*
Greenshank	*Tringa nebularia*
Grey Partridge	*Perdix perdix*
Grey Phalarope	*Phalaropus fulicarius*
Grey Wagtail	*Motacilla cinerea*
Greylag Goose	*Anser anser*
Hawfinch	*Coccothraustes coccothraustes*
Hen Harrier	*Circus cyaneus*
Herring Gull	*Larus argentatus*
Hobby	*Falco subbuteo*
Honey-buzzard	*Pernis apivorus*
Hoopoe	*Upupa epops*
House Martin	*Delichon urbicum*
House Sparrow	*Passer domesticus*
Kestrel	*Falco tinnunculus*
Kingfisher	*Alcedo atthis*
Lapland Bunting	*Calcarius lapponicus*
Lapwing	*Vanellus vanellus*
Leach's Petrel	*Oceanodroma leucorhoa*
Lesser Redpoll	*Acanthis cabaret*
Light-bellied Brent Goose	*Branta bernicla subsp. hrota*
Linnet	*Linaria cannabina*
Little Egret	*Egretta garzetta*
Little Gull	*Hydrocoloeus minutus*
Little Owl	*Athene noctua*
Little Ringed Plover	*Charadrius dubius*
Little Stint	*Calidris minuta*
Little Tern	*Sternula albifrons*
Long-eared Owl	*Asio otus*
Long-tailed Duck	*Clangula hyemalis*
Manx Shearwater	*Puffinus puffinus*
Marsh Harrier	*Circus aeruginosus*
Marsh Tit	*Poecile palustris*
Meadow Pipit	*Anthus pratensis*
Mediterranean Gull	*Larus melanocephalus*

Common Name	Latin Name
Merlin	*Falco columbarius*
Nightingale	*Luscinia megarhynchos*
Olive-backed Pipit	*Anthus hodgsoni*
Osprey	*Pandion haliaetus*
Peregrine	*Falco peregrinus*
Pied Wagtail	*Motacilla alba subsp. yarrellii*
Pintail	*Anas acuta*
Purple Sandpiper	*Calidris maritima*
Red Kite	*Milvus milvus*
Red-backed Shrike	*Lanius collurio*
Red-flanked Bluetail	*Tarsiger cyanurus*
Redstart	*Phoenicurus phoenicurus*
Red-throated Diver	*Gavia stellata*
Redwing	*Turdus iliacus*
Reed Bunting	*Emberiza schoeniclus*
Ring Ouzel	*Turdus torquatus*
Ringed Plover	*Charadrius hiaticula*
Robin	*Erithacus rubecula*
Rock Pipit	*Anthus petrosus*
Roseate Tern	*Sterna dougallii*
Ruddy Shelduck	*Tadorna ferruginea*
Ruff	*Calidris pugnax*
Sabine's Gull	*Xema sabini*
Sand Martin	*Riparia riparia*
Sanderling	*Calidris alba*
Sandwich Tern	*Sterna sandvicensis*
Scaup	*Aythya marila*
Serin	*Serinus serinus*
Shag	*Phalacrocorax aristotelis*
Shelduck	*Tadorna tadorna*
Shore Lark	*Eremophila alpestris*
Short-eared Owl	*Asio flammeus*
Siskin	*Spinus spinus*
Skylark	*Alauda arvensis*
Slavonian Grebe	*Podiceps auritus*
Smew	*Mergellus albellus*
Snow Bunting	*Plectrophenax nivalis*
Song Thrush	*Turdus philomelos*
Sooty Shearwater	*Puffinus griseus*
Spoonbill	*Platalea leucorodia*
Spotted Flycatcher	*Muscicapa striata*
Starling	*Sturnus vulgaris*

Common Name	Latin Name
Stonechat	*Saxicola rubicola*
Swallow	*Hirundo rustica*
Swift	*Apus apus*
Tawny Owl	*Strix aluco*
Tree Pipit	*Anthus trivialis*
Tree Sparrow	*Passer montanus*
Treecreeper	*Certhia familiaris*
Turnstone	*Arenaria interpres*
Turtle Dove	*Streptopelia turtur*
Twite	*Linaria flavirostris*
Velvet Scoter	*Melanitta fusca*
Water Pipit	*Anthus spinoletta*
Waxwing	*Bombycilla garrulus*
Wheatear	*Oenanthe oenanthe*
Whimbrel	*Numenius phaeopus*
Whinchat	*Saxicola rubetra*
White Wagtail	*Motacilla alba subsp. alba*
White-fronted Goose	*Anser albifrons*
White-spotted Bluethroat	*Luscinia svecica subsp. cyanecula*
White-tailed Eagle	*Haliaeetus albicilla*
Whooper Swan	*Cygnus cygnus*
Wood Warbler	*Phylloscopus sibilatrix*
Woodchat Shrike	*Lanius senator*
Woodlark	*Lullula arborea*
Wren	*Troglodytes troglodytes*
Wryneck	*Jynx torquilla*
Yellow Wagtail	*Motacilla flava*
Yellowhammer	*Emberiza citrinella*

Appendix E – Bat Survey Results

Lake Lothing Third Crossing

Lowestoft

Interim Bat Survey Report

December 2016

Produced for
Suffolk County Council

Prepared by

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Document Control Sheet

Project Title	Lake Lothing Third Crossing
Report Title	Interim Bat Survey Report
Report ref no.	
Version	1
Status	Draft
Report Date	December 2016

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
1	Draft	L. Elliott	24.10.16	B. Bailey	10.11.16	A.Bascombe	16.12.16

Distribution

Date	Organisation	Contact	Format	Copies
Feb 17	PINS	-	e and paper	1

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Contents

1 Introduction

1.1 Background

Mouchel was commissioned by Suffolk County Council to undertake surveys for bats at land within and adjacent to the proposed route of the Lake Lothing Third Crossing.

A Phase 1 habitat survey of four potential route options was undertaken by Mouchel in October 2015, the aim of which was to appraise the ecological value of the study area, identify habitats present and determine their likelihood of supporting protected species. The survey reported that buildings within the main study area may be suitable to support roosting bats and it was recommended that further investigations be carried out to inform the scheme design and assessment.

Following selection of a preferred route, an update Phase 1 habitat survey was undertaken by Mouchel in August 2016. Again, it was noted that the buildings within the study area, adjacent to the proposed route were suitable for roosting bats.

Detailed assessments of the buildings were undertaken in August 2016 with emergence/re-entry and activity surveys undertaken between August and October 2016, the aim of which was to establish if roosting bats are present within buildings adjacent to the scheme and to determine the levels of bat activity throughout the scheme area.

1.2 Study Area

The proposed route of the scheme runs from the Peto Way/Denmark Road roundabout at the North Quay Retail Park on the northern side, to the A12 Tom Crisp Way/B1531 Waveney Drive roundabout on the southern side, with the actual crossing point between Denmark Way and Riverside Road. The proposed route area includes several new and existing minor roads near Riverside Road. A study area extending up to 1km from the proposed route was defined, within which field surveys focussed on the proposed route and adjacent habitats.

1.3 Study Aims and Objectives

The study sought to determine whether bat roosts, or foraging and commuting areas used by bats are present within or adjacent to the proposed route of the scheme. To achieve this, the following tasks were undertaken:

- A review of bat records from within the study area received from relevant organisations;
- Field surveys investigating possible bat roosts and possible foraging and commuting features within the study area, and gathering data on the use of the study area by bats; and

- Mapping and analysis of bat data, identification of bat species and number assemblages at specific locations and identification of commuting and foraging areas.

The results of the surveys will inform an assessment of the likely impacts of the scheme on bats and the requirement for any future mitigation that may be required.

2 Methodology

2.1 Desk Study

The following sources were consulted for information on bats within the study area:

- Suffolk Biological Records Centre (SBRC) was consulted in 2015 for records of protected species within the wider study area as part of the ecological assessment undertaken of potential alignment options; and

- The Multi-Agency Geographic Information for the Countryside (MAGIC) online resource was used to identify any records of granted European Protected Species (EPS) licences relating to bats within the study area.

2.2 Preliminary Assessment

A preliminary assessment of the suitability of structures within the study area to support roosting bats was carried out in August 2016 so that suitable roosting features could be subject to further assessment at a later stage. These features were assessed as to their likelihood of supporting roosting bats (low, moderate and/or high) in accordance with the Bat Conservation Trust (BCT) guidelines. An assessment of suitable foraging and commuting features was also undertaken.

2.3 Dusk Emergence Surveys

Dusk emergence surveys were carried out by experienced bat surveyors between 30th August and 4th October 2016 following guidance set out in the Bat Conservation Trust's Good Practice Guidelines[1]. Further surveys will be undertaken in 2017.

Dependant on the likelihood of a structure to support roosting bats (low, moderate or high), each site was surveyed one, two or three times, in line with the guidance. Dusk emergence surveys commenced 20 minutes before sunset and continued for up to two hours after sunset. Each surveyor was equipped with a heterodyne bat detector (Bat Box Duet) and an MP3 recorder and made notes of the times of bat calls and any bat activity seen or heard. Anabat SD1 bat detectors were also used to record levels of bat activity around the structure.

2.4 Activity Surveys

Dusk activity surveys were undertaken on 15th and 19th September 2016. Further activity surveys will be undertaken in 2017. Surveys commenced at sunset and continued for approximately two hours with surveyors walking a predetermined route around the study area, stopping at regular listening points for a period of five minutes. Each surveyor was equipped with a heterodyne bat detector (Bat Box Duet)

[1] Collins, J. et al. (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). Bat Conservation Trust, London

and an MP3 recorder and/or an Anabat and made notes on the levels of bat activity, including times of calls and direction and type of passes.

2.5 Data Analysis

Recorded data was analysed using Analook and/or BatSound as appropriate in order to obtain the following information:

- Species present during each survey (where identification possible);
- Verification of species observed roosting (if required);
- Bat activity levels (commuting/foraging); and
- Any bat calls recorded that were not identified in field notes.

2.6 Limitations

At the time of the 2016 surveys, access was not available to all parts of the survey area. Surveys of these areas will be undertaken in 2017 when access becomes available to ensure that an assessment of the use of these areas by bats can be made.

The emergence and transect surveys undertaken in 2016 were carried out towards the end of the survey season. Further surveys as shown in Table 2 are to be undertaken in 2017 to ensure full coverage.

3 Results

3.1 Desk Study

No records of bats from within the study area were present in the data obtained from SBRC. The data included two records of roosting brown long-eared bat *Plecotus auritus* and common pipistrelle *Pipistrellus pipistrellus*. These roosts are located over 2.5km from the scheme.

There are no records of any previously granted EPS licences relating to bats within the study area.

3.2 Preliminary Assessment

3.2.1 Roosts

Assessment of structures for their suitability to support roosting bats was undertaken during the update Phase 1 habitat survey conducted by Mouchel in August 2016.

Structures considered to be suitable to support roosting bats were considered in the context of their proximity to the location of the proposed scheme to determine the requirement to undertake appropriate surveys. Structures which were not located immediately adjacent to the proposed route alignment were scoped out of any further surveys.

Four sites were identified as requiring further surveys for bat roost presence. The likelihood of each of these sites being able to support roosting bats was assessed as shown in Table 1 below.

Table 1 – Assessment of the suitability of sites to support roosting bats, and the need for further surveys

Site Name	Description	Bat Roost Potential*
Waveney District Council Registry Office, Canning Road	Two-storey office building with brick exterior, a tiled, hipped roof with concrete ridge tiles and hipped dormer sections on the northern and southern aspects. Well-fitting soffit boxes. Good state of repair.	Low – small gap beneath ridge tiles.
Riverside Business Centre, Riverside Road	Large office building with a brick exterior and a complex tiled, hipped roof with several sections. Well-fitting soffit boxes. Solar panels on southern aspect of roof. Good state of repair.	Low – small gap between roof tiles.
Residential House	Two storey residential house with multiple pitched roof sections. Good state of repair.	Low – large parts of roof obscured from view. Features may be hidden.

David's Trade Car Garage, Denmark Road	Single storey brick built building with a concrete tiled, pitched roof. Multiple gaps/cracks in the brick work, large gaps between the top of the walls and the eaves, missing roof tiles. Poor state of repair.	High – multiple entry points, roof space enclosed within, building not in use.

*In accordance with BCT guidelines: High potential = Structure with one or more potential roost sites suitable for use by large numbers of bats. Moderate potential = Structure with one or more potential roost sites that could be used by bats but unlikely to support a roost of high conservation value. Low potential = Structure with one or more potential roost sites that could be used by individual bats opportunistically.

3.2.2 *Activity*

An assessment of the likely value of the habitats within the study area for foraging and commuting bats was undertaken during the update Phase 1 habitat survey which was conducted by Mouchel in August 2016. The habitats within the scheme are dominated by hardstanding and buildings which are of negligible value to foraging and commuting bats. The lake is of some value to foraging bats, however, given the lack of any other suitable habitat within the area, this value is limited. Nevertheless, further activity surveys were undertaken across the whole of the scheme to determine levels of bat activity.

3.3 Dusk Emergence Surveys

The four sites identified as suitable to support roosting bats were scheduled to have one, two or three surveys depending on the likelihood of a bat roost being present. The dates and weather conditions during each of these surveys are detailed in Table 2.

Table 2 – Dates and weather conditions for roost surveys

Site	Survey Records	Survey 1	Survey 2	Survey 3
Waveney District Council Registry Office, Canning Road	Survey Type and Date	Dusk emergence, 30/08/16		
	Weather Conditions	16°C, BF2, 5% CC, dry		
Riverside Business Centre, Riverside Road	Survey Type and Date	Dusk emergence, 12/09/16		
	Weather Conditions	18°C, BF1-2, 50% CC, dry		
Residential House	Survey Type and Date	Pending	Pending	
	Weather Conditions	Pending	Pending	

Site	Survey Records	Survey 1	Survey 2	Survey 3
Car Garage, Denmark Road	Survey Type and Date	Dusk emergence, 08/09/16	Dusk emergence, 04/10/16	Pending
	Weather Conditions	20°C, BF1, 60% CC, dry	17°C, BF3, 70% CC, dry	Pending

No bats were recorded to emerge from any of the buildings surveyed.

At the Registry Office and Riverside Business Centre, both located on the southern side of Lake Lothing, bat activity recorded during these surveys was very low with only a single pipistrelle *Pipistrellus* sp. pass recorded during each survey.

At the car garage, located on the northern side of the lake, low levels of *Myotis* sp. and common pipistrelle passes were recorded. In addition, periods of foraging activity by Nathusius' pipistrelle *Pipistrellus nathusii* were recorded along the southern edge of the garage compound.

3.4 Activity Surveys

The dates and weather conditions during each of the activity surveys are detailed in Table 3.

Table 3 – Dates and weather conditions for activity surveys

Site	Survey Type and Date	Weather Conditions
North Bank Transect	Dusk transect, 15/09/16	20°C, BF1, 30% CC, dry
South Bank Transect	Dusk transect, 19/09/16	17°C, BF2, 10% CC, dry

Activity levels were low during both surveys undertaken, with activity limited to a small number of infrequent and faint commuting passes. A single Myotis bat pass was recorded during the activity survey undertaken on the north side on 15/09/16. A single common pipistrelle pass and two faint, unidentified bat passes were recorded during the activity survey undertaken on the south side on 19/09/16.

4 Discussion

4.1 Bat Roosting Opportunities

No evidence of roosting bats was recorded from any of the buildings surveyed during the surveys undertaken during 2016. Further surveys will be undertaken during 2017.

4.2 Bat Foraging and Wider Context

Activity levels recorded during the emergence surveys and the walked transect surveys was generally low, typically with just a single bat pass recorded.

Surveys undertaken at the car garage on the northern side of Lake Lothing recorded activity by Nathusius' pipistrelle. This species, although widespread, is rare within the UK. Further surveys will be undertaken during 2017 to obtain more information on the use of the habitats within the scheme by this species.

Appendix F – BAP List

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Mammals			
Atlantic White-sided Dolphin *Lagenorhynchus acutus*		No	
Bats (grouped plan)	EPS	Yes	
Bottlenose Dolphin *Tursiops truncates*		No	
Brown hare *Lepus europaeus*		No	
Common Dolphin *Delphinus delphis*		No	
Common Seal *Phoca vitulina*		No	
Dormouse *Muscardinus avellanarius*		No	
Harbour porpoise *Phocoena phocoena*		Yes	
Harvest Mouse *Micromys minutus*		No	
Hedgehog *Erinaceus europaeus*		Yes	
Humpback Whale *Megaptera novaeangliae*		No	
Long-finned Pilot Whale *Globicephala melas*		No	
Killer Whale *Orcinus orca*		No	
Minke Whale Balaenoptera acutorostrata		No	
Otter Lutra lutra	EPS	Yes	
Polecat Mustela putorius		No	
Striped Dolphin *Stenella coeruleoalba*		No	
Water vole *Arvicola terrestris*	EPS	Yes	
Water Shrew *Neomys fodiens*		No	
White Beaked Dolphin *Lagenorhynchus albirostris*		No	
Red squirrel *Sciurus vulgaris*		No	Thought to be extinct in Suffolk
Amphibians & Reptiles			
Adder *Vipera berus*		No	
Common Lizard *Zootoca vivipara*		Yes	
Common Toad *Bufo bufo*		Yes	

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Grass Snake *Natrix natrix*		Yes	
Great crested newt *Triturus cristatus*		No	
Natterjack Toad *Epidalea calamita* **(Formerly** *Bufo calamita***)**		No	
Slow-worm *Anguis fragilis*		Yes	
Birds			
Barn Owl *Tyto alba*	Sch 1	No	
Bittern *Botaurus stellaris*	Sch 1 BoCC Amber	No	
Black-tailed Godwit *Limosa limosa*	Sch 1 BoCC Red	No	
Bullfinch *Pyrrhula pyrrhula*	BoCC Amber	Yes	
Common Cuckoo *Cuculus canorus*	BoCC Red	Limited	
Common Grasshopper Warbler *Locustella naevia*	BoCC Red	No	
Corn Bunting *Miliaria calandra*	BoCC Red	No	
Curlew *Numernius arquata*	BoCC Red	No	
Grey partridge *Perdix perdix*	BoCC Red	No	
Hedge Accentor (Dunnock) *Prunella modularis*	BoCC Amber	Yes	
Herring Gull subspecies *argenteus Larus argentatus argenteus*	BoCC Red	Yes	
House Sparrow *Passer domesticus*	BoCC Red	Yes	
Lesser Redpoll *Carduelis cabaret*	BoCC Red	No	
Lesser Spotted Woodpecker *Dendrocopos minor*	BoCC Red	No	
Linnet *Carduelis cannabina*	BoCC Red	No	
Little tern *Sterna albifrons*	Sch 1 BoCC Amber	No	
Marsh Tit *Poecile palustris*	BoCC Red	Yes	
Nightjar *Caprimulgus europaeus*	BoCC Amber	No	

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Northern Lapwing *Vanellus vanellus*	BoCC Red	No	
Reed Bunting *Emberiza schoeniclus*	BoCC Amber	No	
Savi's Warbler *Locustella luscinoides*	Sch 1 BoCC Red	No	
Skylark *Alauda arvensis*	BoCC Red	No	
Song thrush *Turdus philomelos*	BoCC Red	Yes	
Spotted Flycatcher *Muscicapa striata*	BoCC Red	Yes	
Starling *Sturnus vulgaris*	BoCC Red	Yes	
Stone curlew *Burhinus oedicnemus*	Sch 1 BoCC Amber	No	
Swift *Apus apus*	BoCC Amber	Yes	
Tree Pipit *Anthus trivialis*	BoCC Red	No	
Tree Sparrow *Passer montanus*	BoCC Red	Yes	
Turtle Dove *Streptopelia turtur*	BoCC Red	Yes	
Twite *Carduelis flavirostris*	BoCC Red	No	
Willow Tit *Poecile montanus*	BoCC Red	Yes	
Woodlark *Lullula arborea*	Sch 1	No	
Wood Warbler *Phylloscopus sibilatrix*	BoCC Red	No	
Yellowhammer *Emeriza citronella*	BoCC Red	No	
Yellow Wagtail *Motacilla flava*	BoCC Red	Yes	
Freshwater Fish			
European Eel *Anguilla Anguilla*		Yes	
River Lamprey *Lampetra fluviatilis*		Yes	
Spined Loach *Cobitis taenia*		Yes	Not known to be in the River Waveney
Marine Fish			
Allis Shad *Alosa alosa*		Yes	Not thought to be present in Suffolk
Twaite Shad *Alosa fallax*		Yes	Not thought to be present in Suffolk

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Lesser Sandeel *Ammodytes marinus*		Yes	
Basking Shark *Cetorhinus maximus*		No	
Herring *Clupea harengus*		No	
Common Skate *Dipturus batis*		No	
Cod *Gadus morhua*		Yes	
Tope Shark *Galeorhinus galeus*		Yes	
Long-snouted Seahorse *Hippocampus guttulatus*		No	
Short-snouted Seahorse *Hippocampus hippoglossus*		No	
Atlantic Halibut *Hippoglossus hippoglossus*		No	
Porbeagle Shark *Lamna nasus*		No	
Sea Monkfish *Lophius piscatorius*		No	
Whiting *Merlangius merlangus*		No	
European Hake *Merluccius merluccius*		No	
Ling *Molva molva*		No	Not known to be found in East Anglian waters
Smelt *Osmerus eperlanus*		Yes	
Sea Lamprey *Petromyzon marinus*		Yes	
Plaice *Pleuronectes platessa*		No	
Blue Shark *Prionace glauca*		No	
Undulate Ray *Raja undulata*		No	
White or Bottlenosed Skate *Rostroraja alba*		No	
Brown or Sea Trout *Salmo trutta*		Yes	
Mackerel *Scomber scombus*		No	
Sole *Solea solea*		No	
Spiny Dogfish *Squalus acanthias*		No	

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Angel Shark *Squatina sqatina*		No	
Blue-fin Tuna *Thunnus thynnus*		No	
Horse Mackerel *Trachurus trachurus*		No	
Bees & Antlion			
Brown-banded Carder Bee *Bombus humilis*		No	
Large Garden Bublebee *Bombus ruderatus*		Limited	
Moss Carder Bee *Bombus muscorum*		No	
Red-Shanked Carder-bee *Bombus ruderarius*		No	
Sea-aster Colletes Bee *Colletes halophilus*		Yes	
Antlion *Euroleon nostras*		No	
Beetles			
Wormwood Moonshiner *Amara fusca*		No	
Scarce Four-dot Pin-palp *Bembidion quadripustulatum*		Yes	
Poplar Leaf-rolling Weevil *Byctiscus populi*		Yes	
Necklace Ground Beetle *Carabus monilis*		No	
Pashford Pot Beetle *Cryptocephalus exiguous*		No	
Six-spotted Pot Beetle *Cryptocephalus sexpunctatus*		Yes	
Zircon Reed Beetle *Donacia aquatic*		No	
Brush-thighed Seed-eater *Harpalus froelichii*		Yes	Restricted sites
Stag beetle *Lucanus cervus*	WCA (sale only)	No	
Black Oil Beetle *Meloe proscarabaeus*		Yes	
Alder Flea weevil *Orchestes testaceus*		Yes	
Butterflies			

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Dingy Skipper *Erynnis tages*		Yes	
Grayling *Hipparchia Semele*		Yes	
Silver-studded Blue *Plebejus argus*		No	
Small Heath *Coenonympha pamphilus*		Yes	
Wall *Lasiommata megera*		Yes	
White Admiral *Limenitis camilla*		No	
White-letter Hairstreak *Satyrium w-album*	WCA (sale only)	No	
Cnidarians & Crustaceans			
Starlet sea-anemone *Nematostella vectensis*	WCA	No	
Lagoon Sand Shrimp *Gammarus insensibilis*	WCA (4a – damage to structures)	No	
White-clawed crayfish *Austropotamobius pallipes*	WCA (taking & sale)	No	
Dragonflies & Flies			
Norfolk hawker *Aeshna isoceles*	WCA	No	
Golden Hoverfly *Callicera spinolae*		No	
Fancy-legged fly *Campsicnemus magius*		Yes	
Cigarillo Gall-fly *Lipara similis*		No	
Southern Yellow Splinter *Lipsothrix nervosa*		No	
Molluscs			
Depressed river mussel *Pseudanodonta complanata*		No	
Desmoulin's whorl snail *Vertigo moulinsiana*		No	
Large-mouthed Valve Snail *Valvata macrostoma*		No	
Narrow-mouth whorl snail *Vertigo angustior*		No	
Native Oyster *Ostrea edulis*		Yes	

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Ramshorn snail *Anisus vorticulus*		No	
Shining ram's-horn snail *Segmentina nitida*		No	
Moths			
The Forester *Adscita statices*		Yes	
Sloe Carpet *Aleucis distinctata*		No	
Rest Harrow *Aplasta ononaria*		No	
White-mantled Wainscot *Archanara neurica*		No	
Fenn's Wainscot *Chortodes brevilinea*		No	
The Concolorous *Chortodes extrema*		No	
Water-dock Case-bearer *Coleophora hydrolapathella*		No	
Basil Thyme Case-bearer *Coleophora tricolor*		No	
White Spotted Pinion *Cosmia diffinis*		No	
Goat Moth *Cossus cossus*		Yes	
Dingy Mocha *Cyclophora pendularia*		Yes	
False Mocha *Cyclophora porata*		Yes	
Bordered Gothic *Heliophobus reticulate*		Yes	
Narrow-bordered Bee Hawk-moth *Hemaris tityus*		No	
Grey Carpet *Lithostege griseata*		No	
Horehound Long-horn Moth *Nemophora fasciella*		No	
Lunar Yellow Underwing *Noctua orbona*		No	
Barberry Carpet *Pareulype berberata*	WCA	No	
Pale Shining Brown *Polia bombycina*		Yes	
Olive Crescent *Trisateles emortualis*		No	

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Four-spotted Moth *Tyta luctuosa*		Yes	
Spiders			
Yellow-striped Bear-spider *Arctosa fulvolineata*		No	
Duffy's Bell-headed Spider *Baryphyma duffeyi*		No	
Serrated Tongue Spider *Centromerus serratus*		No	
Rosser's Sac-spider *Clubiona rosserae*		No	
Silky Gallows-spider *Dipoena inornata*		No	
Fen Raft Spider *Dolomedes plantarius*	WCA	No	
Heath Grasper *Haplodrassus dalmatensis*		No	
Swamp Lookout Spider *Notioscopus sarcinatus*		No	
Whelk-shell Jumper *Pseudeuophrys obsolete*		No	
Wasps			
Weevil Hunting Wasp *Cerceris quadricincta*		Yes	
Fen Mason-wasp *Odynerus simillimus*		No	
5-Banded Tailed Digger Wasp *Cerceris quinquefasciata*		Yes	
Bugs			
A Mirid Bug *Orthotylus rubidus*		No	
Bryophytes			
Pitted Frillwort *Fossombronia foveolata*		No	
Thatch Moss *Leptodontium gemmascens*		No	
Texas Balloonwort *Sphaerocarpos texanus*		Yes	
Chalk Screw Moss *Tortula vahliana*		Yes	Not known in Suffolk

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Veilwort *Pallavicinia lyellii*		No	
Fungi			
Bearded Tooth *Hericium erinaceus*		No	
Coral Tooth *Hericium coralloides*		No	
Oak Polypore *Buglossoporus pulvinus*		No	
Orange Chanterelle *Cantharellus friesii*		No	
Sandy stilt puffball *Battarraea phalloides*		Yes	
Pepper Pot *Myriostoma coliforme*		No	
Orchard Tooth *Sarcodontia crocea*		No	
'Tiny Earthstar' *Geastrum minimum*		Yes	
Lichens			
A Lichen *Anaptychia ciliaris* **subsp.** *ciliaris*		Yes	Few mature trees of the host species
A Lichen *Bacidia incompta*		No	
Starry breck-lichen *Buellia asterella*		No	
Orange-fruited elm-lichen *Caloplaca luteoalba*		Yes	
A Lichen *Caloplaca virescens*		Yes	
A lichen *Lecania chlorotiza*		Yes	
A Lichen *Pyrenula nitida*		Yes	
Scaly Breck-lichen *Squamarina lentigera*		Yes	
A Lichen *Toninia physaroides*		No	
A Lichen *Toninia sedifolia*		Yes	
Plants			
Early Marsh-orchid (cream flowered) *Dactylorhiza incarnata* **subs.** *Ochroleuca*		No	
Annual Knawel *Scleranthus annuus*		No	
Basil Thyme *Clinopodium acinos*		No	

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Bearded Stonewort *Chara canescens*		No	
Borrer's Saltmarsh-grass *Puccinellia fasciculate*		No	
Broad-leaved Cudweed *Filago pyramidata*		No	
Corn Buttercup *Ranunculus arvensis*		No	
Cornflower *Centaurea cyanus*		No	
Crested Cow-wheat *Melampyrum cristatum*		No	
Divided Sedge *Carex divisa*		No	
Field Wormwood *Artemisia campestris*		Yes	
Fine-leaved Sandwort *Minuartia hybrida*		Yes	
Fingered Speedwell Veronica triphyllos		Yes	
Flat Sedge *Blysmus compressus*		No	
Fly Orchid *Ophrys insectifera*		No	
Frog Orchid *Dactylorhiza viridis*		No	
Grape-hyacinth *Muscari neglectum*		Yes	
Greater Water-parsnip *Sium latifolium*		No	
Man orchid *Aceras anthropophorum*		No	
Stitchwort *Stellaria palustris*		No	
Native Black Poplar *Populus nigra* **ssp.***betulifolia*		No	
Pillwort *Pilularia globulifera*		No	
Prickly Saltwort *Salsola kali* **subs.** *Kali*		No	
Purple Milk-vetch *Astragalus danicus*		No	
Rare Spring-sedge *Carex ercetorum*		No	
Red Hemp-nettle *Galeopsis angustifolia*		Yes	

Species	Other Designations	Habitats within Scheme Boundary	Additional Notes
Red-tipped Cudweed *Filago lutescens*		Yes	
Sea Barley *Hordeum marinum*		No	
Shepherd's needle *Scandix pectinveneris*		No	
Slender Hare's-ear *Bupleurum tenuissimum*		No	
Small Cord-grass *Spartina maritima*		No	
Small-flowered Catchfly *Silene gallica*		Yes	
Spanish Catchfly *Silene otitis*		Yes	
Spreading Hedge-parsley *Torilis arvensis*		Yes	
Spring Speedwell *Veronica verna*		Yes	
Stinking Goosefoot *Chenopodium vulvaria*		No	
Tassel Stonewort *Tolypella intricata*		No	
Tower Mustard *Arabis glabra*		No	
Tubular Water-dropwort *Oenanthe fistulosa*		No	
Unspotted Lungwort *Pulmonaria obscura*		No	

References

http://www.arkive.org

http://www.brc.ac.uk/plantatlas

http://www.britishlichensociety.org.uk/

http://britishseafishing.co.uk

https://www.buglife.org.uk

http://butterfly-conservation.org

https://www.bto.org/about-birds/birdfacts

*www.**dolomedes**.org.uk*

http://www.habitas.org.uk/

http://www.iucnredlist.org

http://jncc.defra.gov.uk/protectedsites/sacselection/species

http://www.lichensmaritimes.org/

http://www.marlin.ac.uk

http://www.mcsuk.org/

http://www.snh.gov.uk/about-scotlands-nature/species/invertebrates/land-invertebrates/beetles/

http://www.sharktrust.org/en/british_sharks

Appendix H – Written Scheme of Investigation

Lake Lothing Third Crossing, Lowestoft, Suffolk

Written Scheme of Investigation for Watching Brief during Geotechnical Ground Investigation

Lake Lothing THIRD CROSSING

Prepared for:

Suffolk County Council

Prepared by:

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Document Control Sheet

Project Title	Lake Lothing Third Crossing
Report Title	Written Scheme of Investigation for Watching Brief during Geotechnical Ground Investigation
Revision	1.0
Status	Final
Control Date	14th December 2016

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
0.1	Draft	A. Hancock	28.11.16	H Roberts	28.11.16	S Hales	28.11.16
1.0	Final	A. Hancock	13.12.16	H Roberts	14.12.16	S Hales	14.12.16

Distribution

Organisation	Contact	Copies
Suffolk County Council	Michael Wilks	e
Suffolk County Council Archaeological Service	Abby Antrobus	e

Contents

Limitations

This report is presented to Suffolk County Council in respect of the proposed Lake Lothing Third Crossing. It may not be used by Suffolk County Council in relation to any other matters not covered specifically by the agreed scope of this Report.

Notwithstanding anything to the contrary contained in the report, Mouchel Ltd is obliged to exercise reasonable skill, care and diligence in the performance of the services required by Suffolk County Council and Mouchel shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This report has been prepared by Mouchel Ltd. No individual is personally liable in connection with the preparation of this report. By receiving this report and acting on it, the Client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

1 Introduction

Mouchel proposes to implement a programme of archaeological monitoring (Watching Brief) during ground investigation comprising excavation of twenty three trial pits and two T shaped trenches (Figures 1069948/GI/001 and 1069948/GI/002) for the proposed Lake Lothing Third Crossing, Lowestoft.

This Written Scheme of Investigation (WSI) sets out the approach to the archaeological monitoring of the ground investigation trial pits and trenches. The WSI will be agreed with Suffolk County Council Archaeological Service (SCCAS) prior to commencement of the site works.

2 Archaeological Background

2.1 Precis

This section provides a brief outline of the archaeological and historic background of the area of the proposed Lake Lothing Third Crossing. Information is taken from the Suffolk Historic Environment Record (HER) and the National Heritage List for England (NHLE). A more detailed Archaeological and Historical background will be produced as part of the Environmental Impact Assessment.

2.2 History and Archaeology

Heritage assets are described in the context of a timeline of archaeological periods from prehistoric through to modern. The time periods discussed can be broadly divided as follows:

- Prehistoric:
    - Palaeolithic c.800,000 – 10,000 BC
    - Mesolithic 10,000 – 4,000 BC
    - Neolithic 4,000 – 2,500 BC
    - Bronze Age 2,500 – 700 BC
    - Iron Age 800 BC – AD 43
- Roman AD 43 – 410
- Early Medieval AD 410 – 1066
- Medieval AD 1066 – 1540
- Post-Medieval AD 1540 – 1900
- Modern AD 1900 – present

Palaeolithic

There is limited evidence of Palaeolithic activity in the vicinity of the proposed Third Crossing; in the 19th century five early Palaeolithic flints, including one possible handaxe, were recovered from 'Cannon-shot' gravels at Normanston. However, well preserved evidence of the period (c.700,000 BP) has been discovered at Pakefield c.2.5km to the south within the Cromer Forest Bed Formation. This geological formation is likely to be present at Lowestoft, but will be deeply buried beneath alluvial, marine and glacial deposits.

Mesolithic to Iron Age

Evidence for activity of the Mesolithic, Neolithic, Bronze Age or Iron Age periods is restricted to an isolated Neolithic pit found at Walton Road, Lowestoft and scatters of Neolithic flint tools found at Victoria Road, Lowestoft and Heath Road, Oulton.

Episodes of marine transgression affected the area during the latter part of the Neolithic, the early part of the Bronze Age and the late Iron Age. Any evidence of the periods situated at lower lying areas may have been buried by marine, alluvial and peat deposits.

Roman

It has been suggested that a Roman road from Colchester to Burgh Castle passed through Lowestoft. Archaeological remains tentatively interpreted as part of this road, or an associated bridge, were found during 19th century excavation of peat in the vicinity of the current Bascule Bridge. The evidence comprised several large tree trunks, 10-12 feet in length, laid out parallel and approximately two feet apart.

The closest settlement evidence, including a coin hoard, a possible cremation urn and the skeletons of a number of horses was found approximately 700m to the north east of the proposed Lake Lothing Third Crossing during the 19th century at a part of Lowestoft now known as “Roman Hill”. The HER also records five isolated findspots of Roman coins.

The lower lying parts of the area continued to be affected by a marine transgression and its use may been limited to exploitation of marine and estuarine resources.

Early Medieval

The villages of Lowestoft and Kirkley are mentioned in the Domesday Book and consequently had been founded by the latter part of this period. The early focus of Lowestoft is thought to have been located some distance away from the present town centre, perhaps in the vicinity of St Margaret’s church. It is probable that the area of the proposed Third Crossing was marginal land exploited for estuarine and wetland resources

Medieval

Lowestoft was granted markets in 1308 and 1445 and by the end of the medieval period it was a significant fishing port and the most important settlement in the area. Until the latter part of this period the core of Lowestoft may have retained its focus around St Margaret’s church.

Lake Lothing is a remnant of a turbary, an extensive area of medieval peat cutting. The speed of the peat cutting is currently uncertain, but the eastern end of Lake Lothing including Kirkley Ham inlet was open to the sea by the 14th century when the northern side was known as the Inner Harbour and ships were being constructed on the southern side to the east of Kirkley Ham inlet.

Post-medieval

The town and port of Lowestoft saw significant growth during the 19th century and the conurbation eventually expanded to the south of Lake Lothing. The eastern end of the lake was used as a harbour, with boat and ship building yards, fish processing, ancillary and manufacturing industries located along each side. The higher ground in proximity to the proposed Third Crossing remained agricultural land for the majority of this period.

Modern

Lowestoft continued to expand into the early part of the 20th century with the fishing fleet, boat building and associated trades being the mainstay of its economy. By 1911 the population had reached 37,886, which reflects the peak in production for the British fishing industry.

The First World War saw some of the more capable local boats requisitioned by the Admiralty for patrolling and minesweeping. The town was bombed on a number of occasions, and on 25th April 1916, the German High Sea Fleet shelled the town and harbour leaving forty houses destroyed, two hundred damaged and four people killed.

During the inter war period the fishing industry and the town suffered a decline, but the start of the Second World War saw the town transformed into an important naval base with an all-round defensive perimeter of trenches, pillboxes and dense belts of barbed wire. None of the defences now survive but many of their locations have been recorded by the HER and the Defence of Britain project. The town was extensively bombed during the Second World War and much redevelopment was necessary during the post war period.

During the latter part of the 20th century the port remained a focus of shipbuilding and developed as a focal point for operations of the oil and gas industries in the southern North Sea.

3 Aims, Objectives and Standards

3.1 Aims

The aims of the archaeological monitoring are as follows:

- To examine and record the character, extent, significance, condition, quality, depth and date of any archaeological deposits, features and artefacts revealed by GI trial pits and trenches; and
- To record the presence or absence of palaeoenvironmental deposits, such as alluvium and peat;

3.2 Objectives

The objectives of the archaeological monitoring are as follows:

- To use the results of the archaeological monitoring to inform a future mitigation strategy; and
- To complete a report and archive to the required standard.

3.3 Updating Aims and Objectives

The aims and objectives will be updated to respond to the archaeological evidence as it is uncovered on site in accordance with *Research and Archaeology Revisited: A Revised Framework for the East of England* (Medleycott 2011).

3.4 Standards

The project will be carried out with reference to *Standards for Field Archaeology in the East of England* (Gurney 2003) the Chartered Institute for Archaeologists (CIfA) Code of Conduct, the CIfA *Standard and Guidance for an archaeological watching brief* (2014a) and other relevant CIfA Standards and Guidance documents.

4 Methodology

4.1 General Requirements

Archaeological monitoring will be carried out during ground investigation works, comprising the machine excavation of twenty three trial pits which are distributed along the route of the proposed third crossing and two T shaped trenches situated close to the north and south quaysides (Figures 1069948/GI/001 and 1069948/GI/002).

The scheduled maximum depth of the trial pits is 3m and the two T shaped trenches will be excavated to sufficient depth to determine the location of quay wall tie rods and no greater than 250mm deeper than the tie levels.

The archaeological contractor will prepare a brief Method Statement for the archaeological monitoring. The Method Statement will include summary detail of the archaeological contractor's staff, programme, contingencies and specialists. The Contractor will not commence any site work until the Method Statement has been approved by SCCAS.

The archaeological contractor will consult the Suffolk HER Officer to obtain an event number prior to the commencement of site work. This number must be clearly marked on all documentation relating to the work.

The archaeological contractor will have demonstrable experience of working on similar projects and with comparable archaeological remains. The archaeological contractor will supply a suitably qualified and experienced archaeologist to carry out the monitoring and will maintain regular consultation with Mouchel during the course of the works.

The archaeological contractor will prepare a Risk Assessment for approval by Mouchel. Health and Safety considerations mean that it will not be possible for the monitoring archaeologist to enter ground investigation trial pits or trenches.

The geotechnical contractor will supply plant and will work closely with the archaeological contractor to provide details of their programme and to facilitate access.

Mouchel Heritage Consultants will oversee all archaeological work and will undertake all consultation with SCCAS.

The following sections set out minimum standards that will apply during the archaeological monitoring.

4.2 Archaeological Monitoring

The excavation of each trial pit or trench will be monitored by an archaeologist at all times.

The spoil from the trial pits and trenches will be inspected by the monitoring archaeologist to recover artefacts or ecofacts of archaeological interest and if practicable the spoil will be scanned using a metal detector.

The monitoring archaeologist will record any palaeoenvironmental deposits and archaeological deposits, features or finds revealed by the trial pits and trenches, but

will not enter trial pits or trenches to investigate further unless given express permission to do so by the geotechnical contractor.

Deposits and features of archaeological and palaeoenvironmental significance will be excavated, recorded and sampled as appropriate (subject to access constraints) to establish a stratigraphic and chronological sequence, recognise structural evidence and recover economic, artefactual and environmental evidence.

Environmental sampling will be collected from securely stratified fills of archaeological features and deposits with high palaeoenvironmental potential (subject to access constraints) and sampling procedures will follow guidance provided in *Environmental Archaeology – A guide to the theory and practice of methods, from sampling and recovery to post-excavation (Historic England 2011)* and *Geoarchaeology – Using earth sciences to understand the archaeological record* (Historic England 2015a).

The monitoring archaeologist will work closely with the geotechnical team to ensure that any investigation and recording of palaeoenvironmental deposits, archaeological deposits, features or finds is completed with minimum delay to the geotechnical works.

If archaeological deposits or features of high significance or sensitivity are encountered during trial pitting and trenching, the ground investigation must be halted and no further ground disturbance may occur at that area until SCCAS have been consulted.

4.3 Recording

All archaeological deposits, features and finds will be recorded according to accepted professional standards (see references section) and in line with the archaeological contractor's established recording systems.

A site diary, comprising a description and discussion of the archaeology, is to be maintained on a daily basis.

All survey will be completed relative to Ordnance Survey National Grid in 3D at a resolution sufficient to fulfil the requirements of reporting.

All features (subject to access constraints) shall be recorded in plan at least 1:20 scale and in section at least 1:10 scale. All site drawings will be completed on plastic drafting film

A 'Harris Matrix' stratification diagram will be used to record all stratigraphic relationships on the site. Spot dating should be incorporated where applicable.

A photographic record of the work shall be made and incorporated into the site archive. This will consist of high quality, colour digital photographs taken in approved formats as directed by the digital archive policies of Suffolk Archaeological Services Store.

4.4 Artefacts

Any artefacts that fall under the statutory definition of Treasure (as defined by the Treasure Act of 1996 and its revision of 2002) will be reported immediately to the relevant Coroner's Office and Finds Liaison Officer (FLO), the landowner and SCCAS. A Treasure receipt must be completed and a report submitted to the Coroner's Office and the FLO within 14 days of understanding the find is Treasure. Failure to report within 14 days is a criminal offence.

Artefacts will be carefully recovered by hand and initial conservation and storage will follow *First Aid for Finds*. Bulk artefacts will be collected and bagged according to their archaeological context. The location of registered finds, including in situ worked flint will be recorded three dimensionally. If necessary, an appropriately qualified and experienced archaeological conservator will be appointed to advise and assist in the lifting of fragile finds of significance and or value and to arrange for the X-raying and investigative conservation of objects as may be necessary.

All pottery, bone and worked flint will be washed and then marked in accordance with the archive depository guidelines to identify the site and context. Most building material and burnt flint (not including significant diagnostic material) will be identified, counted, weighed and discarded. Samples will be retained as appropriate. The finds identification and specialist work will be undertaken by specialists agreed with SCCAS and will use relevant county or region specific type series, where available.

Records of artefact assemblages will clearly state how they were recovered, sub-sampled and processed. Sub-sampling procedures will be agreed with SCCAS and follow the guidance and advice of the depository in which the site archive will be deposited.

All artefacts will be suitably packed in accordance with *First Aid for Finds*, the United Kingdom Institute for Conservation, Conservation Guidelines no.2, and the Institute for Archaeologists *'Standard and Guidance for the collection, documentation, conservation and research of archaeological materials*' (CIfA 2014c).

Consideration should be given for donation of appropriate artefacts to type series reference collections.

4.5 Human Remains

In the event that human burials are discovered these will be left in situ and their treatment agreed with Mouchel and the Curator. Should their excavation and removal from the site be required, the Contractor shall obtain a Ministry of Justice Exhumation Licence in accordance with Section 25 of the Burial Act 1857 before the remains are disturbed.

5 Reporting

5.1 General Requirements

A report on the fieldwork and archive will be completed. Its conclusions will include a clear statement of the archaeological value of the results, and their significance. The results will be related to the relevant known archaeological information held by the Suffolk HER.

The report may include an opinion as to the necessity and scope of further archaeological work, although the final decision regarding any further work will be determined by Mouchel in consultation with SCCAS.

In the first instance the archaeological contractor will submit a digital copy of the draft report in .docx format to Mouchel for review and comment.

Following any amendment required by Mouchel the draft report will be submitted by the archaeological contractor to SCCAS for approval. After approval of the report by SCCAS, a single hard copy and a digital copy will be presented to the Suffolk HER.

5.2 Report Content

The report will include, as a minimum:

1. A summary sheet providing the following information:

- Site name and grid reference;
- Site activity (i.e. type of investigation);
- Suffolk HER Event Number;
- Date and duration of project;
- Contractor Site code;
- Area of site;
- Summary of results;
- Monuments identified; and
- Location and reference of archive.

2. And the following main sections, as appropriate to results:

- Summary;
- Site location;
- Methodology;
- Description of results (including stratigraphic description, if necessary);
- Interpretation of the results in the appropriate context;
- Summary of the archaeological potential of the proposed development site and its immediate surrounding area;

- Consideration of the significance of the findings on a local, regional and national basis;
- Critical review of the effectiveness of the methodology;
- References;
- Appropriate photographs in colour;
- Location Plan (no smaller than 1:10 000);
- Site layout plans on an OS base, with north point and scale with the location of trial pits/trenches;
- Plans and sections of significant archaeological remains, as necessary, including Cardinal Points, Ordnance Datum, vertical and horizontal scales;
- Site matrices where appropriate;
- Specialist descriptions of artefacts and ecofacts as required;
- Summary of the contents of the project archive and its location (including summary catalogues of finds);
- Photographic Register; and
- Copy of the OASIS record form.

5.3 Dissemination

If the archaeological monitoring discovers significant archaeological remains the archaeological contractor will prepare a summary report for the *Proceedings of the Suffolk Institute of Archaeology and History*.

6 Archive

All recovered artefacts are the property of the Landowner. Prior to the commencement of fieldwork the Landowner(s) will be contacted to transfer title to artefacts to SCCAS so that the archive, including all artefacts, can be deposited with Suffolk Archaeological Services Store.

The site archive will be assembled in accordance with *Guidelines for Preparation and Deposition of Archaeological Archives in Suffolk* (SCCAS Conservation Team 2014). MoRPHE (Historic England 2015), *Guidelines for the Preparation of Excavation Archives for Long-term Storage* (United Kingdom Institute for Conservation, 1990), *Standards in the Museum Care of Archaeological Collections* (Museums and Galleries Commission, 1994); and relevant CIfA standards and guidance will be used as good practice guidance.

The site archive will contain all the data collected during the fieldwork, including records and finds, and all reports. The archaeological contractor will ensure that the archive is quantified, ordered, indexed and internally consistent, and adequate resources will be provided to ensure that all records are checked. Archive consolidation will be undertaken immediately following the conclusion of fieldwork.

The archaeological contractor will contact the SCCAS Archaeological Collections Officer to determine costs and accession arrangements for the archive prior to deposition at Suffolk Archaeological Services Store.

The archaeological monitoring will be recorded on the OASIS database. All parts of the OASIS online form http://ads.ahds.ac.uk/project/oasis/ will be completed and a copy will be included in the final report and also with the site archive. A digital copy of the approved report will be uploaded to the OASIS website.

7 Operational Factors

7.1 Project Timetable and Monitoring Arrangements

Mouchel will liaise with the geotechnical contractor in regard to access and the health and safety requirements in force on the site. Information will be provided to SCCAS as relevant. A programme of works, monitoring, recording and access will be agreed by the archaeological contractor, the geotechnical contractor, Mouchel and SCCAS before the project commences.

Mouchel will be kept informed of progress by the archaeological contractor to allow for any monitoring visits by SCCAS to be conducted during the course of the fieldwork.

The archaeological monitoring will be undertaken to the schedule of the geotechnical contractor.

7.2 Health and Safety

With specific regard to site hazards, both the archaeological and geotechnical contractor will be responsible for ensuring that all works are conducted in a safe manner. Mouchel must be notified immediately of the nature and extent of any unexpected site hazards and the appropriate health and safety precautions required.

The archaeological contractor will be supplied with an overall site risk assessment by the geotechnical contractor and these documents and all relevant health and safety regulations will be adhered to throughout. Site inductions will also be provided.

7.3 Insurance

Full details of the insurance and copies of certificates covering the archaeological contractor shall be supplied upon request.

7.4 Project Team

The work will be undertaken by a Contractor who is a Registered Organisation with the Chartered Institute for Archaeologists (CIfA) or by a Contractor who will agree to abide by the standards and guidance documents of CIfA. The project will be managed by Alastair Hancock, Senior Heritage Consultant at Mouchel and fully qualified archaeologist with full membership of the CIfA.

Details of the project team and specialist staff including post-excavation specialists will be provided once the archaeological contractor has been appointed. CVs of the key members of staff will be available upon request.

7.5 Copyright

Copyright will remain with the archaeological contractor under the Copyright, Designs and Patents Act 1988 with all rights reserved. An exclusive licence will be provided to the client, or their appointed representative, for use of all project records and reports in all matters directly relating to the project. The archaeological contractor retains the right to be identified as the author of all project documentation and reports.

8 References

Gurney, D 2003 *Standards for Field Archaeology in the East of England.* East Anglian Archaeology Occasional Papers 14

Historic England 2015 *MoRPHE (Management of Research Projects in the Historic Environment)*

Historic England 2007, *Understanding the Archaeology of Landscapes; a guide to good recording practice*

Historic England 2010 *Waterlogged Wood: Guidelines on the Recording, Sampling, Conservation and Curation of Waterlogged Wood*

Historic England 2011 *Environmental Archaeology: A guide to the theory and practice of methods of sampling and recovery to post excavation*

Historic England 2014 *Animal Bones and Archaeology – Guidelines for Best Practice*

Historic England 2015a *Geoarchaeology – Using earth sciences to understand the archaeological record*

Historic England 2015b *Archaeometallurgy – Guidelines for Best Practice*

CIfA 2014a *Standards and Guidance for Archaeological Watching Brief*

CIfA 2014b *Standards and Guidance for Archaeological Excavation*

CIfA 2014c *Standard and guidance for the collection, documentation, conservation and research of archaeological materials*

Medleycott, M 2011 *Research and Archaeology Revisited: A Revised Framework for the East of England.* East Anglian Archaeology Occasional Papers 24

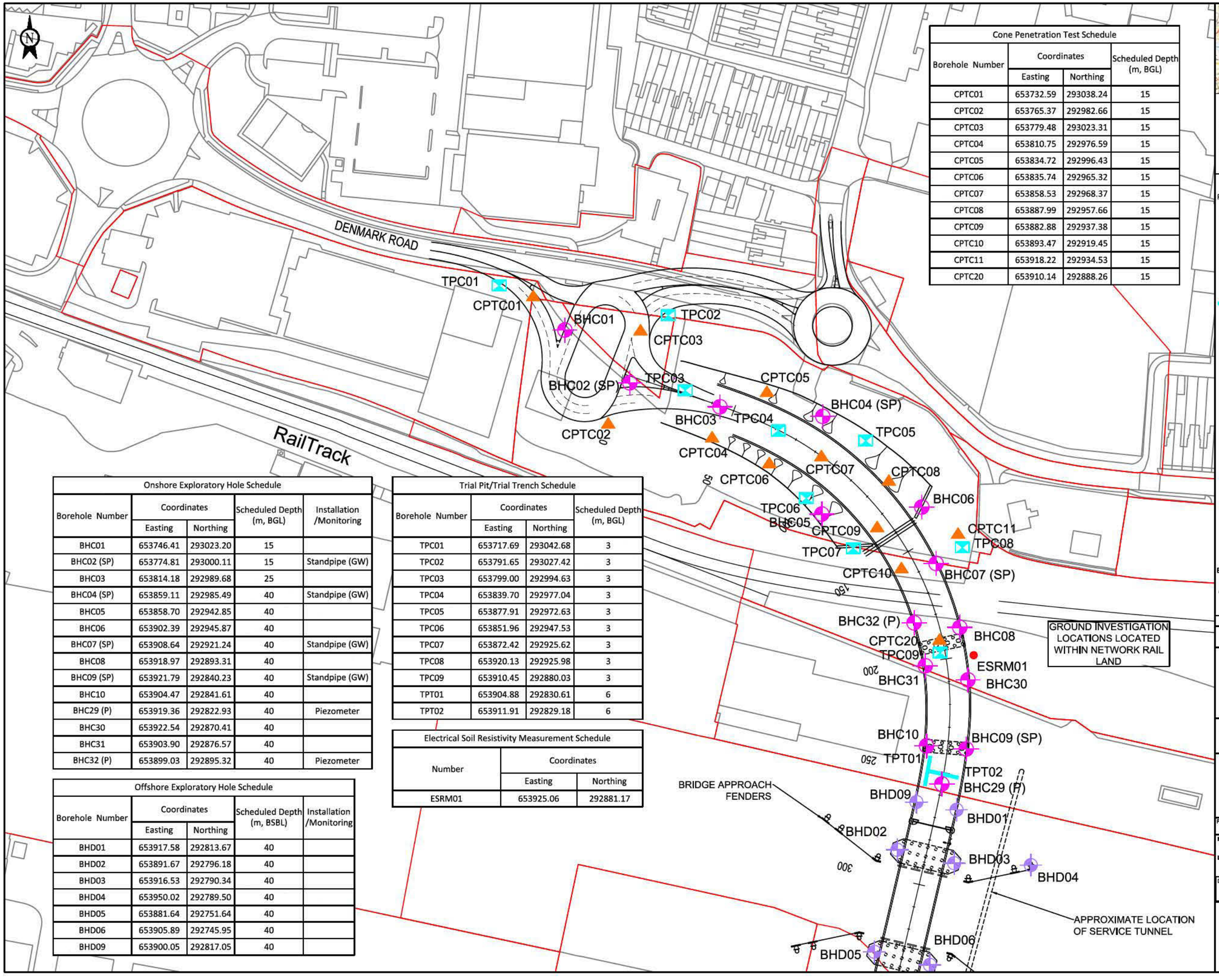
Museums and Galleries Commission, 1994 *Standards in the Museum Care of Archaeological Collections*

SCCAS Conservation Team 2014 *Guidelines for Preparation and Deposition of Archaeological Archives in Suffolk*

Watkinson D and Neal V 1998 (3rd ed) *First Aid for Finds*

United Kingdom Institute for Conservation 1990 *Guidelines for the Preparation of Excavation Archives for Long-term Storage*

Figures



Cone Penetration Test Schedule			
Borehole Number	Coordinates		Scheduled Depth (m, BGL)
	Easting	Northing	
CPTC01	653732.59	293038.24	15
CPTC02	653765.37	292982.66	15
CPTC03	653779.48	293023.31	15
CPTC04	653810.75	292976.59	15
CPTC05	653834.72	292996.43	15
CPTC06	653835.74	292965.32	15
CPTC07	653858.53	292968.37	15
CPTC08	653887.99	292957.66	15
CPTC09	653882.88	292937.38	15
CPTC10	653893.47	292919.45	15
CPTC11	653918.22	292934.53	15
CPTC20	653910.14	292888.26	15

Onshore Exploratory Hole Schedule				
Borehole Number	Coordinates		Scheduled Depth (m, BGL)	Installation /Monitoring
	Easting	Northing		
BHC01	653746.41	293023.20	15	
BHC02 (SP)	653774.81	293000.11	15	Standpipe (GW)
BHC03	653814.18	292989.68	25	
BHC04 (SP)	653859.11	292985.49	40	Standpipe (GW)
BHC05	653858.70	292942.85	40	
BHC06	653902.39	292945.87	40	
BHC07 (SP)	653908.64	292921.24	40	Standpipe (GW)
BHC08	653918.97	292893.31	40	
BHC09 (SP)	653921.79	292840.23	40	Standpipe (GW)
BHC10	653904.47	292841.61	40	
BHC29 (P)	653919.36	292822.93	40	Piezometer
BHC30	653922.54	292870.41	40	
BHC31	653903.90	292876.57	40	
BHC32 (P)	653899.03	292895.32	40	Piezometer

Offshore Exploratory Hole Schedule				
Borehole Number	Coordinates		Scheduled Depth (m, BSBL)	Installation /Monitoring
	Easting	Northing		
BHD01	653917.58	292813.67	40	
BHD02	653891.67	292796.18	40	
BHD03	653916.53	292790.34	40	
BHD04	653950.02	292789.50	40	
BHD05	653881.64	292751.64	40	
BHD06	653905.89	292745.95	40	
BHD09	653900.05	292817.05	40	

Trial Pit/Trial Trench Schedule			
Borehole Number	Coordinates		Scheduled Depth (m, BGL)
	Easting	Northing	
TPC01	653717.69	293042.68	3
TPC02	653791.65	293027.42	3
TPC03	653799.00	292994.63	3
TPC04	653839.70	292977.04	3
TPC05	653877.91	292972.63	3
TPC06	653851.96	292947.53	3
TPC07	653872.42	292925.62	3
TPC08	653920.13	292925.98	3
TPC09	653910.45	292880.03	3
TPT01	653904.88	292830.61	6
TPT02	653911.91	292829.18	6

Electrical Soil Resistivity Measurement Schedule		
Number	Coordinates	
	Easting	Northing
ESRM01	653925.06	292881.17

NOTES

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KEY:

PROPOSED EXPLORATORY BOREHOLES

BHD01	OFFSHORE EXPLORATORY HOLE
BHC01	ONSHORE EXPLORATORY HOLE
CPTC01	CONE PENETRATION TEST
TPC01	TRIAL PIT
TPT01	TRIAL PIT OBSERVATION TRENCH
ESRM01	ELECTRICAL SOIL RESISTIVITY MEASUREMENT
BGL	BELOW GROUND LEVEL
BSBL	BELOW SEA BED LEVEL
(P)	PIEZOMETER INSTALLATION
(SP)	STANDPIPE INSTALLATION

Version	Description	By	Chkd	Appd	Date
B	AMENDMENTS TO GI	LT	MC	AC	24.08.16
A	PROPOSED GROUND INVESTIGATION SCOPE OF WORKS	LT	MC	AV	10.05.16

DRAFT – NOT FINAL

Lake Lothing THIRD CROSSING

LAKE LOTHING THIRD CROSSING

PROPOSED EXPLORATORY HOLE LOCATION PLAN
SHEET 1 OF 2

Project number	Brief number	Scale @ A1
1069948		1:750

HA PIN	Originator	Volume
1069948		HGT
Location	Type	Role
LOWESTOFT		GE

Drawing No.	Version
1069948/GI/001	C

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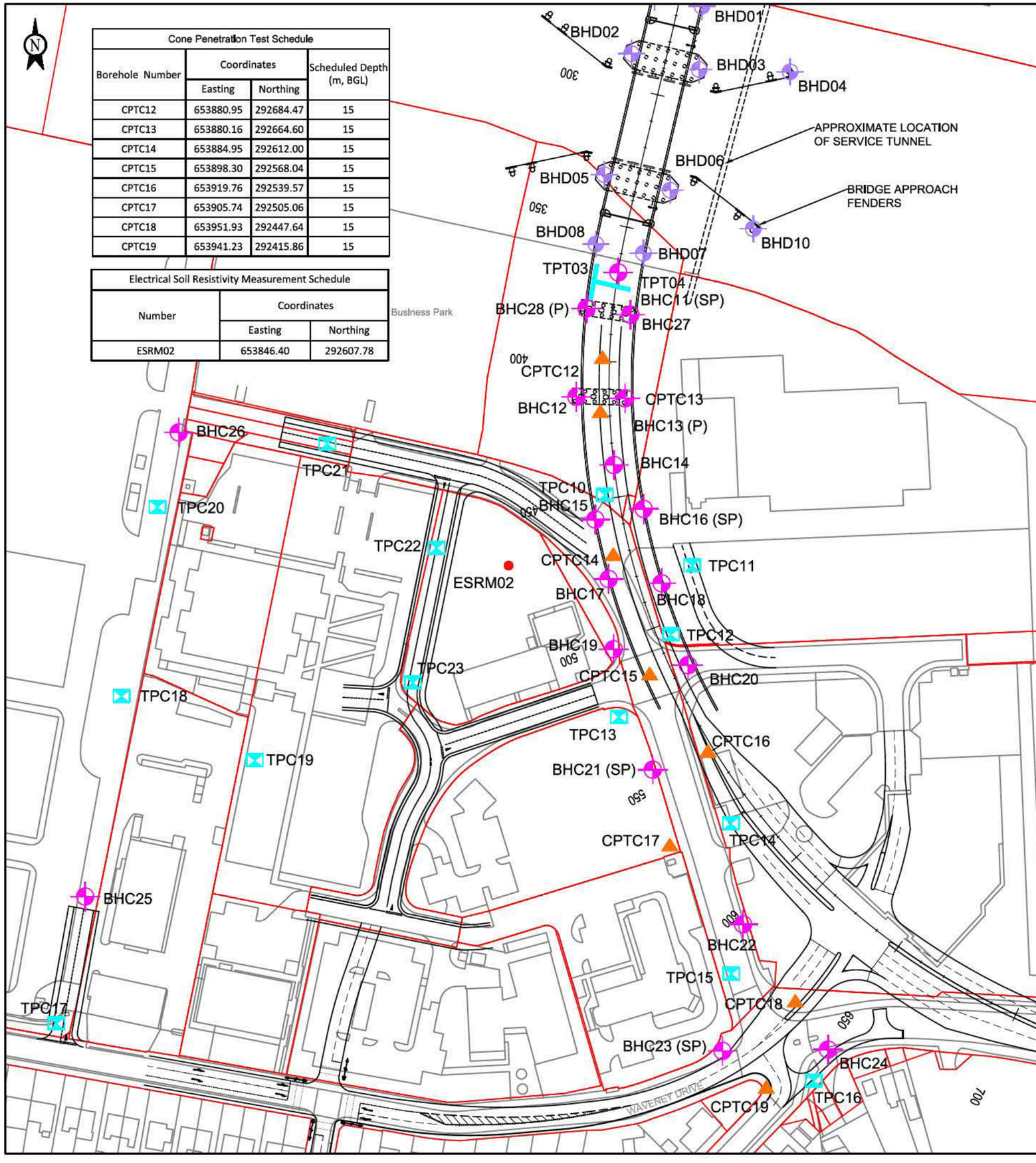

Cone Penetration Test Schedule			
Borehole Number	Coordinates		Scheduled Depth (m, BGL)
	Easting	Northing	
CPTC12	653880.95	292684.47	15
CPTC13	653880.16	292664.60	15
CPTC14	653884.95	292612.00	15
CPTC15	653898.30	292568.04	15
CPTC16	653919.76	292539.57	15
CPTC17	653905.74	292505.06	15
CPTC18	653951.93	292447.64	15
CPTC19	653941.23	292415.86	15

Electrical Soil Resistivity Measurement Schedule		
Number	Coordinates	
	Easting	Northing
ESRM02	653846.40	292607.78

Onshore Exploratory Hole Schedule				
Borehole Number	Coordinates		Scheduled Depth (m, BGL)	Installation /Monitoring
	Easting	Northing		
BHC11 (SP)	653886.75	292715.71	40	Standpipe (GW)
BHC12	653871.35	292669.87	40	
BHC13 (P)	653889.28	292669.33	40	Piezometer
BHC14	653885.19	292644.82	40	
BHC15	653874.06	292622.66	40	
BHC16 (SP)	653896.10	292628.67	40	Standpipe (GW)
BHC17	653883.22	292602.84	40	
BHC18	653902.72	292601.29	40	
BHC19	653885.05	292577.01	25	
BHC20	653912.43	292571.14	25	
BHC21 (SP)	653899.46	292532.70	25	Standpipe (GW)
BHC22	653932.72	292475.79	25	
BHC23 (SP)	653925.13	292429.19	15	Standpipe (GW)
BHC24	653963.96	292429.68	15	
BHC25	653690.47	292486.01	15	
BHC26	653724.93	292656.79	15	
BHC27	653891.22	292700.14	40	
BHC28 (P)	653875.07	292702.44	40	Piezometer

Offshore Exploratory Hole Schedule				
Borehole Number	Coordinates		Scheduled Depth (m, BSBL)	Installation /Monitoring
	Easting	Northing		
BHD02	653891.67	292796.18	40	
BHD03	653916.53	292790.34	40	
BHD04	653950.02	292789.50	40	
BHD05	653881.64	292751.64	40	
BHD06	653905.89	292745.95	40	
BHD07	653896.02	292722.75	40	
BHD08	653878.51	292726.13	40	
BHD09	653900.05	292817.05	40	
BHD10	653936.47	292731.75	40	

Trial Pit/Trial Trench Schedule			
Borehole Number	Coordinates		Scheduled Depth (m, BGL)
	Easting	Northing	
TPC10	653881.86	292631.56	3
TPC11	653914.00	292605.54	3
TPC12	653906.18	292580.15	3
TPC13	653887.01	292549.85	3
TPC14	653928.21	292510.69	3
TPC15	653928.39	292455.39	3
TPC16	653958.65	292416.04	3
TPC17	653679.95	292437.01	3
TPC18	653703.86	292557.53	3
TPC19	653752.99	292533.88	3
TPC20	653717.12	292627.15	3
TPC21	653779.60	292650.44	3
TPC22	653819.89	292612.10	3
TPC23	653811.14	292562.48	3
TPT03	653877.72	292712.30	6
TPT04	653884.75	292710.88	6

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DRAFT – NOT FINAL

Lake Lothing THIRD CROSSING

LAKE LOTHING THIRD CROSSING

PROPOSED EXPLORATORY HOLE LOCATION PLAN
SHEET 2 OF 2

Project number	Brief number	Scale @ A1
1069948		1:750

HA PIN	Originator	Volume
1069948		HGT
Location	Type	Role
LOWESTOFT		GE

Drawing No.	Version
1069948/GI/002	C

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Appendix A1: Contractors Method Statement; T-Shaped Trenches

ARCHAEOLOGICAL PROJECT SERVICES

The aim of the work will be to record and interpret the deposits and any archaeological features exposed during the development groundwork.

The objectives of the investigation will be to:

- Determine the form and function of the archaeological features encountered;
- Determine the spatial arrangement of the archaeological features encountered;
- As far as practicable, recover dating evidence from the archaeological features, and
- Establish the sequence of the archaeological remains present on the site.

SITE OPERATIONS

General considerations

All work will be undertaken following statutory Health and Safety requirements in operation at the time of the investigation. A Risk Assessment will be prepared.

The work will be undertaken according to the relevant codes of practise issued by the Chartered Institute for Archaeologists (CIfA), under the management of a Member of the institute (MCIfA). Archaeological Project Services is CIfA registered organisation no. 21.

Any and all artefacts found during the investigation and thought to be 'treasure', as defined by the Treasure Act 1996, will be removed from site to a secure store and promptly reported to the appropriate coroner's office and the Portable Antiquities'/Finds Liaison Officer. The archaeological curator will also be informed.

Methodology

The scheme of archaeological works will be undertaken during the ground works phase of development, and includes the archaeological monitoring of all phases of soil movement.

Stripped areas and trench sections will be observed to identify and record archaeological features that are exposed and to record changes in the geological conditions. The section drawings of the trenches will be recorded at a scale of 1:10. Should features be recorded in plan these will be drawn at a scale of 1:20. Written descriptions detailing the nature of the deposits, features and fills encountered will be compiled on Archaeological Project Services pro-forma record sheets.

Finds recovered will be bagged and labelled for later analysis.

Throughout the investigation a photographic record will be compiled. The photographic record will consist of:

- the site during the investigation to show specific stages of work, and the layout of the archaeology within the area.

- individual features and, where appropriate, their sections.

- groups of features where their relationship is important.

Should human remains be located they will be left ***in situ*** and only excavated if absolutely necessary. Should removal be required the appropriate Ministry of Justice licence will be obtained before the exhumation of the remains. In addition, the Local Environmental Health Department, coroner and the police will be informed, where appropriate. The archaeological curator will also be notified.

In the event of the discovery of significant archaeological remains that are beyond the scope of watching brief recording and which require fuller excavation, construction groundwork will cease until the applicant has secured the implementation of a further programme of archaeological work in accordance with a written scheme of investigation that has been submitted to and approved in writing by the archaeological curator/Local Planning Authority.

POST-EXCAVATION

Stage 1

On completion of site operations, the records and schedules produced during the investigation will be checked and ordered to ensure that they form a uniform sequence forming a level II archive. A stratigraphic matrix of the archaeological deposits and features present on the site will be prepared. All photographic material will be catalogued and labelled, the labelling referring to schedules identifying the subject/s photographed.

All finds recovered during the fieldwork will be washed, marked and packaged according to the deposit from which they were recovered. Any finds requiring specialist treatment and conservation will be sent to York Archaeological Trust.

Stage 2

Detailed examination of the stratigraphic matrix to enable the determination of the various phases of activity on the site.

Finds will be sent to specialists for identification and dating.

Stage 3

On completion of stage 2, a report detailing the findings of the investigation will be prepared.

This will consist of:

- A non-technical summary of the results of the investigation.
- A description of the archaeological setting of the investigation.
- Description of the topography of the site.
- Description of the methodologies used during the investigation.
- A text describing the findings of the investigation.
- A consideration of the local, regional and national context of the investigation findings.
- Plans of the archaeological features exposed. If a sequence of archaeological deposits is encountered, separate plans for each phase will be produced.
- Sections of the trenches and archaeological features.
- Interpretation of the archaeological features exposed, and their chronology and setting within the surrounding landscape.
- Specialist reports on the finds from the site.
- Appropriate photographs of the site and specific archaeological

features.

REPORT DEPOSITION

A draft copy of the report will be supplied to the Suffolk County Council Historic Environment Service for approval. Copies of the final investigation report will be sent to: the client; and the Suffolk County Council Historic Environment Record.
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ARCHIVE

The documentation and records generated during the investigation will be sorted and ordered into the format acceptable to Suffolk County Council Archaeology Service.

PUBLICATION

Details of the investigation will be input to the Online Access to the Index of Archaeological Investigations (OASIS).

If appropriate, notes on the findings will be submitted to the appropriate national journals: ***Britannia*** for discoveries of Roman date, and ***Medieval Archaeology*** for findings of medieval or later date.

CURATORIAL RESPONSIBILITY

Curatorial responsibility for the archaeological work undertaken on the site lies with the Suffolk Historic Environment Service.

VARIATIONS AND CONTINGENCIES

Variations to the proposed scheme of works will only be made following written confirmation of acceptance from the archaeological curator.

In the event of the discovery of any unexpected remains of archaeological importance, or of any changed circumstances, it is the responsibility of the archaeological contractor to inform the archaeological curator.

Where important archaeological remains are discovered and deemed to merit further investigation additional resources may be required to provide an appropriate level of investigation, recording and analysis.

Any contingency requirement for additional fieldwork or post-excavation analysis outside the scope of the proposed scheme of works will only be activated following full consultation with the archaeological curator and the client.

PROGRAMME OF WORKS AND STAFFING LEVELS

The investigation will be integrated with the programme of construction and is dependent on the developers' work programme, and also on the quantity and complexity of archaeological remains encountered. It is therefore not possible to specify the person-hours for the archaeological site. Post-excavation work is likewise dependent on the quantity and complexity of archaeological remains encountered.

An archaeological supervisor with experience of investigations of this type will undertake the work.

Post-excavation analysis and report production will be undertaken by the archaeological supervisor, or a post-excavation analyst as appropriate, with assistance from a finds supervisor, illustrator and external specialists.

SPECIALISTS TO BE USED DURING THE PROJECT

The following organisations/persons will, in principle and if necessary, be used as subcontractors to provide the relevant specialist work and reports in respect of any objects or material recovered during the investigation that require their expert knowledge and input. Engagement of any particular specialist subcontractor is also dependent on their availability and ability to meet programming requirements.

Task	Body to be undertaking the work
Conservation	York Archaeological Trust
Pottery Analysis	Prehistoric – A Beeby Roman – A Beeby, APS Post-Roman - A Beeby, APS
Non-pottery Artefacts	J Cowgill, Independent Specialist/G Taylor, APS
Animal Bones	P Cope-Faulkner, APS/J Rackham/M Holmes, independent specialists
Environmental Analysis	J Rackham, Independent Specialist
Human Remains Analysis	Dr R Kendall, Independent Specialist
Carbon dating	SUERC

INSURANCES

Archaeological Project Services, as part of the Heritage Trust of Lincolnshire, maintains Employers Liability Insurance of £10,000,000, together with Public and Products Liability insurances, each with indemnity of £5,000,000. Copies of insurance documentation can be supplied on request.

COPYRIGHT

Archaeological Project Services shall retain full copyright of any commissioned reports under the Copyright, Designs and Patents Act 1988 with all rights reserved; excepting that it hereby provides an exclusive licence to the client for the use of such documents by the client in all matters directly relating to the project as described in the Project Specification.

Licence will also be given to the archaeological curators to use the documentary archive for educational, public and research purposes.

In the case of non-satisfactory settlement of account then copyright will remain fully and exclusively with Archaeological Project Services. In these circumstances it will be an infringement under the Copyright, Designs and Patents Act 1988 for the client to pass any report, partial report, or copy of same, to any third party. The Planning Authority and/or archaeological curator will be notified by Archaeological Project

Services that the use of any such information previously supplied constitutes an infringement under the Copyright, Designs and Patents Act 1988 and may result in legal action.

The author of any report or specialist contribution to a report shall retain intellectual copyright of their work and may make use of their work for educational or research purposes or for further publication.

Archaeological Project Services
Archaeological Project Services has provided professional archaeological services since 1993 and is a Chartered Institute for Archaeologists Registered Organisation. APS is part of the Heritage Trust of Lincolnshire, a registered charity formed in 1998.

APS employs a core team of professional archaeologists undertaking archaeological investigations, post-excavation and research as well as in-house artefact specialists.

APS core staff summary CVs

Managers

Denise Drury BA (Hons), MCIfA, Team Leader
Denise has been working in professional archaeology since 1981 and has extensive experience of all types of excavations in rural and urban environments in Scotland and England and all types of archaeological projects including site research, survey, preparation of reports to publication. Since joining APS in 1997 her role has included project management, and acting as a scheduling consultant on behalf of English Heritage. A senior manager in the organisation since 2005, Denise has overall responsibility for the management of the archaeology team, overseeing archaeological sites from project design and costing through investigation and reporting to deposition of the archive. She is responsible for the management and deployment of resources to ensure the successful delivery of projects as well as line management of staff.

Senior Project Officers

Paul Cope-Faulkner BA (Hons), Senior Project Officer
Paul is an experienced field archaeologist, following his degree at the Institute of Archaeology he worked on numerous excavations across the country, including work as environmentalist. After spending time in India training local archaeologists he joined APS in 1993, since when he has directed a large number of excavations in both urban and rural environments. Paul is an experienced post-excavation analyst, producing numerous grey literature reports, articles and publications, for example monographs on the Car Dyke and the Middle Saxon settlement at Fishtoft, near Boston. He is experienced in undertaking desk-based assessments and Environmental Impact Assessments.

Paul's chief research interest is in Saxon and medieval monasticism, although he is also partial to landscape surveys and has undertaken extensive surveys of woodland in south Lincolnshire and the massive and detailed Sempringham Priory survey for English Heritage.

Neil Parker BA (Hons), MA, Senior Project Officer
Neil is an experienced field archaeologist, following an undergraduate degree he completed a masters in Medieval History at the University of Nottingham. He began his archaeological career as a volunteer excavator with APS in 2003 and rose to the post of Project Officer undertaking a wide range of archaeological excavations and investigations. From 2009 he worked for a number of archaeological units across the country returning to APS in 2014. Neil undertakes field excavation, survey and post-excavation analysis and report production. He also undertakes desk-based assessments and building recording. His area of specialist interest is medieval agricultural techniques.

Project Officers

Mark Peachey BA (Hons), Project Officer
After obtaining a geography degree at Newcastle and working briefly in the natural history section at New Walk Museum, Leicester, Mark began excavating in 1983. Since then he has

gained extensive excavation experience working on sites of all types throughout Britain. From 1987 Mark worked predominantly in Winchester and Essex before joining APS in 2003. He has extensive experience supervising large scale excavations and post-excavation analysis. He has authored many reports, several of which have been published.

Chris Moulis BA (Hons), Project Officer
Following graduation in English and Landscape Archaeology at the University of East Anglia Chris began his digging career on a medieval site in France in 1992. Subsequently he gained wide ranging archaeological experience working on sites across the country with a number of archaeological Units, including APS. He has worked on major urban excavations in London, and sites such as Sutton Hoo cemetery. He returned to APS in 2000 and supervises small to large field excavations of all types and periods. In addition he is an experienced surveyor.

Jonathon Smith BA (Hons) MA, Project Officer
Following graduation Jonathon completed a Masters in Archaeology at the University of Durham. He has worked in archaeology since 2005 on major infrastructure and industrial archaeology projects. He joined APS in 2007 and is an experienced field archaeologist and a key member of the geophysical survey team, producing a number of reports for small and large survey projects. Jon's academic interest lies in the early Bronze Age and with prehistoric artwork.

Supervisors

Fiona Walker HND, BA (Hons), Supervisor
Following an HND in Practical Archaeology Fiona completed a degree in Archaeology (Southampton University) and has been working in field archaeology for over 20 years. Fiona first worked for APS in 1993 and between 2009 and 2014 for a number of archaeological organisations across the country before returning in 2014. She has worked on a very wide range of site types spanning the prehistoric to medieval periods. She undertakes site monitoring projects, supervises evaluations and excavations.

Appendix I – LVIA Detailed Methodology

1 TOWNSCAPE AND VISUAL EFFECTS

1.1 *Introduction*

1.1.1 This methodology sets out the approach to be taken in assessing potential significant effects on townscape and visual amenity as a result of the construction and operation of the third crossing of Lake Lothing, Lowestoft (Proposed Scheme).

1.1.2 We have identified in this draft methodology the proposed structure of the assessment, the form of study that will be undertaken and how the eventual report will be presented.

1.2 *Scope of the Assessment*

1.2.1 The early stages of the scoping exercise suggests that an assessment of the landscape and visual effects is carried out to determine the potential effects of the *Proposed Scheme* within the receiving environment. The assessment will consider:

- Potential effects on the perception of local townscape character; and
- Potential effects on visual amenity experienced by the surrounding visual receptors.

1.2.2 The study area is to be defined as the area through which existing townscape character may change or be influenced as a direct result of construction and operation of the *Proposed Scheme*. This will be identified and refined through a combination of 3-D modelling and site work within a pre-defined limited study area that we are seeking to establish and agree at this early stage. This is proposed to be defined as a 3km radius around the Proposed Scheme, beyond which the potential for significant effects are not anticipated to arise due to the scale and nature of the development. A preliminary survey and site visit has identified that this is a suitable study area.

1.3 *Statutory and Planning Context*

1.3.1 The eventual assessment will include a section that outlines current statutes, guidance, policies and plans relevant to the environmental interests forming the focus of the assessment reported in the chapter. This would be presented under the headings of National Legislation (NPPF) and Local Planning and Policy documents.

1.4 *Method of Assessment*

1.4.1 The assessment is proposed to be undertaken in accordance with the Guidelines for Landscape and Visual Impact Assessment (Third Edition), published by the Landscape Institute and the IEMA (2013) (GLVIA3).

1.4.2 As the scheme comprises a bridge structure and supporting link roads reference has also been made to Highways England's Interim Advice Note (IAN) 135/10 that supersedes the relevant section of the Design Manual for Roads and Bridges. Reference has also been made to Landscape Character Assessment: Guidance for England and Scotland published by Scottish Natural Heritage and the Countryside Agency (2002).

1.4.3 The guidance acknowledges the relationship between the perception of landscape and townscape and the similarities in the approach to be undertaken in the assessment process. It also identifies the perception of townscape, and the experience of viewers (referred to as receptors - defined as residents, people in their workplace, attending school, using recreational facilities and using the countryside, shoppers etc) and the development proposals.

Stages in the Assessment Process

1.4.4 There will be four key stages in the assessment:

- Recording and analysis of the existing townscape and visual context of the receiving environment (the baseline environment);
- Identification of changes and associated impacts that will be associated with the proposals and their significance in the context of the baseline townscape and visual context of the study area;
- Identification of mitigation where the assessment identifies potentially significant effects appropriate to the proposed development and the views of the receiving local area; and
- Description of the residual effects and their significance associated with the Proposed Scheme.

1.5 *Townscape Character*

1.5.1 The townscape character assessment will be based on the identification of the sensitivity of the townscape within the proposed study area, and the magnitude of change within the townscape that will result from the construction, operation and de-commissioning of the Proposed Scheme and the effect that this will have on the perception of townscape.

Baseline Environment and Sensitivity

1.5.2 The identification and evaluation of the existing townscape and visual context of the study area and wider area will involve the following tasks:

- Desk based analysis of OS mapping relating to landform, built form, vegetation, settlement patterns and the drainage regime in the wider area;
- Desk based analysis of aerial photography for the area;
- Preliminary review of the townscape units/types and relevant designations e.g. Conservation Areas, Registered Parks and Gardens;

- Site surveys and identification of townscape units/types. Site recording involved annotation of 1:1,250 and 1:25,000 scale OS plans defining the units and the key elements determining character;
- Development and agreement of representative/key viewpoints to be assessed for potential effects on visual amenity;
- Site photography to illustrate character units, notable views / viewpoints and key landscape elements; and
- Drafting and description of local townscape character units within the context of the broader assessment and associated with the Proposed Scheme and wider setting including an evaluation of their quality, value and sensitivity to change in the context of the proposed form of development.

Townscape Quality

1.5.3 Townscape quality relates to the intrinsic aesthetic appeal demonstrated by a character unit or feature / composition within the townscape, including the relative condition of the townscape and features therein.

1.5.4 A five point scale will be adopted to describe quality prior to development.

1.5.5 Highest Quality - Areas comprising a clear composition of valued townscape components in robust form and health, free of disruptive visual detractors and with a strong sense of place. Areas containing a strong, balanced structure with distinct features worthy of conservation. Such areas would generally be internationally or nationally recognised, e.g. World Heritage Sites, Registered Parks and Gardens, and National Parks.

1.5.6 Very Attractive - Areas primarily of valued townscape components combined in an aesthetically pleasing composition and lacking prominent disruptive visual detractors. Areas containing a strong structure with noteworthy features or elements, exhibiting a sense of place. Such areas would generally be nationally or regionally recognised locations, e.g. Areas of historic townscapes, including Conservation Areas.

1.5.7 Good - Areas primarily of valued townscape components combined in an aesthetically pleasing composition with low levels of disruptive visual detractors, exhibiting a recognisable townscape structure. Such areas would generally be regionally and locally recognised areas, e.g. Areas of Local Landscape Importance and areas fringing Conservation Areas.

1.5.8 Ordinary - Areas containing some features of townscape value but lacking a coherent and aesthetically pleasing composition with frequent detracting visual elements, exhibiting a distinguishable structure often concealed by mixed land uses or development. Such areas would be commonplace at the local level and would generally be undesignated, offering scope for improvement.

1.5.9 Poor - Areas lacking valued townscape components or comprising degraded, disturbed or derelict features, lacking any aesthetically pleasing composition with a dominance of visually detracting elements, exhibiting mixed land uses

which conceal the baseline structure. Such areas would generally be restricted to the local level and identified as requiring recovery.

Townscape Value

1.5.10 Townscape value relates to areas of particular scenic quality or those displaying important historic and cultural associations. Townscape value is frequently addressed by reference to international, national, regional and local designations. An absence of a formal designation does not, however, determine that a townscape is necessarily of low value; factors such as accessibility and local scarcity can render areas of unremarkable quality highly valuable as a local resource.

Capacity to Accommodate Change

1.5.11 Capacity to accommodate change is broadly derived from a combination and correlation of the quality, value and sensitivity of a given area.

1.5.12 Although there is common ground between the aspects of sensitivity and capacity, the relationship between the degree of sensitivity and capacity are not always directly related. A highly sensitive area should not, by definition, infer that it has little or no capacity to accommodate future change. Similarly, an area expressing low sensitivity to change does not automatically have a higher capacity to accommodate development.

Sensitivity to Change

1.5.13 Sensitivity to change relates to the quality and value of the townscape and the extent to which it is considered capable of accepting the type of development proposed. Three orders of sensitivity have been adopted:

- High sensitivity - a townscape displaying particularly distinctive character, of good or greater quality which is highly valued and considered susceptible to relatively small changes;
- Moderate sensitivity - a townscape of good or ordinary quality which is moderately valued and considered reasonably tolerant of change; and
- Low sensitivity - a townscape of ordinary or poor quality which is of relatively low value and considered tolerant of substantial levels of change.

Significance of Effect Assessment

1.5.14 The evaluation of effects will involve consideration of the sensitivity to change, derived during the baseline assessment, and the predicted magnitude of the impact that will occur in light of the construction and subsequent operation of the Proposed Scheme.

Magnitude of Impact

1.5.15 The magnitude of impact will be determined through a description of the changes likely to arise, such as changes to the grain of the built form, loss of vegetation, including green space and severance or modification to key townscape components and evaluation of the extent to which the proposed

development will emerge as a new component in the townscape or change the balance between components that currently constitute baseline character. Four grades of magnitude will be adopted: high; medium; low; and no change.

1.5.16 High Magnitude - Where the development would appear as a significant new component in the townscape and result in the total loss of or major alteration to the existing balance of components in the baseline context.

1.5.17 Medium Magnitude - Where the development would appear as a distinctly noticeable new component in the townscape and result in a partial loss of or alteration to the existing balance of components in the baseline context.

1.5.18 Low Magnitude - Where the development would appear as a noticeable new component in the townscape and result in a minor loss of or alteration to the existing balance of components in the baseline context.

1.5.19 Negligible - Where the development would appear as a barely perceptible component in the townscape and result in very minor loss of or alteration to the existing balance of components in the baseline context.

1.5.20 No Change – Where the development would have no direct effect on the components in the townscape resulting in no alteration to the existing balance of components in the baseline context.

Townscape Character Significance of Effect Ratings

1.5.21 The identification of the resulting effects are to be established through an evaluation of the sensitivity of the baseline or receptor and the magnitude of the impact likely to occur as a result of the Proposed Scheme. An indication of the interactions between sensitivity and magnitude of impact and the likely resulting effects that are proposed are outlined below:

Table 1 – Significance of Effect Categories

Magnitude	**High**	Slight/Moderate	Moderate/Large	Large/Very Large
	Medium	Slight	Moderate	Moderate/Large
	Low	Neutral/Slight	Slight	Slight/Moderate
	Negligible	Neutral/Slight	Neutral/Slight	Slight
	No change	Neutral	Neutral	Neutral
		Low	**Medium**	**High**
	Sensitivity			

1.5.22 This is only a framework to aid consistency of reporting and provide an initial indication of the likely effect, either beneficial or adverse, arising from the assessment of magnitude of impact and sensitivity of the resource. Given that the criteria of 'low/medium/high /negligible/no change' represent levels on a continuum or continuous gradation, application of the framework will also require professional judgement and awareness of the relative balance between sensitivity and magnitude.

1.5.23 The findings of the assessment will be represented using a descriptive, descending scale ranging from large - moderate - slight and adverse through neutral to an ascending scale of slight - moderate - large and beneficial. There is a further effect rating, very large adverse, used to indicate adverse effects on a very high quality townscape or on important and rare combinations of townscape features and their elements. Such a rating would indicate that the effect is considered highly prejudicial in relation to the specific topic of townscape character. Explanation of the significance of effect ratings that are proposed is provided below.

1.5.24 Large Beneficial Effect - The proposals:

- Constitute a major restructuring of a degraded townscape or form an essential part of a townscape strategy to redevelop a major area of dereliction, leading to establishment of a new, attractive environment.

1.5.25 Moderate Beneficial Effect - The proposals provide an opportunity to enhance the townscape because:

- They fit very well with the scale, built form and pattern of the townscape.
- There is potential, through mitigation, to enable the restoration of characteristic features, partially lost or diminished as the result of changes to the baseline context, e.g. from previous inappropriate development.
- They will enable a sense of place and scale to be restored through careful design and appropriate mitigation measures, that is, characteristic features are perhaps enhanced through the use of local materials and appropriate scale of the development that fits well into the surrounding townscape.
- They enable some sense of quality to be restored or enhanced through design features.
- They further government objectives to regenerate degraded urban areas.

1.5.26 Slight Beneficial Effect - The proposals:

- Fit well with the scale, built form and pattern of the townscape.
- Incorporate measures for mitigation to ensure they will compliment the surrounding townscape structure.
- Will enable some sense of place and scale to be restored through careful design and appropriate use of materials as mitigation measures.
- Maintain or enhance existing townscape quality and character.

1.5.27 Neutral Effect - The proposals are well designed to:

- Complement the scale, built form and pattern of the townscape.
- Incorporate measures for mitigation to ensure that the scheme will blend in well with surrounding features and elements.
- Maintain existing townscape quality and character.

1.5.28 Slight Adverse Effect - The proposals:

- Do not quite fit the built form and scale of the townscape.
- Although not very visually intrusive, will impact on certain views into and across the area.
- Cannot be completely mitigated for because of the nature of the proposal itself or the character of the townscape in which the development would sit.
- May affect an area of recognised townscape quality.

1.5.29 Moderate Adverse Effect - The proposals:

- Are out of scale with, or at odds with, the local townscape pattern and built form.
- Are not possible to fully mitigate for, that is, mitigation will not prevent the Proposed Scheme from scarring or detrimentally affecting the townscape in the longer term as some features of interest will be partly destroyed or their setting reduced or removed.
- Will have an adverse effect on a townscape of recognised quality or on vulnerable and important characteristic features or elements.

1.5.30 Large Adverse Effect - The proposals are very damaging to the townscape in that they:

- Are at considerable variance with the built form, scale and pattern.
- Are visually intrusive and would disrupt fine and valued views of the area.
- Are likely to degrade, diminish or even destroy the integrity of a range of characteristic features and elements of their setting.
- Will be substantially damaging to a high quality or highly vulnerable townscape, resulting in fundamental change and be considerably diminished in quality.
- Cannot be adequately mitigated for.

1.5.31 Very Large Adverse Effect - The proposals would result in exceptionally severe adverse effects on the townscape because they:

- Are at complete variance with the built form, scale and pattern.
- Are highly visually and extremely intrusive, destroying fine and valued views both into and across the study area.
- Would irrevocably damage or degrade, badly diminish or even destroy the integrity of characteristic features and elements and their setting.
- Would cause a very high quality or highly vulnerable townscape to be irrevocably changed and its quality very considerably diminished.
- Cannot be mitigated for, that is, there are no measures that would protect or replace the loss of a nationally important townscape.

1.6 *Assessment of Visual Effects*

1.6.1 The assessment of visual effects will involve the adoption of the four stages of assessment described in paragraph 1.4.4.

1.6.2 Establishment of the existing visual context for the Proposed Scheme would involve consideration of the information relating to existing townscape character established during the townscape character baseline assessment, the definition of a Zone of Theoretical Visibility (ZTV) for the Proposed Scheme, and the identification of key visual receptors (represented by key viewpoints) within the visual envelope.

Zone of Theoretical Visibility (ZTV)

1.6.3 The ZTV represents the extent of the area within which there would be potential for views of the Proposed Scheme. A preliminary plotting of the ZTV was undertaken by reviewing current OS mapping for the area to establish where landform, large scale established planting and areas of built development would be likely to define the availability of views. This preliminary ZTV is shown on the attached figure 1073877-MOU-ELS-LL3C-SK-AL-3000 01.

1.6.4 The initial plotting, once agreed with SCC and WDC will then be checked on site and modified. The assumptions adopted in drafting the ZTV have been that the observer height is 1.5m and that the tallest moving component associated with the Proposed Scheme will be a 4m Heavy Goods Vehicle (HGV) visible on embankment.

1.6.5 Inclusion of an area within the ZTV is not an indicator that all potential receptors within the defined area will experience views of the Proposed Scheme, there being many localised features such as individual buildings, hedgerows, small copses or localised variations in landform which may obstruct views from a receptor. The prime objective is to establish an area within which key receptors or viewpoints, whose views may be influenced by the Proposed Scheme can be identified.

Key Viewpoints

1.6.6 The identification of key viewpoints involved a review of prominent buildings, areas open to public use, informal routes and local roads located within the ZTV. Site surveys were then undertaken to establish the nature, location and actual availability of the anticipated view. We have proposed 8 key viewpoints as shown on Figures 1073877-MOU-ELS-LL3C-SK-AL-3000 01 to 05.

Identification of Key Viewpoints

1.6.7 Potential viewpoints have been initially recorded by reviewing the settlement pattern, land use, topography, vegetation, access and transportation pattern of the study area contained within the boundaries of the ZTVI. Key Viewpoints plotted via the desk based review and validated through site survey include the following:

- Residential clusters and individual properties;
- Roads with views of the proposed development site; and
- Recreational and public access areas including footpaths and other rights of way.

Field Assessment of Key Viewpoints

1.6.8 Each identified Key Viewpoint was visited and assessed. Factors considered during the visual assessment include:

- Associated receptor types and numbers where appropriate (e.g. dwelling / footpath);
- Existing view;
- Distance of view;
- Percentage and elements of the proposed scheme visible;
- Viewpoint position (view up / view down / level view);
- Angle of view (acute / perpendicular / oblique);
- Type of view (foreground / mid ground / background) and position of the Proposed Scheme in the view; and
- Analysis of potential impact.

Analysis of Visual Effects

1.6.9 Analysis of the likely visual impacts and evaluation of their associated effects will involve consideration of the sensitivity to change and magnitude of impact based upon information gathered through site surveys and analysis of the aesthetics of the proposals.

1.6.10 Evaluation of visual effects relates to the potential impacts during construction, subsequent opening of the facilities and ten years into operation (the end of the assessment period), for both summer and winter periods. The analysis will assume that the visual context applicable at the year of opening is that which would be experienced during winter months when the degree of visual exposure is potentially greatest.

1.6.11 The analysis at ten years into operation demonstrates the effectiveness of any landscape mitigation proposals associated with the scheme, allowing for its maturation. The analysis relates to each Key Viewpoint and concludes with an evaluation of the predicted significance of effect.

Sensitivity to Change

1.6.12 Sensitivity to change will consider the nature, location and context of the viewpoint or the associated receptor. Key viewpoints associated with less sensitive receptors are considered, for example, to be people engaged in work whose primary focus would not necessarily be on the surrounding landscape views. Conversely, more emphasis is placed upon receptors whose change in view or visual amenity is either the prime focus, greater in scale or potentially covers a wider area.

1.6.13 The degree and importance of the view gained from a Key Viewpoint by a receptor also contributes to an understanding of how sensitive a given receptor is towards change. Therefore, value of the view, scenic quality and visual expectations of the receptor are also taken into account in the assessment. In this assessment, sensitivity to change is proposed to be ranked as follows:

1.6.14 High Sensitivity - This applies where a Key Viewpoint is associated with:

- Individual dwellings or dwelling groupings with a view in which the Proposed Scheme would become an important focal element from either gardens or room windows, either from upper or lower storey.
- Roads, footpaths, bridleways and publicly accessible open spaces with a view in which the Proposed Scheme would be an important focal element in that view.

1.6.15 Medium Sensitivity - This applies where a Key Viewpoint is associated with:

- Individual dwellings or dwelling groupings with a view from either gardens or room windows, either from upper or lower storey, in which the Proposed Scheme would not be a focal element but would be a notable element in the view.
- Roads, footpaths, bridleways and publicly accessible open spaces with a view in which the Proposed Scheme would not be a focal element but would be a notable element in the view.
- Industrial / commercial buildings with a view in which the Proposed Scheme would be a focal element in the view.

1.6.16 Low Sensitivity - This applies where a Key Viewpoint is associated with:

- Dwellings with a view from either gardens or room windows, either from upper or lower storey, in which the Proposed Scheme would not be a notable element in the view but would be discernible.
- Roads, footpaths, bridleways and publicly accessible open spaces with a view in which the Proposed Scheme would not be a notable element in the view but would be discernible.
- Industrial / commercial buildings with a view in which the Proposed Scheme would not be a focal element but would be a notable element in the view.

Magnitude of Impact

1.6.17 Magnitude of impact considers the extent of the development that is visible, the percentage of the existing view newly occupied by the Proposed Scheme and the viewing distance from the receptor to the development. In this assessment magnitude is proposed to be ranked as follows:

- High Magnitude - Where the Proposed Scheme would cause a substantial change to the existing view.
- Medium Magnitude - Where the Proposed Scheme would cause a very noticeable change to the existing view.
- Low Magnitude - Where the Proposed Scheme would cause a noticeable change to the existing view.
- Negligible – Where the Proposed Scheme would cause a barely perceptible change to the existing view.
- No Change - Where the Proposed Scheme would cause no discernible change to the existing view.

Significance of Effect Criteria

1.6.18 The prime criteria used to evaluate visual effects will relate to the extent to which existing views associated with Key Viewpoints (such as residents, users of public facilities and visitors to open space and public areas), will change, taking into account mitigation measures.

1.6.19 Other criteria proposed to be used to ascertain visual effect include the size, elevation and proportion of the Proposed Scheme in respect of the receiving environment and the degree to which activity within the receiving environment would alter, both during and post construction, and be visible. Cumulative visual effects on the baseline environment will also be taken account of in respect of the Proposed Scheme, where appropriate.

1.6.20 Effects can be detrimental where features or key characteristics such as established planting, old buildings or structures will have to be removed, directly affecting the view. Conversely, effects can prove beneficial where derelict buildings or poorly maintained landscape features are proposed to be restored, replaced or maintained, or where there is the introduction of new tree planting and a landscape structure where none currently exists, constituting an improvement in the current view.

Significance of Visual Effect Ratings

1.6.21 The identification of the resulting effects will be established through an evaluation of the sensitivity of the baseline and the magnitude of the impact likely to occur as a result of the Proposed Scheme. An indication of the interactions between sensitivity and magnitude of impact and the likely resulting effects are outlined below:

Table 2 – Significance of Visual Effect Categories

Magnitude	**High**	Slight/Moderate	Moderate/Large	Large/Very Large
	Medium	Slight	Moderate	Moderate/Large
	Low	Neutral/Slight	Slight	Slight/Moderate
	Negligible	Neutral/Slight	Neutral/Slight	Slight
	No change	Neutral	Neutral	Neutral
		Low	**Medium**	**High**
	Sensitivity			

1.6.22 The ratings presented in Table 2 is only a framework to aid consistency of reporting and provide an initial indication of the likely effect, either beneficial or adverse, arising from the assessment of magnitude and sensitivity. Given that the criteria high/ medium/ low/ negligible or no change represent levels on a continuum or continuous gradation, application of the framework will also require judgement and awareness of the relative balance between sensitivity and magnitude.

1.6.23 The findings are proposed to be represented using a descriptive scale ranging from large - moderate - slight and adverse through neutral to an ascending scale of slight - moderate - large and beneficial. There is a further effect rating, very large adverse, which is used to indicate effects on a receptor of very high sensitivity, significantly affecting an existing view of very high value and quality. Such a rating would indicate that the effect is considered highly prejudicial in relation to the specific topic of visual effect.

1.6.24 Explanation of the significance of effect ratings that we proposed is provided below.

1.6.25 Large Beneficial Effect - This would typically apply where the Proposed Scheme would:

- Lead to the removal of a significant eyesore such as a derelict site or buildings and incorporates landscape measures which substantially remodel and enhance the outlook for a large number of people, or where the proposal would cause a significant improvement in the existing view.

1.6.26 Moderate Beneficial Effect - This would typically apply where the Proposed Scheme would:

- Visual intrusion associated with the existing view is noticeably relieved, or where the Proposed Scheme would result in a noticeable improvement. It would also apply where the Proposed Scheme includes provision for landscape proposals which would largely reduce the visual intrusion of the existing outlook and enhance views for a considerable number of people.

1.6.27 Slight Beneficial Effect - This would typically occur where the Proposed Scheme would:

- Existing visual effect associated with the current outlook is slightly relieved, or where the Proposed Scheme would cause a barely perceptible improvement in existing receptor view.

1.6.28 Neutral Effect - This would typically occur where the Proposed Scheme would:

- Implementation of the Proposed Scheme would not result in a discernible improvement or deterioration in existing receptor view or outlook.

1.6.29 Slight Adverse Effect - This would typically occur where the Proposed Scheme would:

- The Key Viewpoint is at some distance from the Proposed Scheme, or where the Proposed Scheme would not constitute a new point of principal focus. It would also occur where the Proposed Scheme is closely located to the viewpoint but is seen at an acute angle and at the extremity of the overall available view, or viewed from rarely occupied upper storey rooms or less sensitive receptor types.

1.6.30 Moderate Adverse Effect - This would typically apply where the Proposed Scheme would:

- The Proposed Scheme would result in a noticeable deterioration to the current outlook, involving removal of existing, visually screening elements in the view, exposing the scheme. It would also occur where large new structures are introduced as part of the Proposed Scheme which may appear at distance but be positioned as a focal point the field of view, or where the Proposed Scheme can only be partially mitigated.

1.6.31 Large Adverse Effect - This would typically apply where the Proposed Scheme would:

- The Proposed Scheme would cause a significant deterioration in the current receptor view or outlook, be positioned prominently within an existing view of local interest in a valued landscape, or where only selected elements of the Proposed Scheme can be effectively mitigated.

1.6.32 Very Large Adverse Effect - This would typically apply where the Proposed Scheme would:

- The Proposed Scheme would cause a highly prejudicial deterioration in the current view, be positioned prominently within an existing view of regional or national importance in a valued landscape, or where the Proposed Scheme cannot be effectively mitigated.

1.6.33 The Structure of the remainder of the Townscape and Visual Chapter is proposed to be as follows:

- Baseline Environment
  - Introduction
  - National Character Areas
  - Local Townscape Character Areas (LTCA)
  - Summary of Townscape Character
  - Conservation Areas
  - Visual Context
  - Zone of Theoretical Visibility (ZTV)
- Predicted Effects
  - Impacts on local planning policies
  - Construction Effects
  - Operational Effects
  - Effects on Townscape Character
  - Assessment of Visual Effects
  - Receptors
  - Rights of Way
- Proposed Mitigation
- Summary and Conclusions