Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8A: Legislation, Policy and Guidance

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ("APFP")

APFP regulation Number: 5(2)(a)

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Tables

1 Legislation, Policy and Guidance

1.1.1 Tables 1.1 to 1.3 summarise the applicable legislation, policy and guidance to Chapter 8: Nature Conservation.

Table 1.1: Summary of Legislation

Legislation	Summary	Chapter Reference
The Conservation of Habitats and Species Regulations (Habitats Regulations) (2017) (as amended)	The EC Habitats Directive and EC Birds Directive are transposed into UK law via the Conservation of Habitats and Species Regulations 2017 (as amended), referred to as the Habitats Regulations. All species listed under Annex IV of the Habitats Directive require strict protection and are known as European Protected Species (EPS). Certain EPS are also listed under Annex II of the Habitats Directive and are afforded protection by the establishment of core areas of habitat known as Special Areas of Conservation (SAC). The Birds Directive seeks to maintain populations of all wild bird species across their natural range (Article 2). All bird species listed under Annex I of the Birds Directive are rare or vulnerable and afforded protection by the classification of Special Protection Areas (SPAs). These are also designated under all regularly occurring migratory species, with regard to the protection of wetlands of international importance (Article 4).	Natura 2000 sites (the collective term for the network of sites in the European Union including SACs and SPAs) identified for consideration in this chapter are detailed in Section 8.5 of the Chapter and further assessed in the Habitat Regulations Report (document reference 6.11) for the Scheme.
The Wildlife and Countryside Act (WCA) (1981) (as amended)	Under the WCA (England and Wales) all birds, their nests and eggs (with exception of species listed under Schedule 2) are protected by the WCA. It is an offence to intentionally kill, injure, or take any wild bird, their eggs or to damage or destroy the nest of any wild bird (whilst being built, or in use). Species listed on Schedule 5 of the WCA, which includes species of reptile native to the UK, gives either full or partial protection against the killing, injuring or taking, the possession or control of	Species listed on the schedules of the WCA relevant to the Application Site are detailed in Section 5 and assessed through the framework in Section 8.6 of the Chapter. In

Legislation	Summary	Chapter Reference
	individuals (live or dead) and the damage, destruction, disturbance or obstruction of places of shelter or protection. Schedule 9 of the WCA also makes provision for the control of invasive species and makes it illegal to cause such plants to grow in the wild. In addition, the WCA makes it an offence (subject to exceptions) to pick, uproot, trade in, or possess (for the purposes of trade) any wild plant listed in Schedule 8, and prohibits the unauthorised intentional uprooting of such plants.	addition, Appendix 8D details the surveys undertaken for breeding birds, Appendix 8B and 8C detail the potential for reptiles and invasive species to be present within the Principal Application Site.
Countryside Rights of Way (CRoW) Act (2000)	The CRoW Act has amended the WCA in England and Wales strengthening the protection afforded to Sites of Special Scientific Interest (SSSI) and the legal protection for threatened species. It adds the word 'reckless' to the wording of the offences listed under section 9(4) of the WCA. This alteration makes it an offence to recklessly commit an offence, where previously an offence had to be intentional to result in a breach of legislation.	SSSIs identified for consideration in this chapter are detailed in Section 8.5.
Natural Environment and Rural Communities Act (2006)	Species and Habitats of Principal Importance in England and Wales are listed under section 41 and section 42 respectively of the NERC Act. The section 41 and 42 lists detail species that are of principal importance for the conservation of biodiversity in England and Wales, and should be used to guide decision-makers when implementing their duty to have regard for the conservation of biodiversity in the exercise of their functions.	Species listed on the schedules of the NERC Act (2006) relevant to the Application Site are detailed in Section 8.5 and assessed through the framework in Section 8.6. The potential presence of such species within the Principal Application Site is also outlined in Appendices 8B and 8C.

Table 1.2: Summary of Policy

Policy	Summary	Chapter Reference
National Policy Statement (NPS) for National Networks (2014)	Applicants assessment - Paragraphs 5.22 – 5.23 *"Where the project is subject to EIA the applicant should ensure that the environmental statement clearly sets out any likely significant effects on internationally, nationally and locally designated sites of ecological or geological conservation importance (including those outside England) on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity and that the statement considers the full range of potential impacts on ecosystems.* *The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests."*	Species and sites as detailed in the NPS NN to the Application Site are described in Section 8.5 and assessed through the framework in Section 8.6 of the Chapter. Measures taken to conserve and /or, enhance mitigate biodiversity features are described in Section 8.7. Additional mitigation measures deemed to be required are outlined in Section 8.8.
National Policy Statement (NPS) for National Networks (2014)	Decision making - Paragraph 5.25 *"As a general principle, and subject to the specific policies below, development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives. The applicant may also wish to make use of biodiversity offsetting in devising compensation proposals to counteract any impacts on biodiversity which cannot be avoided or mitigated. Where significant harm cannot be avoided or mitigated, as a last resort, appropriate compensation measures should be sought."*	Species and sites relevant to the assessment of the Scheme are described in Section 8.5 and as-sessed through the framework in Section 8.6 of the Chapter. Measures taken to conserve and / or, enhance biodiversity features are described in Section 8.7. These measures have focused on key species relevant to the

Policy	Summary	Chapter Reference
		Scheme and are designed to produce gains for biodiversity. Additional mitigation measures deemed to be required are outlined in Section 8.8.
National Policy Statement (NPS) for National Networks (2014)	International sites - Paragraph 5.27 *"The most important sites for biodiversity are those identified through international conventions and European Directives. The Habitats Regulations provide statutory protection for European Directives. The National Planning Policy Framework states that the following wildlife sites should have the same protection as European sites:* • *potential Special Protection Areas and candidate Special Areas of Conservation;* • *listed or proposed Ramsar sites; and* • *sites identified, or required, as compensatory measures for adverse effects on European sites, potential Special Protection Areas, possible Special Areas of Conservation and listed or proposed Ramsar sites."*	Natura 2000 sites (the collective term for the network of sites in the European Union including SACs and SPAs) identified for consideration in this chapter are detailed in Section 8.5 of the Chapter and further assessed in the Habitat Regulations Report (document reference 6.11) for the Scheme.
National Policy Statement (NPS) for National Networks (2014)	Sites of Special Scientific Interest - Paragraph 5.29 *"Where a proposed development on land within or outside a SSSI is likely to have an adverse effect on a SSSI (either individually or in combination with other developments), development consent should not normally be granted. Where an adverse effect on the site's notified special interest features is likely, an exception should be made only where the benefits of the development at this site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest, and any broader impacts on the national*	SSSIs identified for consideration for the nature conservation assessment of the Scheme are detailed in Section 8.5 and assessed in Section 8.6 of the Chapter.

Policy	Summary	Chapter Reference
	network of SSSIs. The Secretary of State should ensure that the applicant's proposals to mitigate the harmful aspects of the development and, where possible, to ensure the conservation and enhancement of the site's biodiversity or geological interest, are acceptable. Where necessary, requirements and/or planning obligations should be used to ensure these proposals are delivered."	
National Policy Statement (NPS) for National Networks (2014)	Regional and local sites - Paragraph 5.31 *"Sites of regional and local biodiversity and geological interest (which include Local Geological Sites, Local Nature Reserves and Local Wildlife Sites and Nature Improvement Areas) have a fundamental role to play in meeting overall national biodiversity targets, in contributing to the quality of life and the well-being of the community, and in supporting research and education. The Secretary of State should give due consideration to such regional or local designations. However, given the need for new infrastructure, these designations should not be used in themselves to refuse development consent."*	Regional and local sites identified for consideration for the nature conservation assessment of the Scheme are detailed in Section 8.5 and assessed in Section 8.6 of the Chapter.
National Policy Statement (NPS) for National Networks (2014)	Biodiversity within and around developments - Paragraph 5.33 *"Development proposals potentially provide many opportunities for building in beneficial biodiversity or geological features as part of good design. When considering proposals, the Secretary of State should consider whether the applicant has maximised such opportunities in and around developments. The Secretary of State may use requirements or planning obligations where appropriate in order to ensure that such beneficial features are delivered."*	Measures taken to conserve and /or, enhance biodiversity features are described in Section 8.7 (and included in the Outline CoCP (document reference 6.16). These measures have focused on key species relevant to the Scheme and are designed to produce gains for biodiversity. Additional mitigation

Policy	Summary	Chapter Reference
		measures deemed to be required are outlined in Section 8.8.
National Policy Statement (NPS) for National Networks (2014)	Protection of other habitats and species - Paragraphs 5.34 - 5.35 *"Many individual wildlife species receive statutory protection under a range of legislative provisions.* *Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales and therefore requiring conservation action. The Secretary of State should ensure that applicants have taken measures to ensure these species and habitats are protected from the adverse effects of development. Where appropriate, requirements or planning obligations may be used in order to deliver this protection. The Secretary of State should refuse consent where harm to the habitats or species and their habitats would result, unless the benefits of the development (including need) clearly outweigh that harm"*	Species and habitats relevant to the assessment of the Scheme are described in Section 8.5 and assessed through the framework in Section 8.6. Mitigation measures deemed required for the Scheme are described in Section 8.7 of the Chapter.
National Policy Statement (NPS) for National Networks (2014)	Mitigation - Paragraph 5.36 *"Applicants should include appropriate mitigation measures as an integral part of their proposed development, including identifying where and how these will be secured. In particular, the applicant should demonstrate that:* • *during construction, they will seek to ensure that activities will be confined to the minimum areas required for the works;* • *during construction and operation, best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised*	Mitigation measures deemed required for the Scheme are described in Section 8.8. Embedded mitigation and enhance-ment measures are also described in Section 8.7 and included in the Out-line CoCP (document ref-erence 6.16).

Policy	Summary	Chapter Reference
	(including as a consequence of transport access arrangements); • *habitats will, where practicable, be restored after construction works have finished;* • *developments will be designed and landscaped to provide green corridors and minimise habitat fragmentation where reasonable;* • *opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals, for example through techniques such as the 'greening' of existing network crossing points, the use of green bridges and the habitat improvement of the network verge."*	
National Planning Policy Framework (2019)	Section 15, paragraph 170 states that the planning system should contribute to and enhance the natural and local environment by *"minimising impacts on biodiversity and providing net gains in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures"*.	Mitigation measures deemed required for the Scheme are described in Section 8.8 of the Chapter and included in the Outline CoCP (document reference 6.16). Additional mitigation measures deemed to be required are outlined in Section 8.8.
National Planning Policy Framework (2019)	Section 15, paragraph 174 states that planning applications should *"promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity".*	Embedded mitigation and enhancement measures are described in Section 8.7 of the Chapter and included in the Outline CoCP (document reference 6.16). These measures have focused on key species relevant to the Scheme and are designed to produce gains for biodiversity.
East	Plan Policy BIO1 states that *"Appropriate*	Habitats and species

Policy	Summary	Chapter Reference
Inshore and East Offshore Marine Plans (2014)	*weight should be attached to biodiversity, reflecting the need to protect biodiversity as a whole, taking account of the best available evidence including on habitats and species that are protected or of conservation concern in the East marine plans and adjacent areas (marine, terrestrial).”*	recorded during baseline surveys of benthic, terrestrial and marine ecology are outlined in Appendix 8I and summarised in Section 8.5 of the ES. These features are then assessed through the framework in Section 8.6 of the Chapter.
East Inshore and East Offshore Marine Plans (2014)	Plan Policy BIO2 Sates that *“Where appropriate, proposals for development should incorporate features that enhance biodiversity and geological interests.”*	Embedded mitigation and enhancement measures are also described in Section 8.7 of the Chapter and included in the Outline CoCP (document reference 6.16). These measures have focused on key species relevant to the Scheme and are designed to produce gains for biodiversity.
The Norfolk Biodiversity Action Plan	The Norfolk Biodiversity Action Plan identifies objectives and targets to promote and protect biodiversity within the county during the development planning process.	Habitats and species relevant to this Plan are identified in Section 8.5 and assessed through the framework in Section 8.6 of the Chapter.

Table 1.3: Summary of Guidance

Guidance	Summary	Chapter Reference
The UK Post-2010 Biodiversity Framework (2011-2020) Biodiversity Action Plan (JNCC and DEFRA, 2012) (Ref. 8A.1)	This Framework lists the UK’s most threatened species and habitats and sets out targets and objectives for their management and recovery. The UK Biodiversity Action Plan (BAP) process is delivered nationally, regionally and	Notable species and habitats set out in this Framework are described in Section 8.5 and assessed through the framework in Section 8.6 of the Chapter. Mitigation measures deemed required for the Scheme are described in Section

Guidance	Summary	Chapter Reference
	locally and should be used as a guide for decision-makers to have regard for the targets set by the framework and the goals they aim to achieve. The UK BAP has now been replaced by the UK Post-2010 Biodiversity Framework. However, it contains useful information on how to characterise important species assemblages and habitats which is still relevant (UK Post-2010 Biodiversity Framework, 2012).	8.8.
Biodiversity 2020: A strategy for England's wildlife and ecosystem services (DEFRA, 2011) (Ref. 8A.2)	This document provides a strategy for England on the implementation of international legislation and provides a strategic plan for biodiversity policy for terrestrial, aquatic and marine habitats.	Species and habitats relevant to the assessment of the Scheme are described in Section 8.5 and assessed through the framework in Section 8.6 of the Chapter. Mitigation measures deemed required for the Scheme are described in Section 8.8.
IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment (Highways Agency, 2010) (Ref. 8A.3)	DMRB Volume 11 SECTION 2, Part 5 presents a framework for the development of significance criteria based around consideration of resource value, the magnitude of impacts and the significance of effects for ecology and nature conservation. This Interim Advice Note (IAN) provides supplementary guidance, on the application of such significance criteria for use in the assessment of the	Chapter 8 follows the broad guidance presented in this document. Section 8.5 presents the methodology followed for the impact assessment of nature conservation which accords with IAN 130/10.

Guidance	Summary	Chapter Reference
	potential impacts of road projects on nature conservation resources.	
Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland published by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018) (Ref. 8A.4)	Guidance on Ecological Impact Assessment (EcIA) for terrestrial, costal and marine environments.	Section 8.5 presents the methodology followed for the impact assessment of nature conservation which refers to the framework in CIEEM (2018) in conjunction with that given in IAN 130/10.

2 References

Ref. 8A.1: JNCC and DEFRA (2012). *The UK Post-2010 Biodiversity Framework (2011-2020) Biodiversity Action Plan.* Published by JNCC and Defra on behalf of the Four Countries' Biodiversity Group.

Ref. 8A.2: DEFRA (2011). *Biodiversity 2020: A Strategy for England's wildlife and ecosystem services.* Department for Environment, Food and Rural Affairs.

Ref. 8A.3: Highways Agency (2010). *Interim Advice Note 130/10: Ecology and Nature Conservation: Criteria for Impact Assessment.*

Ref. 8A.4: CIEEM (2018). *Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland*. Chartered Institute of Ecology and Environmental Management.

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8B: Preliminary Ecological Appraisal

Planning Act 2008

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Great Yarmouth Third River Crossing

Preliminary Ecological Appraisal

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Contents

1 Introduction

1.1 Background

Mouchel was commissioned by the Applicant to undertake a Preliminary Ecological Appraisal (PEA) of land at the proposed site of the Great Yarmouth Third River Crossing, hereafter referred to as the 'Site' shown in Figure 8B.1. The Site has been identified by the Applicant as the site of a future link to cross the River Yare.

This report presents the results of the PEA undertaken in September 2016. This report identifies ecological constraints located up to 2 km from the Site and makes recommendations for further survey work and/or avoidance or mitigation measures as appropriate.

1.2 Site Location

The amends the existing William Adams Way so that the crossing ties in directly with the A12, in the centre of Great Yarmouth, to the west of the river. On the west of the river, there are several residential properties as well as parkland and allotments. The crossing meets South Denes Road (the A1243) on the east of the river, with the land here being used by several industrial complexes.

1.3 Study Objectives

An area, extending up to 2 km from the was surveyed in order to determine impacts and likely constraints to the Site. The study set out to:

- Consult records of statutory protected sites within 2 km of the Site;
- Identify habitats and species present or likely to be present that are ecologically important and/or have legal protection; and
- Identify invasive species that might be present on Site.

2 Methods

2.1 Desk Study

The Norfolk Biodiversity Information Service (NBIS) was consulted to gather information on records of species and nature conservation designations from within the survey area.

A review of the Multi-Agency Geographic Information for the Countryside[1] online resource was also undertaken to gather information on statutory nature conservation designations within the survey area.

2.2 Field Survey

A walkover survey, undertaken broadly in accordance with Phase 1 habitat survey methodology[2], was carried out on 28th and 29th September 2016. Habitat types were identified and mapped, with target notes made to identify features of interest. The suitability of habitats within the site to support legally protected, valuable or controlled species was assessed with incidental field signs or sightings of species recorded as seen.

2.3 Limitations

Survey work was undertaken at the end of the accepted optimal season for carrying out botanical surveys, generally accepted to be April to September (inclusive). However, it is considered that sufficient information was gathered to enable an assessment of the habitat types present, in line with standard Phase 1 habitat categories and the potential for these to support protected or notable species.

[1] *Multi-Agency Geographic Information for the Countryside (MAGIC) (2016) Home [Online]. Available at www.magic.gov.uk [accessed 18 March 2016].*

[2] *Joint Nature Conservation Committee (JNCC) (2010). Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit. Peterborough, UK*

3 Results

3.1 Desk Study Results

3.1.1 Statutory Designated Sites

The Outer Thames Estuary Special Protection Area (SPA) is within 2km of the Site. This site is designated because it supports 38% of the Great British population of redthroated diver *Gavia stellate*, which is listed on Annex 1 of the EU Birds Directive.

3.1.2 Non-Statutory Designated Sites

There are no non-statutory designated sites within 2km of the Site.

3.1.3 Invertebrates

The information returned from the desk study contained a record of the goat moth *Cossus cossus*, which is a UK Biodiversity Action Priority (BAP) species.

3.1.4 Amphibians

One record of natterjack toad *Epidalea calamita* was returned. This record was for Gorleston on Sea and is undated.

There are three records for common toad *Bufo bufo*, the most recent being dated March 1999. These records are for Southtown Common, approximately 800m west of the Site.

3.1.5 Reptiles

There are four records for common lizard *Zootoca vivipara*, the most recent from Southtown Common in June 2008.

There are two records for slow-worm *Anguis fragilis,* the most recent of which was from grid reference TG52530771 in August 2008.

3.1.6 Mammals

There are fourteen records of water vole *Arvicola amphibius* from within 2km of the Site, the most recent being from December 2012.

There are three records of otter *Lutra lutra* within 2km of the Site, the most recent for a site by the name of Coopers in October 2011.

There are multiple records of bat species within 2km of the Site, many of which are from within the footprint of the Site. The most recent of these are described in the table below.

Species	Number of Records	Most Recent Record
Common pipistrelle, *Pipistrellus pipistrellus*	5	June 2015
Soprano pipistrelle, *Pipistrellus pygmaeus*	1	May 2015
Nathusius' pipistrelle, *Pipistrellus nathusii*	2	May 2015
Serotine, *Eptesicus serotinus*	1	May 2015
Daubenton's bat, *Myotis daubentonii*	1	May 2015
Noctule, *Nyctalus noctula*	3	May 2015
Brown long-eared bat, *Plecotus auritus*	1	May 2015

There are eight records of hedgehog *Erinaceus europaeus,* the most recent being from September 2009. Brown hare *Lepus europaeus*, has been also been recorded within 2km of the Site, in August 2013.

There is one record of [redacted] *Meles meles* within 2km of the Site, dating from September 2014.

3.1.7 Birds

A large number of bird species have been recorded within 2km of the Site. These include 50 species included on Schedule 1 Part 1 of the Wildlife and Countryside Act 1981 (as amended) which are protected at all times of the year.

3.2 Field Survey Assessments

3.2.1 Habitat Assessments

A plan showing the habitats identified within the Site is shown in Figure 8B.1.

3.2.1.1 William Adams Way and Suffolk Road

Southtown Common recreation ground lies to the south of William Adams Way. This area contains amenity grassland dominated by perennial rye-grass *Lolium perenne*, with some white clover *Trifolium repens*, ribwort plantain *Plantago lanceolata* and common dandelion *Taraxacum officinale* also present.

To the north and west, the common is bordered by a ditch containing standing water. The banks are covered by common nettle *Uritca dioica*, bramble *Rubus fruticosa*, great willowherb *Epilobium hirsutum*, dog rose *Rosa canina* and creeping thistle *Cirsium arvense*.

A mixture of broadleaf trees are present in the margins of the common, as well as bordering William Adams Way to the north and south. Pedunculate oak *Quercus robur*, beech *Fagus sylvatica*, poplar *Populus* spp., willow *Salix* spp., hawthorn *Crataegus*

monogyna, sweet chestnut *Castanea sativa* and horse chestnut *Aesculus hippocastanum* are all present alongside ash *Fraxinus excelsior* and elder *Sambucus nigra*.

To the north of William Adams Way and to the west of Suffolk road, is an area of wet scrub. The ditch passes under William Adams Way and runs north away from the road. The area around the ditch contains willow, great willowherb, bramble, common nettle, hawthorn, poplar and field bindweed *Convolvulus arvensis* and hogweed *Heracleum sphondylium*.

The area to the east of Suffolk Road contains several allotments which, in addition to the native species already listed, contained varieties of arable crops and introduced garden plants.

The trees and scrub in this area are suitable for use by nesting birds. Overall, the habitats around William Adams Way and Suffolk Road are of low ecological value.

3.2.1.2 South Denes Road

The area to the east of the river Yare is well built up with roads, industrial buildings and concrete storage space for materials being shipped. Butterfly bush *Buddleja davidii*, creeping thistle and ragwort *Jacobaea vulgaris* were seen to be growing amongst the concrete.

The hedgerows and trees surrounding the site are suitable for nesting birds (an active woodpigeon nest was seen during the survey). Overall, the hedgerows are of low ecological value.

There are many old buildings in states of disrepair to the east of the river. These buildings may provide roosting sites for bats.

3.2.2 Species Assessments

3.2.2.1 Amphibians

There are areas of terrestrial habitat within 250m of the that are suitable for use by amphibians. This includes the land on the northern and western edge of Southtown Common, which also includes a ditch with standing water. The ditch passes under William Adams Way and runs north beneath Queen Anne's Road before running north-west. As the ditches are linked underneath the two roads, they are considered here as one water body.

There is a small pond at TG523058. This and the surrounding habitat of grassland, scrub and woodland is suitable for use by amphibians.

3.2.2.2 Reptiles

The majority of the site is made up of either short and open sward or hard open concrete urban areas and is of negligible value for reptiles. The allotments south of Queen Anne's Road at TG523058 provide habitat suitable for use by reptiles including

a mix of tall ruderal vegetation and rough sward amongst areas of compost and logs that could be used as refugia.

3.2.2.3 Mammals

There are several structures within 100m of the Site that may be suitable for use by roosting bats. There are two uninhabited and poorly maintained houses at TG524058 as well as old brick buildings at TG524057 on the west side of the river Yare.

On the east side a disused pub at TG525060, a smokery at TG52606 and empty, damaged buildings at TG526059 offer further possible roosting sites for bats.

The drainage ditches associated with the A12 provide suitable habitat for water vole.

3.2.2.4 Birds

Bird species recorded within the site during the survey include wood pigeon *Columba palumbus*, magpie *Pica pica*, carrion crow *Corvus corone*, house sparrow *Passer domesticus*, blue tit *Cyanistes caeruleus* and robin *Erithacus rubecula*.

Trees and areas of scrub within and adjacent to the Site are suitable for use by nesting birds. Old brick buildings where access is possible through broken windows and other gaps provide suitable nesting sites for pigeons.

The mosaic of urban areas with scattered ruderal vegetation provides some suitable habitat for black redstart *Phoenicurus ochruros*.

4 Evaluation & Recommendations

4.1 Statutory Designated and Non-Statutory Protected Sites

The Outer Thames Estuary SPA is within 2km of the Site. Screening for Habitats Regulations Assessment is strongly recommended.

4.2 Habitats

The site is largely comprised of urban areas, with areas of improved grassland, scattered trees, scrub and standing water. These habitats are of low biodiversity value.

4.3 Species

4.3.1 Amphibians and Reptiles

Overall, amphibians and reptiles are unlikely to be present. Although small areas of habitat that is suitable to provide foraging, shelter and hibernation areas exist, the site is located within a predominantly urban environment and is not connected to areas of suitable offsite habitat. Accordingly, no further work in respect of amphibians and reptiles is recommended.

Both water bodies were assessed using the Habitat Suitability Index (HSI) to estimate their suitability for supporting breeding great crested newts *Triturus cristatus* (Table 8B.1). The scores of 0.49 (ditches) and 0.52 (pond) indicate that great crested newts are unlikely to use these ponds and further surveys are therefore not recommended.

4.3.2 Birds

Black redstart is listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). This species is recorded as breeding within Norfolk and Suffolk and further surveys are recommended to determine the presence of this species with regards to the location of the proposed works.

Areas of scrub and woodland which are present are suitable for use by breeding birds. No further surveys are recommended, however, in order to minimise the risk of disturbing breeding birds, the removal of woody vegetation should ideally be undertaken outside of the breeding season (typical breeding bird season is March to July inclusive). If tree and vegetation removal has to take place during this period, the vegetation should be checked prior to removal for the presence of nests by an appropriately experienced ecologist. If nests that are in use are present, it may be necessary to delay work in immediate proximity to the nest until the young have fledged.

4.3.3 Mammals

The buildings within the site are either to be purchased for demolition or will be subject to disturbance during the construction phase. It is recommended that further surveys are undertaken to confirm the presence or absence of bats within these buildings.

The wider area supports water voles *Arvicola amphibius* and the ditches associated with the A12 are suitable to support this species. Further surveys are therefore recommended.

The habitats within the site, and the surrounding residential gardens, are suitable to support hedgehogs *Erinaceus europaeus*. It is recommended that a watching brief is maintained during the works to protect individual hedgehogs that may be present.

5 Figures

Figure 8B.1 – Habitat Map

Great Yarmouth Third River Crossing

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1 Introduction

1.1 Overview

1.1.1 WSP was commissioned by the Applicant to undertake a Preliminary Ecological Appraisal (PEA) of land at the proposed site of the Great Yarmouth Third River Crossing, hereafter referred to as the 'Project Site'. The site has been identified by the Applicant as the site of a future link to cross the River Yare. An initial survey was undertaken in September 2016, the results of which were reported in The Great Yarmouth Third River Crossing: Preliminary Ecological Appraisal (Mouchel, 2016) presented in Appendix 8B. Since the publication of this report the Project Site area has undergone minor alterations in its extent. An update to the field survey component of the PEA was therefore carried out. This update included a Habitat Survey and a Protected Species Assessment and is documented in this memo report.

1.1.2 The scope of the survey has been extended west, such that the Survey Area now includes sections the A47 north and south of the A47/William Adams Way roundabout, the habitats adjacent to these areas, and the roundabout itself.

1.1.3 This report presents the results of the field survey update undertaken in July 2018. This report should be read in conjunction with the 2016 report.

1.1.4 In January 2019 an additional site visit was carried out on six Satellite Sites where installation of Variable Messaging Signs (VMS) is proposed. The results of this are presented in Annex 8C.1

1.1.5 The PEA update set out to:

- Describe habitats not previously detailed in the 2016 report;
- Identify the suitability of these habitats to support protected or notable species; and
- Address any alterations and discrepancies between the current survey findings and the 2016 report.

2 Survey Methods

2.1 Habitat Survey

2.1.1 A Phase 1 habitat survey was carried out on 25th July 2018. This survey specifically included the areas which had not been previously considered in the 2016 report. Figure 8C.1 shows the extent of the amended survey area. Habitats were described and mapped following the standard Phase 1 habitat survey methodology (Ref. 8C.1). Phase 1 habitat survey is a standard technique for classifying and mapping British habitats. The dominant plant species are recorded and habitats are classified according to their vegetation types. Where appropriate, consideration was given to whether habitats qualify, or could qualify, as a Habitat of Principal Importance in accordance with the habitat descriptions published by the Joint Nature Conservation Committee (Ref. 8C.2).

2.1.2 Habitats were marked on paper base maps which were subsequently digitised using a Geographical Information System (GIS). Target notes were made to provide information on specific features of ecological interest (e.g. a [redacted] *Meles meles* sett) or habitat features too small to be mapped.

2.1.3 Invasive plant species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) which were evident during the Phase 1 habitat survey were noted. Detailed mapping of such species or a full survey of the Site for all invasive plant species is beyond the scope of this commission.

2.2 Protected Species Assessment

2.2.1 The suitability of the survey area to support legally protected and notable species was assessed based on the desk study results from the 2016 report combined with field observations made during the PEA update survey. Assessment of habitat suitability for protected and notable species was based on standard sources of guidance on habitat suitability assessment for key faunal groups including: birds (Ref. 8C.3 and Ref. 8C.4); bats (Ref. 8C.5 and Ref. 8C.6); great crested newt (Ref. 8C.7 and Ref. 8C.8); and water vole (Ref. 8C.9).

3 Results

3.1 Habitat Survey

3.1.1 Habitats surveyed comprised woodland, watercourses, dry ditches, scrub, ruderal vegetation, amenity grassland and scattered trees. Within the area surveyed in 2016 additional small parcels of amenity grassland have been identified, as well as a line of scattered trees running parallel to Queen Anne's Road behind the residential house and gardens. The habitats present within the survey area are all of low biodiversity value.

Broad-Leaved Semi-Natural Woodland - A1.1.1

3.1.2 There are linear sections of woodland running adjacent to the road across the surveyed area. The section to the north-west of the roundabout comprises semi-mature ash *Fraxinus excelsior*, willow *Salix* spp., oak *Quercus robur* and hawthorn *Crataegus monogyna*. A dry ditch runs through the centre of this wooded area. There are no indications of management of this area (Plate 1).

3.1.3 Woodland also occurs adjacent to the eastern side for the A47 north and south of the roundabout. The southern section was described in the 2016 survey as dense continuous scrub but has matured since this time. Both sections of woodland have similar structure, with a dense understorey dominated by blackthorn *Prunus spinosa*, hawthorn and bramble *Rubus fruticosus* agg. Taller willow and birch *Betula* spp. dominate the canopy layer. Watercourses run adjacent to these wooded areas. A hoof print and droppings of muntjac deer *Muntiacus reevesi* were recorded in these woodland sections (Plate 2-4).

3.1.4 The watercourse that runs parallel to the north of Queens Anne's Road is shaded by woodland dominated by Lawson cypress *Chamaecyparis lawsoniana* and willow trees.

Dense/Continuous Scrub - A2.1

3.1.5 Dense continuous scrub occupies the area to the southeast adjacent to the roundabout. This vegetation is dominated by bramble and has not been regularly managed (Plate 5).

Scattered Scrub - A2.2

3.1.6 Scattered scrub is present to the north and south of the roundabout on the western side of the A47. This comprises small trees adjacent to the carriageway, which include willow, oak and hawthorn.

Mixed Scattered Trees - A3.1

3.1.7 There are scattered trees throughout the site. A line of mature Scots pine *Pinus sylvatica* and birch were identified amongst the areas shown in the 2016 survey. These trees were well-managed with no evidence of damage or other characteristics that would suggest roosting opportunities for bats (Plate 6).

Tall Ruderal Vegetation - C3.1

3.1.8 Tall ruderal vegetation has been recorded within the land areas adjacent to Queen Anne's Road. This vegetation is between 50cm-1.0m in height and dominated by rosebay willow herb *Chamaerion angustifolium* (Plate 7).

Standing Water/Dry Ditch - G2/J2.6

3.1.9 Watercourses run parallel to the western side of the A47. At the time of the survey these watercourses had become partly or completely dry. The watercourse to the north was completely dry and was heavily shaded by the woodland and scattered scrub detailed above (Plate 8).

3.1.10 The watercourse to the south was partly dry, up to 2m wide, with pools of water along its length, and was dominated by dense tall vegetation including reed mace *Typha latifolia* and common reed *Phragmites australis* (Plate 9). Some sections of the watercourse were heavily shaded by the scattered scrub detailed above. Towards the southernmost extent of the survey area this watercourse widens to 4m and has a depth of 2m, and is connected to a watercourse where evidence of water voles was found in 2017 (Plate 10). As such, water voles may be present within this watercourse.

Amenity Grassland - J1.2

3.1.11 There were various sections of amenity grassland throughout the survey area. These areas were short-cropped and regularly managed with ruderal vegetation encroaching along some edges.

Introduced Shrubs - J4

3.1.12 The roundabout within the survey area has landscaped introduced planting (Plate 10).

Buildings – J3.6

3.1.13 Buildings within the survey area comprised private housing and commercial warehouses. The buildings were assessed for their potential to support roosting bats. Gulls *Larus* spp were observed roosting on warehouse rooves.

3.2 Protected Species Assessment

3.2.1 The watercourses within the surveyed area provide suitable habitat for amphibians and water voles. The watercourse to the west of the A47, south of the roundabout, is connected to the watercourse on the east side of the road and because of this these watercourses should be considered as the same continuous habitat. Further, this watercourse continues south beyond the redline boundary running parallel to both sides of the A47. The watercourse was assessed using the Habitat Suitability Index to quantify its likely suitability to support breeding great crested newts, and scored 0.66, indicating 'Average' suitability. Further studies to confirm whether or not this species occurs are therefore recommended, however, the urban location and relative isolation of the watercourse make it unlikely that great crested newts would be present.

3.2.2 Scrub, woodland and scattered trees across the whole Scheme are suitable for use by nesting birds. Further to this Gulls *Larus* spp were observed roosting on rooves of the warehouses present within the surveyed area (Plate 16).

3.2.3 Buildings within the survey area were assessed for their suitability to support roosting bats in accordance with the methodology outlined in Collins (2016) (Ref. 8C.5). Figure 8C.1 shows buildings and structures surveyed. Buildings labelled B1 and B2 contained features indicating low suitability to support roosting bats. B1 was a terrace of private house (Plate 12) with slipped tiles on the south facing side to the roof, revealing gaps which might allow bats to access the roof void (Plate 13). B2, also a terrace of private houses (Plate 14), had slipped tiles on its eastern side, again revealing gaps which might allow bats to access the roof void (Plate 15). Buildings labelled B3-B5 were assessed as having negligible suitability to support roosting bats.

4 Recommendations

4.1.1 The protected species assessment undertaken and mitigation identified in the 2016 report remain appropriate but are extended to include the recently surveyed areas, in particular, consideration of the watercourse identified for evidence of water voles.

4.1.2 Inclusion of the watercourses connected to the ditch assessed in 2016 has led to an increased HSI score, indicating the watercourse to have 'Average' suitability to support breeding great crested newts. However, the urban environment within which these watercourses are set and their relative isolation mean that great crested newts are unlikely to be present.

4.1.3 Removal of trees and scrub, or structures, will be undertaken outside of the bird breeding season (typical breeding bird season is March to July inclusive) to avoid risk of effects on breeding birds. If demolition has to take place during this period, the structures will be checked, prior to the commencement of demolition, for the presence of nests by an appropriately experienced ecologist. If nests that are in use are present, it may be necessary to delay work in immediate proximity of the nest until the young have fledged.

4.1.4 If buildings assessed as of low suitability to support roosting bats are to be demolished, these will be subjected to internal inspections to confirm whether or not they are roost sites and if further actions in respect of bats are required.

Plate 1 – Woodland south west of the roundabout

Plate 2 – Woodland adjacent to the east of the A47, running north from the roundabout

Plate 3 – Woodland adjacent to the east of the A47, running north from the roundabout

Plate 4 – Woodland adjacent to the east of the A47, running south from the roundabout

Plate 5 – Dense scrub southeast of the roundabout

Plate 6 – Tree line behind residential area, running parallel with Queen Anne's Road

Plate 7 – Tall ruderal vegetation

Plate 8 – Dry ditch running parallel to the west of the A47, north of the roundabout

Plate 9 – Partly dry watercourse running parallel to the western edge of the A47, south of the roundabout

Plate 10 – Partly dry watercourse running parallel to the western edge of the A47, south of the roundabout

Plate 11 – Introduced scrub planting on the William Adam's Way/A47 roundabout

Plate 12 – Buildings B1, assessed for bat roost potential

Plate 13 – Features on B1 assessed as providing low suitability for roosting bats

Plate 14 – Buildings B2, assessed for bat roost potential

Plate 15 – Features on B2 assessed as providing low suitability for roosting bats

Plate 16 – Example warehouse structures

5 References

Ref. 8C.1: Joint Nature Conservation Committee (JNCC) (2010). Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit. Peterborough, UK.

Ref. 8C.2: Joint Nature Conservation Committee (JNCC) (ed. Ant Maddock) (2008). UK Biodiversity Action Plan Priority Habitat Descriptions. JNCC, Peterborough.

Ref. 8C.3: Gilbert, G., Gibbons, D.W. and Evans, J. (1998). Bird Monitoring Methods: A Manual of Techniques for Key UK Species. RSPB.

Ref. 8C.4: Bibby, C.J., Burgess, N.D., Hill, D.A. and Mustoe, S.H. (2000). Bird Census Techniques. Second Edition. Elsevier Ltd.

Ref. 8C.5: Collins, J. (ed.) (2016). Bat Surveys for Professional Ecologists, Good Practice Guidelines (3rd Edition). The Bat Conservation Trust, London.

Ref. 8C.6: Mitchell-Jones, A.J, (2004). Bat Mitigation Guidelines. English Nature, Peterborough.

Ref. 8C.7: Gent, A. and Gibson, S. (2003). Herpetofauna Workers Manual. JNCC, Peterborough.

Ref. 8C.8: English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature, Peterborough.

Ref. 8C.9: Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series). Eds. Fiona Matthews and Paul Chanin. The Mammal Society, London.

Annex 8C.1 – Ecological Survey of Satellite Sites

Site Walkover

8C1.1 Each of the six Satellite Sites were visited on 14th January 2019 and broadly assessed for their suitability to support protected or notable species. These sites are limited in extent and therefore a full Phase 1 Habitat assessment was not carried out. Habitats present largely consisted of amenity grassland and hardstanding and all six Satellite Sites were considered to be of negligible value.

8C1.2 Satellite Site 9-01 had a large number of mole hills, indicating the likely presence of moles within the area. Moles are not a protected species and the installation of the VMS will result in only a small loss of negligible quality amenity grassland, which will not impact the species.

Satellite Sites 5-01 and 5-02


Plates 17 and 18 – Hardstanding layby adjacent to the A47. Beyond the layby was a steep scrubby bank leading down to a small watercourse. Habitats were of negligible value

Satellite Sites 6-01 and 6-02


Plates 19 and 20 – Habitats comprised mainly of hardstanding and short amenity grassland of negligible value

Satellite Sites 7-01 to 7-07


Plates 21 and 22 – Habitats comprised hardstanding and short amenity grassland of negligible value

Plate 23 – Mature broadleaved tree present, but considered unlikely to be impacted (see Detailed Arboriculture Report Appendix 8H)

Satellite Sites 8-01 and 8-02


Plates 24 and 25 – Habitats comprised hardstanding and short amenity grassland of negligible value

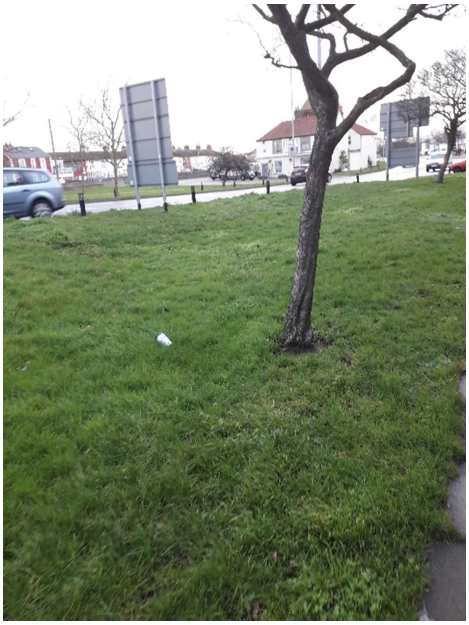

Plate 26 – Young broadleaved trees also present, but considered unlikely to be impacted (see Detailed Arboriculture Report Appendix 8H)

Satellite Sites 8-03 and 8-04

Plate 27 – Habitats comprised hardstanding, introduced shrubs (young) and short amenity grassland of negligible value. Additionally, young broadleaved trees were present, but considered unlikely to be impacted (see Detailed Arboriculture Report Appendix 8H)

Satellite Site 9-01

Plates 28 and 29 – Habitats comprised hardstanding and short amenity grassland of negligible value

Plate 30 – Western areas supported large numbers of moles

Satellite Sites 10-01 to 10-03

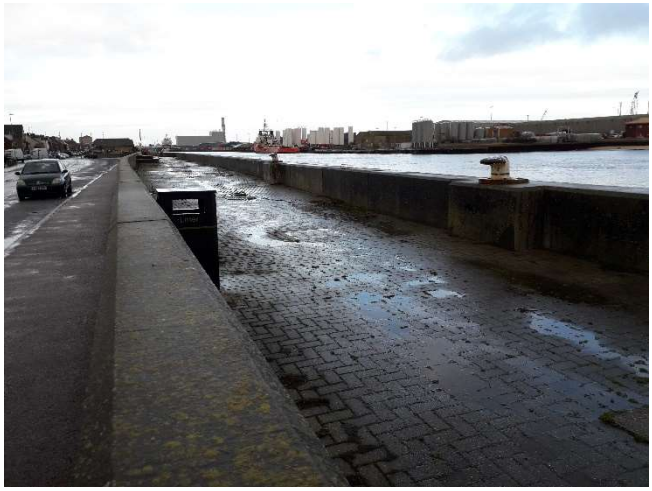

Plate 31 – Area dominated by hardstanding

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8D: Bird Survey Report

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ("APFP")

APFP regulation Number: 5(2)(a)

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Breeding Bird Survey and Vantage Point Survey of a site in Great Yarmouth, Norfolk, associated with the catchment area for a potential new road crossing over the River Yare.

2018

FINAL REPORT

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Notice to Interested Parties

Document Information

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Document ref:	P0696-R-001a **FINAL REPORT**
Author(s):	Darren Frost
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0 EXECUTIVE SUMMARY

0.1 On behalf of their client, Cambridge Ecology Ltd was commissioned by WSP to carry out a Breeding Bird Survey and Vantage Point Survey on land in Great Yarmouth, Norfolk, associated with the catchment area for a potential new road crossing over the River Yare.

0.2 The information gathered from the Breeding Bird and Vantage Point Survey visits was considered to provide a robust and valid indication of the breeding bird assemblage, population size of breeding bird species and bird activity in the survey area at the time of the survey visits.

0.3 Four Breeding Bird Survey visits were conducted between mid-May and mid-June. These survey visits recorded a total of 35 bird species. The species recorded reflect an assemblage typical of the habitat present at the site.

0.4 Observations of bird activity during the Breeding Bird Survey indicated that 33 species recorded were confirmed and/or considered to be probable/possible breeding species. Two species were not considered to be breeding in the survey area, but were seen flying over the site.

0.5 Black Redstart, a Schedule 1 species of the Wildlife & Countryside Act 1981 (as amended), was observed during the first survey visit. It was considered that 2-3 territories were present in the survey area.

0.6 Of the other breeding/probable/possible breeding species, the survey area supported six bird species (14 pairs of Herring Gull, 4 Starling nesting sites, 1 Song Thrush territory, 7 pairs of House Sparrow, 5 Dunnock territories and 1 pair of Linnet) that are recognised for their conservation value by being UK BAP listed species and Principal Species of Importance (Section 41 NERC Act 2006). As such, national species action plans have been created for these species to safeguard current populations and reverse population declines.

0.7 All the species mentioned here are listed on recognised conservation criteria and therefore are of some conservation importance. The presence of these species should be of material consideration when the proposals for the site.

0.8 A total of 33 hours of Vantage Point survey visits were carried out between mid May and July. These surveys recorded a total of seven bird species (Cormorant, Sparrowhawk, Oystercatcher, Black-headed Gull, Lesser Black-backed Gull, Herring Gull and Hobby). It was considered that the survey results presented an accurate reflection of the bird species present during the survey visits.

0.9 There were no observations made of the Common Tern, the main target species of the survey. There were also no observations of any other waterbirds that qualify as features of the Breydon Water SPA.

0.10 Of the species, recorded (Herring Gull, and Hobby) are recognised for their conservation value by being either listed on the BoCC Red List in recognition

of their significant population decline (>50%) and consequently of conservation concern and Schedule 1 species of the Wildlife & Countryside Act 1981 (as amended), respectively.

0.11 A single Hobby, a species listed on Schedule 1 of the Wildlife & Countryside Act 1981 (as amended), was recorded on the 19th July for 125 seconds in the 35-125m height band.

0.12 Herring Gull and Lesser Black-backed Gull and Kestrel were breeding in the study area they were recorded during all eleven survey visits, throughout the 3-hour survey periods, at all three height bands and all directions.

0.13 The presence of these species should be of material consideration when assessing the potential impact of the scheme proposals on birds.

0.14 Without mitigation, the development proposals would likely result in a number of direct adverse impacts on breeding birds. These direct impacts would include, (i) habitat loss through land-take and (ii) direct mortality.

0.15 There were no observations made of the Common Tern, which was the main target species of the Vantage Point survey. There were also no observations of any other waterbirds that qualify as features of the Breydon Water SPA. Therefore, within the limitations of the survey and based on the survey findings, the integrity of the Breydon Water SPA and waterbirds that qualify as features of the Breydon Water SPA would not appear to be a constraint to the development.

0.16 Based on the findings of this Breeding Bird and Vantage Point Survey, a number of measures can be recommended that should be incorporated into the scheme proposals that would limit the impact of the scheme on the existing local bird assemblage.

1 INTRODUCTION

1.1 On behalf of their client, Cambridge Ecology Ltd was commissioned by WSP to carry out a Breeding Bird Survey and Vantage Point Survey on land in Great Yarmouth, Norfolk, associated with the catchment area for a potential new road crossing over the River Yare.

1.2 This survey was required to investigate the presence of breeding birds along the proposed route of the river crossing and which could therefore potentially be affected by the development and could cause a constraint to the proposed development. Breeding birds would need to be considered in relation to maintaining compliance with wildlife legislation and planning policy.

1.3 Previous survey work (WSP pers. comm.) within the site boundary had highlighted the potential for the area to support breeding birds that are of conservation concern specifically Black Redstart *Phoenicurus ochruros*. Therefore, a breeding bird survey, with particular emphasis on detecting Black Redstart was required.

1.4 It is understood (WSP pers. comm.) that the proposed extension to the Breydon Water Special Protected Area (SPA) will include the River Yare, and therefore the catchment area for a potential new road crossing over the River Yare. During the breeding season Common Tern *Sterna hirundo* are a qualifying feature of Breydon Water SPA, with the SPA supporting approximately 1.3% of the Common Tern population within Great Britain (155 breeding pairs) (JNCC 2006). There is potential for the proposed development to impact upon the distribution of Common Tern, which could potentially be in breach of the SPA's conservation objectives (Natural England 2014).

1.5 The existing boundary of the Breydon Water SPA lies approximately 2km to the north west of the proposed new river crossing.

1.6 Therefore, a Vantage Point (VP) survey with particular emphasis on detecting Common Tern was required to appropriately assess the activity of Common Tern and other waterbird species in the vicinity of the proposed new river crossing.

1.7 For clarity in this report the development site (or 'site') refers to land within survey area including the red line boundary of the catchment area for proposed development.

Aims and objectives

1.8 Aims of the Breeding Bird Survey and Vantage Point Survey were primarily to inform the planning application process pertaining to the development proposals on the land associated with the catchment area for a potential new road crossing over the River Yare. The survey results would be expected to:

- highlight the current breeding status of birds that are of conservation concern in the area especially breeding Black Redstart;

- highlight the current usage of the area by waterbird species that are qualifying features of Breydon Water SPA, especially Common Tern;
- provide baseline information on the current assemblage and abundance of breeding birds within the study area;
- identify appropriate mitigation measures, necessary to comply with legal requirements pertaining to breeding bird legislation; and
- identify enhancement opportunities in relation to national planning policy in terms of the National Planning Policy Framework (NPPF). The key principles in the NPPF require that *"the planning system should contribute to and enhance the natural and local environment by minimising impacts on biodiversity and delivering net gains in biodiversity where possible*."

1.9 This report summarises the background to the study and details the results and key findings of the 2018 Breeding Bird Survey and Vantage Point Survey. The data may be used to provide guidance on the need and design of any appropriate mitigation measures. These measures may be necessary to minimise any potential adverse effects of the development proposals on breeding birds and waterbird species that are qualifying features of Breydon Water SPA. In addition, the data may also help the design of any appropriate ecological enhancement measures such as habitat creation and site management for the benefit of breeding birds.

Study Area and Development Proposals

1.10 The study area was located towards the northern end of Great Yarmouth.

1.11 For the breeding bird survey, the north of the study area was bordered by Tollgate Road on the western side of the River Yare and by Newcastle Road on the eastern side of the River Yare. To the south the study area was bordered by Manor Road on the western side of the River Yare and by Salmon Road on the eastern side of the River Yare. To the west the study area was bordered by the A47 dual carriage way and by Harbord Crescent to the east. Figure 1.1 shows the approximate area covered during the breeding bird survey visits.

1.12 For the Vantage Point Survey the study area comprised both banks of the river yare extending from Boundary Road to the north and Queen Anne's Road to the south. Figure 1.2 shows the approximate location of the vantage points and the area covered during the survey visits.

1.13 Within the survey area the dominant habitat comprised, urban residential and commercial land, which was centred around the River Yare.

1.14 Other habitats included amenity and improved grassland, tall ruderal, dense and scattered scrub, ephemeral/short perennial, broad-leaved lowland deciduous woodland (including plantation woodland) and hedgerows.

1.15 The development proposals for the study area comprised the construction of a new road bridge across the River Yare.

Relevant Legislation and Policy

1.16 Relevant legislation and policies relating to the remit of this survey are listed below and outlined in more detail in the proceeding tables, divided into protected habitats and species.

- The Conservation of Habitat and Species Regulations 2017;
- Natural Environment and Rural Communities (NERC) Act 2006 (as amended);
- The Wildlife and Countryside Act 1981 (as amended);
- The Countryside and Rights of Way (CRoW) Act 2000;
- National Planning Policy Framework 2012;
- Government Circular (ODPM 06/2005) Biodiversity and Geological Conservation - Statutory Obligations & Their Impact Within the Planning System;
- The UK and Norfolk Biodiversity Action Plan.

Breeding Bird Legislation

1.17 Under the terms of the Wildlife & Countryside Act 1981 (as amended) - All birds, their nests, eggs and young are protected by law. It is an offence, with certain exceptions, to:

- intentionally kill, injure or take any wild bird.
- intentionally take, damage or destroy the nest of any wild bird while it is in use or being built.
- intentionally take or destroy the egg of any wild bird.
- have in one's possession or control any wild bird (dead or alive), part of a wild bird or egg of a wild bird which has been taken in contravention of the Act, the Protection of Birds Act 1954 or the law of any EU Member State (which implements the EU Birds Directive 1979).
- intentionally or recklessly (revised under the terms of the CRoW Act 2000) disturb any wild bird listed on Schedule 1 while it is nest building or is in, on or near a nest with eggs or young; or disturb the dependent young of such a bird.

1.18 Special penalties are available for offences related to bird species on Schedule 1 of the Act, for which there are additional offences of disturbing these birds at their nests and/or their dependent young.

1.19 Therefore, any activities, such as site clearance work, must avoid contravention of this legislation.

1.20 Various bird species are listed as priority species under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. This places a duty on all government departments to have regard for the conservation of these species and to promote other stakeholders to further, the conservation of these species.

1.21 The presence of bird species listed as either UKBAP, Species of Principal Importance and/or BoCC Red List species is of material consideration during

the planning process and mitigation measures would be necessary to address their presence.

1.22 National Planning Practice Guidance (NPPG) includes the following information in regard to development. ”Local planning authorities should consider the opportunities that individual development proposals may provide to enhance biodiversity and contribute to wildlife and habitat connectivity in the wider area

2 METHODS

Breeding Bird Survey Registration Mapping

2.1 The survey methodology involved standard territory (registration) mapping techniques as detailed in Bird Monitoring Methods (Gilbert *et al.*, 1998) and the national Black Redstart survey methodology (Morgan and Glue, 1981).

2.2 This method is based on the observation that many species during the breeding season are territorial. This is found particularly amongst passerines, where territories are often marked by conspicuous song, display, and periodic disputes with neighbouring individuals. Registrations of birds, using standard British Trust for Ornithology (BTO) two letter species codes, were placed onto an appropriate field map (scale 1:5000). Specific codes were also used for singing, calling, movements between areas, flying, carrying food, nest building, aggressive encounters and other behaviour. The expected outcome of this technique is that mapped registrations fall into clusters, approximately coinciding with territories. Where a species has closely packed territories (e.g. Reed Warbler), the mapping of simultaneously singing birds becomes essential. Territory boundaries are taken to be between such birds.

2.3 A species was assumed to be breeding if one or more of the following activities were recorded:

- Territorial/Alarm
- Song
- Aggressive Encounter
- Occupied Nest / Nest Box / Sitting on Nest
- Carrying Nest Material
- Carrying Food

2.4 The study area was defined as the red line boundary of the development site where access was possible (Figure 1.1).

2.5 The study area was walked at a slow pace in appropriately fine weather in order to locate and identify all individual birds. All field boundaries and suitable breeding habitats were walked. Visits were undertaken early in the morning from dawn (04:30 – 1100). The whole survey area was covered during each visit, using suitable optical equipment (binoculars x10 magnification, and telescope x20-60 magnification) to observe bird behaviour. Survey routes were alternated on each visit, to ensure that all areas were covered at various times of day across the duration of the survey.

2.6 Surveys were undertaken between May and June 2018, with four survey visits taking place. The survey dates were as follows:

1. 18th May
2. 30th May
3. 15th June
4. 29th June

2.7 All surveys were undertaken by Darren Frost (holder of a Natural England Schedule 1 Barn Owl Licence: CL29/00166) and Martin Sutherland professional ecologists, each with at least 20 years knowledge and experience of undertaking breeding bird surveys.

2.8 The weather conditions encountered during the Breeding Bird Survey visits are detailed in Table 2.1

Table 2.1 Weather conditions during the 2018 Breeding Bird Survey visits

Date	Survey Period	Wind conditions		Temperature (Ave. ^{o}C)	Visibility	Cloud %	Rain (mm)
		Direction	Speed (Ave. mph)				
18/05/2018	0500-1100	NW	8	8	>3km	100	Dry
30/05/2018	0450-1100	N	10	13	>3km	60	Dry
15/06/2018	0430-1100	SW	6	12	>3km	50	Dry
29/06/2018	0430-1100	NE	9	13	>3km	50	Dry

*http://*www.metoffice.gov.uk and http://www.accuweather.com

2.9 Observations of birds made in the field were recorded directly on to handheld computers. These devises displayed Ordnance Survey (OS) base maps and the location of the surveyor - using Global Positioning Systems (GPS) technology. This aided in the accurate recording of the birds' location. Upon completion of the surveys the data were then downloaded and used to create individual species master maps.

2.10 The data analyses followed procedures detailed in Gilbert *et al.* (1998). From species master maps, the number of territories for each species was calculated. If there were eight or fewer survey visits (as in this case which comprised four visits) during the period when a species is expected to be present, then only one registration of a bird, in the same area, was required as the minimum number necessary to assume a breeding territory.

2.11 For late flying migrants, e.g. Spotted Flycatcher *Muscicapa striata*, for which fewer potential contacts are possible, only one registration is required, this approach was also applied to inconspicuous species, e.g. Grey Partridge *Perdix perdix*.

2.12 A number of species are not territorial, e.g. Linnet *Carduelis cannabina*, where data represent aggregations or loose colonies. Therefore, a territory represents a colony of a certain number of pairs of breeding birds.

2.13 Species that do not form territories or nest colonially e.g. certain wildfowl, the term territory is replaced by breeding pair and/or brood.

2.14 Standard registration mapping techniques were also used to record nonbreeding species.

2.15 The criteria set out within the Bird Atlas 2007-2011 (Balmer *et al.,* 2014) would be used to assess the breeding status of each species recorded.

Therefore, the following definitions have been used to identify the breeding status of the species recorded:

- Confirmed Breeding: Includes species for which territories were positively identified as a result of the number of registrations, the location of an active nest, the presence of recently fledged young or downy young.
- Probable Breeding: Includes a pair observed in suitable nesting habitat in breeding season, agitated behaviour or anxiety calls from adults, suggesting probable presence of nest or young nearby. Behaviour was observed on insufficient occasions to confirm the presence of a territory.
- Possible Breeding: Includes species observed in breeding season in suitable nesting habitats, singing male present (or breeding calls heard) in breeding season in suitable breeding habitat.
- Non-Breeding: Fly-over species observed considered to be still on migration. Species present as a summering non-breeder.

2.16 The conservation status of the species recorded as breeding were measured against the following criteria:

- Annex 1 of the EU Birds Directive (Directive 79/409/EEC);
- Schedule 1 of the Wildlife and Countryside Act 1981, (as amended);
- UK Biodiversity Action Plan (UK BAP) priority species (Anon, 2007);
- Species of Principal Importance listed under Section 41 of the Natural Environment & Rural Communities Act (2006), (as amended);
- Birds of Conservation Concern (BoCC) Red List (Hayhow et al., 2017).

2.17 Based on the findings of the survey and bird registrations, species master map production and territory assessment was only undertaken for those species that were considered to be breeding within the survey area and were listed on one or more of the above criteria.

Vantage Point Survey

2.18 The Vantage Point Survey was designed to quantify the level of flight activity of Common Tern and other waterbirds that qualify as features of the Breydon Water SPA and their distribution over the survey area. Focal counts of activity of non-waterbirds that were considered to be of conservation concern was also be undertaken.

2.19 The Vantage Point Survey involved standard counts and activity and height categories as detailed within 'Recommended bird survey methods to inform impact assessment of onshore wind farms' (Scottish Natural Heritage (SNH), 2014), as recommended by Natural England in Guidance Note TIN069 (Natural England, 2010).

2.20 The surveyor was located at a single Vantage Point location to observe the survey area on the River Yare as identified on Figure 1.2.

2.21 A view across the whole survey area was covered during each visit, using suitable optical equipment (binoculars x10 magnification, and telescope x20-60 magnification) to observe bird activity and behaviour.

2.22 The surveyor collected data on the relative use of the survey area and time spent flying over the defined survey area by target species.

2.23 The data collected during the 33 hours of survey included recording:

- the species;
- the number of birds;
- the type of behaviour exhibited by the birds in the survey area;
- the height at which the birds were flying over the survey area in one of three band widths (i.e. water level up to 35m, 35-125m and >125m);
- the direction of travel; and
- the time period the birds spent in the survey area.

2.24 The weather conditions encountered during the Vantage Point Survey visits are detailed in Table 2.2.

Table 2.2 Weather conditions during the 2018 Vantage Point Survey visits

Date	Start/End Time	Wind conditions		Temperature (Ave. ^{o}C)	Visibility	Cloud %	Rain (mm)
		Direction	Speed (Ave. mph)				
17/05/2018	0830-1130	N-NNE	15	11	>3km	50	0
	1430-1730	N	15	12	>3km	50	0
29/05/2018	0800-1100	NE	14	15	>3km	75	0
	1400-1700	NE	17	17	>3km	85	0
14/06/2018	0900-1200	SW	23	18	>3km	100	<2
	1500-1800	W	18	21	>3km	25	0
28/06/2018	1200-1500	NE	10	20	>3km	25	0
29/06/2018	0600-0900	NNE	7	15	>3km	33	0
19/07/2018	1100-1400	E	7	22	>3km	75	0
	1700-2000	SE	10	23	>3km	0	0
20/07/2018	0530-0830	SE	<5	15	>3km	0	0

*http://*www.metoffice.gov.uk and http://www.accuweather.com

2.25 Surveys were undertaken between May and July 2018, with seven survey visits taking place. A total of 33 hours of observation time was undertaken during the period. These involved eleven three-hour surveys. No more than nine hours of observation was carried out within a single 24-hour period. Surveys were scheduled once every two weeks and hours of observation will range between sunrise and sunset over the survey period.

2.26 The survey dates were as follows:

1. 17th May
2. 29th May
3. 14th June
4. 28th June
5. 29th June

6. 19th July
7. 20th July

2.27 All surveys were undertaken by Darren Frost (holder of a Natural England Schedule 1 Barn Owl Licence: CL29/00166) and Martin Sutherland professional ecologists, each with at least 20 years knowledge and experience of undertaking breeding bird surveys.

Survey Constraints

2.28 The Breeding Bird Survey followed the standard method described in Bird Monitoring Methods (Gilbert *et al.,* 1998) and the national Black Redstart survey methodology (Morgan and Glue, 1981).

2.29 It was considered that the Breeding Bird Survey provided a robust and valid indication of the species present, their abundance, territory location and their usage of the site between May and June 2018.

2.30 The surveys were carried out in suitable weather conditions and at a time of day when birds would likely be most active and visible to surveyors.

2.31 Access to some commercial and residential areas as well certain habitats was not possible. Therefore, the status of breeding birds and the assemblage present could not be determined. These areas are however limited in area and quality for breeding birds.

2.32 It was recognised that the breeding bird survey was commenced in mid-May rather than in March - April as recommended by Gilbert *et al.* (1998). Therefore, there is some potential for early breeding bird species and their territories to have been overlooked. However, considering the site was located in an urban environment, early breeding species of conservation interest, such as owl species, would not be present. In addition, widespread breeding bird activity was observed during the survey visits and the species observed was thought to be representative of the assemblage present.

2.33 It was also recognised that the Black Redstart survey was commenced in mid-May rather than in mid-April as recommended by Morgan and Glue (1981). Therefore, some early breeding activity and territories may have been overlooked. However, the surveys did record the presence of Black Redstart, so their presence was detected and the precautionary assumption made that all three territories detected were active.

2.34 The Vantage Point Survey followed the methodologies described by SNH (2014) and Natural England (2010).

2.35 It was considered that the Vantage Point Survey provided robust and valid indication of the species present, their abundance and usage of the site between May and July 2018.

2.36 The survey comprised 33 hours of observations, covering all periods of daylight hours.

2.37 It was recognised that no nocturnal vantage point surveys were carried out. Therefore, conclusions cannot be drawn about nocturnal bird activity from this survey.

2.38 In addition, both surveys took place over one season, therefore conclusion about other seasons or variations in bird activity from year to year cannot be drawn from this survey.

3 RESULTS AND EVALUATION

Breeding Bird Survey

3.1 During the breeding bird survey, a total of 35 species were recorded between 18th May and 29th June 2018. Of these 35 species and based on the criteria set out in para 2.15, 28 species were confirmed as breeding within the study area, while another was probably breeding and four possibly breeding. Two species were considered to be non-breeding species. All species recorded during the breeding bird surveys, their breeding status in the study area, together with their conservation status are detailed in Table 3.1.

3.2 The English and Latin names of all the species recorded during the breeding bird survey detailed in this report can be found in Appendix A.

Table 3.1 Bird species recorded in the survey area during the breeding bird survey

Species	Likely breeding status	Annex 1 EU Birds Directive[1]	Schedule 1 Wildlife & Countryside Act 1981[2]	Birds of Conservation Concern[3]	UK BAP Priority Species[4]	Species of Principle Importance[5]
Mallard	Possible			Amber		
Sparrowhawk	Possible					
Moorhen	Breeding					
Oystercatcher	Non-breeding			Amber		
Herring Gull	Breeding			Red		
Lesser Black-backed Gull	Breeding			Amber		
Woodpigeon	Breeding					
Collared Dove	Breeding					
Swift	Possible			Amber		
Great Spotted Woodpecker	Probable					
Green Woodpecker	Possible					
Kestrel	Breeding			Amber		42
Hobby	Non-breeding		X			
Magpie	Breeding					
Carrion Crow	Breeding					
Blue Tit	Breeding					
Great Tit	Breeding					
Long-tailed Tit	Breeding					
Chiffchaff	Breeding					
Reed Warbler	Breeding					
Blackcap	Breeding					
Wren	Breeding					
Starling	Breeding			Red	X	41, 42
Blackbird	Breeding					
Song Thrush	Breeding			Red	X	41, 42
Robin	Breeding					

Species	Likely breeding status	Annex 1 EU Birds Directive[1]	Schedule 1 Wildlife & Countryside Act 1981[2]	Birds of Conservation Concern[3]	UK BAP Priority Species[4]	Species of Principle Importance[5]
Black Redstart	Breeding		X	Red		
House Sparrow	Breeding			Red	X	41, 42
Dunnock	Breeding			Amber	X	41, 42
Pied Wagtail	Breeding					
Chaffinch	Breeding					
Greenfinch	Breeding					
Linnet	Breeding			Red	X	41, 42
Goldfinch	Breeding					
Feral Pigeon	Breeding					
Total species = 35						

[1.] Species included on Annex 1 of the EU Birds Directive (79/409/EEC).
[2.] Species protected by Schedule 1 of the Wildlife & Countryside Act 1981.
[3.] Species on the Birds of Conservation Concern Red and Amber list (Hayhow *et al*., 2017).
[4.] Priority Species in the UK Biodiversity Action Plan (Anon, 2012).
[5.] Species included in Section 41 of the Natural Environment and Rural Communities Act 2006 (Ref: Anon 2006).

3.3 Of the 33 species recorded as breeding (confirmed, probable and possible) within the study area, seven were covered by one or more of the criteria listed in paragraph 2.16 (N.B. for BoCC Amber listed species only those that also held other designated have been included). Table 3.2 summarises the seven species, the number of breeding territories and their conservation status.

Table 3.2 Summary of bird species of specific conservation value considered to be breeding during the 2018 Breeding Bird Survey.

Species	Breeding Territories/Pairs in 2018	Conservation Status
Herring Gull	14	Red
Starling	4	UKBAP, Red, SPI
Song Thrush	1	UKBAP, Red, SPI
Black Redstart	2-3	WCA1, Red
House Sparrow	7	UKBAP, Red, SPI
Dunnock	5	UKBAP, Amber, SPI
Linnet	1	UKBAP, Red, SPI

Annex1 - Annex 1 of the Birds Directive; **WCA1** - Wildlife and Countryside Act 1981 (as amended) Schedule 1; **UKBAP** - UK Biodiversity Action Plan species; **Red -** Birds of Conservation Concern Red list, **SPI** - NERC Act 2006 (as amended) Species of Principal Importance.

3.4 Of the species considered to be of highest conservation value; there were 14 pairs of Herring Gull, 4 Starling nesting sites, 1 Song Thrush territory, 2-3 Black Redstart territories, 7 pairs of House Sparrow, 5 Dunnock territories and 1 pair of Linnet.

3.5 Figures 3.1 shows the territory maps for those species that were considered to be breeding within the survey area and which were listed as Annex 1, WCA1, UKBAP, BoCC Red list and SPI. The territory maps show the location and number of breeding territories/pairs present of the target species.

Herring Gull

3.6 There was a total of 14 pairs of Herring Gull in the survey area.

3.7 Ten pairs were nesting on the roof-tops of buildings on the eastern side of the River Yare and four pairs were nesting on the roof-tops of buildings on the western side of the River Yare.

Starling

3.8 There was a total of four pairs of Starling in the survey area.

3.9 One pair was nesting on the eastern side of the River Yare and three pairs were nesting on the western side of the River Yare. All nests were situated within suitable features on buildings.

Song Thrush

3.10 There was one pair of Song Thrush in the survey area.

3.11 The territory was situated on the western side of the River Yare, near William Adams Way next to Southtown Common Recreation Ground.

Black Redstart

3.12 There were two-three Black Redstart territories in the survey area.

3.13 Two territories were on the eastern side of the River Yare, one bird was singing near Swanston's Road and another near Suffling Road and Admiralty Road. A probable third territory was on the western side of the River Yare, a bird was heard singing at the intersection between William Adam's Way, Malthouse Land and Beccles Road.

House Sparrow

3.14 There was a total of seven pairs of House Sparrow in the survey area.

3.15 All seven were nesting on the western side of the River Yare. All nests were situated within suitable features on residential buildings.

Dunnock

3.16 There was a total of five pairs of Dunnock in the survey area.

3.17 All five were nesting on the western side of the River Yare. All nests were situated within suitable habitat along William Adams Way next to Southtown Common Recreation Ground.

Linnet

3.18 There was one pair of Linnet in the survey area.

3.19 The territory was situated on the eastern side of the River Yare, near the intersection between Newcastle Road and Southgates Road, where a small area of derelict land provided some suitable bramble scrub habitat.

Vantage Point Survey

3.20 During the Vantage Point Survey visits, seven bird species were recorded flying within the study area along the River Yare. These included Cormorant, Sparrowhawk, Oystercatcher, Black-headed Gull, Lesser Black-backed Gull, Herring Gull and Hobby.

3.21 Of these, Herring Gull and Hobby are considered to be of highest conservation value, being covered by one or more of the criteria listed in paragraph 2.16 (N.B. for BoCC Amber listed species only those that also held other designated have been included).

3.22 A single Hobby, a species listed on Schedule 1 of the Wildlife & Countryside Act 1981 (as amended), was recorded on the 19th July for 125 seconds in the 35-125m height band.

3.23 Herring Gull, a BoCC Red list species was recorded during all seven survey visits.

3.24 With the exception of Lesser Black-backed Gull, Herring Gull and Kestrel, Table 3.3 shows the details of the species recorded during the Vantage Points survey visits.

3.25 As Lesser Black-backed Gull, Herring Gull and Kestrel were breeding in the study area they were recorded during all eleven survey visits, throughout the 3 hour survey periods, at all three height bands and all directions. Therefore the details of these species have been omitted from the results Table 3.3.

3.26 There were no observations made of the Common Tern, the main target species of the survey. There were also no observations of any other waterbirds that qualify as features of the Breydon Water SPA.

3.27 The behaviour of all the birds seen comprised flights over the survey area. Black-headed Gull, Lesser Black-backed Gull and Herring Gull were also seen feeding in the survey area picking food items from the surface of the water.

3.28 The direction of flight of the birds observed was primarily either north to south or south to north along the route of the river. As a result of their breeding activity, Lesser Black-backed Gull and Herring Gull were seen flying in all directions within the survey area.

Table 3.3 Summary of bird activity recorded during the 2018 Vantage Point Survey.

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
Cormorant																	
19/07/18	1323	Adult	70	W	C > 125m												
					B35-125m	Y	Y	Y	Y								
					A 0 - 35m												
Sparrowhawk																	
29/05/18	0909	Adult male	60	SW	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y								
29/05/18	0910	Adult female	40	NW	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y										

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
19/07/18	1251	1st Sum	145	N	C > 125m												
					B35-125m	Y	Y	Y	Y	Y	Y	Y	Y	Y			
					A 0 - 35m												
Hobby																	
19/07/18	1336	Adult	125	N then W	C > 125m												
					B35-125m	Y	Y	Y	Y	Y	Y	Y	Y				
					A 0 - 35m												
Oystercatcher																	
29/06/18	0700	Adult	40	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y										
19/07/18	1732	2 Adults	45	S	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y									

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
20/07/18	0657	1	45	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y									
Black-headed Gull																	
17/05/18	0951	2 Adults	80	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y							
17/05/18	1108	Adult	180	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
17/05/18	1441	Adult	45	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y									
17/05/18	1448	Adult	80	N	C > 125m												

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y							
					C > 125m												
29/05/18	1638	Adult	50	N	B35-125m												
					A 0 - 35m	Y	Y	Y									
					C > 125m												
14/06/18	1050	Adult	45	S	B35-125m												
					A 0 - 35m	Y	Y	Y									
					C > 125m												
28/06/18	1305	2 Adults	40	N	B35-125m												
					A 0 - 35m	Y	Y										
					C > 125m												
28/06/18	1356	Adult	40	N	B35-125m												
					A 0 - 35m	Y	Y										

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
29/06/18	0708	Adult	150	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
29/06/18	0715	Adult	100	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y	Y						
29/06/18	0721	Adult	90	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y	Y						
29/06/18	0729	Adult	110	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y	Y	Y					
29/06/18	0734	2 adults	95	N	C > 125m												
					B35-125m												

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
					A 0 - 35m	Y	Y	Y	Y	Y	Y						
29/06/18	0737	Adult	60	S	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y								
19/07/18	1104	Adult	50	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y									
19/07/18	1113	Adult	60	S	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y								
19/07/18	1121	Adult	30	S	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y										
19/07/18	1135	4 adults	60	N	C > 125m												

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
					B35-125m												
					A 0 - 35m	Y	Y	Y	Y								
					C > 125m												
19/07/18	1153	Adult	45	NW	B35-125m	Y	Y	Y									
					A 0 - 35m												
					C > 125m												
19/07/18	1219	Adult	30	S	B35-125m												
					A 0 - 35m	Y	Y										
					C > 125m												
20/07/18	0555	Adult	50	S	B35-125m												
					A 0 - 35m	Y	Y	Y									
					C > 125m												
20/07/18	0602	Adult	85	S	B35-125m												
					A 0 - 35m	Y	Y	Y	Y	Y							

Date	Time	Number Age/Sex	Time (sec) in 500m	Dir	Height Band	Flight Time in Each height Band Within 500m Survey area (15 second Intervals)											
						15	30	45	60	15	30	45	60	15	30	45	60
20/07/18	0640	Adult	45	N	C > 125m												
					B35-125m												
					A 0 - 35m	Y	Y	Y									

4 KEY POINTS AND FINDINGS

4.1 Four Breeding Bird Survey visits were conducted between mid May and June. These surveys recorded a total of 35 bird species. It was considered that the survey results presented an accurate reflection of the bird species present during the survey visits.

4.2 It was recognised that survey visits were not made in late March or April when birds' breeding behaviour would also be observable. For instance, Black Redstart breeding activity was only recorded on the first visit in mid-May, subsequent visits failed to detect this species, as they become less conspicuous. Guidance for this species (Gilbert et al., 1998) suggests that surveys can commence from mid-April at the start of the period when this species is frequently more activity singing and setting up breeding territories. As this species was only recorded on the single survey visit, precaution is required and these records all are considered here to constitute confirmed breeding territories.

4.3 Overall the species recorded reflected an assemblage typical of the habitat present at the site. The habitats comprised primarily urban residential and industrial land; however, there were also small isolated areas of amenity and improved grassland, tall ruderal, dense and scattered scrub, ephemeral/short perennial, broad-leaved lowland deciduous woodland (including plantation woodland) and hedgerows.

4.4 Observations of bird activity during the breeding bird survey indicated that 33 species recorded were considered to be confirmed and/or probable/possible breeding species.

4.5 Of the breeding/probable/possible breeding species, the survey area supported seven bird species (Herring Gull, Black Redstart, Starling, Song Thrush, House Sparrow, Dunnock, and Linnet) that are recognised for their conservation value by being either Schedule 1 species of the Wildlife & Countryside Act 1981 (as amended), UK BAP listed species, Principal Species of Importance (Section 41 NERC Act 2006) and/or listed on the BoCC Red List in recognition of their significant population decline (>50%) and consequently of conservation concern.

4.6 As such, national species action plans have been created for these species to safeguard current populations and reverse population declines.

4.7 All the species mentioned here listed on recognised conservation criteria are of some conservation importance. The presence of these species should be of material consideration when assessing the potential impact of the scheme proposals on birds.

4.8 Without mitigation, the development proposals would likely result in a number of direct adverse impacts on breeding birds. These direct impacts would include, (i) habitat loss through land-take and (ii) direct mortality.

4.9 In addition to the direct adverse impacts there would also be a number of indirect adverse impacts, which would include disturbance.

4.10 The provision of habitat to support nesting birds would be necessary to ensure the development did not have a permanent adverse effect on the individual breeding birds and the breeding bird assemblage as a whole.

4.11 During the breeding season, all nesting birds are protected are protected under the terms of the Wildlife & Countryside Act 1981 (as amended) and Countryside Rights of Way Act (2000) with the aim of avoiding damage/destruction of nests, eggs and young. While Black Redstart, as Schedule 1 species, has additional protection from disturbance. Therefore, measures will be necessary to avoid contravention of the law.

4.12 In addition, the NERC Act, 2006 (Section 41) lists Species of Principal Importance (SPI) for the purpose of conserving biodiversity, which is a duty of all public authorities under Section 40 of the NERC Act. The planning of the new river crossing should therefore aim to incorporate and promote the protection and conservation of these species through appropriate mitigation and enhancement measures.

4.13 A total of 33 hours of Vantage Point survey visits were carried out between mid May and July. These surveys recorded a total of seven bird species (Cormorant, Sparrowhawk, Oystercatcher, Black-headed Gull, Lesser Black-backed Gull, Herring Gull and Hobby). It was considered that the survey results presented an accurate reflection of the bird species present during the survey visits.

4.14 Of the species, recorded Herring Gull, and Hobby are recognised for their conservation value by being either listed on the BoCC Red List in recognition of their significant population decline (>50%) and consequently of conservation concern and Schedule 1 species of the Wildlife & Countryside Act 1981 (as amended), respectively.

4.15 The presence of these species should be of material consideration when assessing the potential impact of the scheme proposals on birds.

4.16 Without mitigation, the development proposals would likely result in a number of direct adverse impacts on breeding birds. These direct impacts would include, (i) habitat loss through land-take and (ii) direct mortality.

4.17 There were no observations made of Common Tern, which was the target species of the Vantage Point survey. There were also no observations of any other waterbirds that qualify as features of the Breydon Water SPA. Therefore, based on the results of this survey the integrity of the Breydon Water SPA and waterbirds that qualify as features of the Breydon Water SPA would not appear to be a constraint to the development. The Vantage Point survey methodology did not include nocturnal surveys, although as common terns are considered be amongst the least nocturnally active of seabirds (see for example Bradbury et al., 2014) this not considered to be a constraint. The surveys were completed over a single breeding season so that no conclusions can be drawn

with regards inter-annual variability. The surveys in 2018 were however considered to be robust and carried out over a considerable span if the Common Tern breeding season; the fact that the species was not recorded at all suggests that even when considering inter-annual variability in foraging movements there is not likely to be significant connectivity with the survey area.

4.18 Based on the findings of this Breeding Bird and Vantage Point Survey, a number of mitigation measures can be recommended that should be incorporated into the scheme proposals that would limit the impact of the scheme on the existing local bird assemblage.

5 RECOMMENDATIONS

5.1 Based on the results of the Breeding Bird and Vantage Point Surveys a number of recommendations can be made. These can be divided into two distinct areas. Firstly, recommendations with regards to the bird survey and secondly, recommendations regarding bridge design and construction.

5.2 Recommendations with regard to bird surveys are as follows:

1. carry out a species-specific Black Redstart Survey in 2019, that covers the full survey period, that is commences in March 2019;
2. consider repeating the Breeding Bird Survey in 2019, that covers the full survey period, that is commences in March 2019;
3. consider whether nocturnal Vantage Point surveys are necessary; and
4. consider whether Vantage Point surveys are necessary to cover the autumn/winter period.

5.3 Recommendations with regard to bridge design and construction are as follows:

1. ensure bridge design incorporates features (e.g. high sided screens) that encourage birds to fly above the height of any vehicles, especially, heavy goods vehicles. This will aim to minimise bird mortality as a result of collision with vehicles.
2. ensure any lighting on the bridge is designed to avoid light spillage into surrounding areas of water and/or land. This will aim to avoid attracting birds to the light source or any prey that may themselves be attracted to the light source.
3. ensure legal compliance is maintained pertaining to breeding birds, therefore site clearance should place outside the birds' breeding season, (March-September inclusive) or, if this not possible, include measures to ensure breeding birds remain unaffected by the de-vegetation/demolition activities. For instance, the vegetation and buildings affected should be checked, by an experienced ornithologist acting as an ECoW, prior to de-vegetation/demolition work commencing. If nesting birds were found to be present, these works would need to be delayed until the nesting birds had completed their breeding cycle.
4. ensure legal compliance is maintained pertaining to Schedule 1 breeding birds namely Black Redstart therefore de-vegetation/demolition activities must avoid disturbing these species during the breeding season. To achieve this the actual nest sites must be identified before work commences and a suitable sized exclusion zone established around the nesting area.
5. consider provision of nesting sites and feeding areas for Black Redstart to be located in areas that avoids potential bird mortality as a result of collision with vehicles.
6. consider provision of nesting boxes of various designs (e.g. Peregrine, Kestrel, Robin, , Swift, Starling, House Sparrow) to replace those natural

sites potentially lost to the scheme, to be located in areas that avoids potential bird mortality as a result of collision with vehicles.

7. consider habitat creation and/or breeding bird enhancement measures (e.g. areas of native flowering plants and shrubs aimed to provide breeding birds with nest sites and sources of food) to be located in areas that avoids potential bird mortality as a result of collision with vehicles.

5.4 A long term (25 year) Ecological Management Plan (EMP) should be prepared as part of the development. The EMP would help to ensure any of the mitigation and enhancement measures summarised in this report that are implemented as part of the scheme are described in detail and prescribe their creation and management such that it would have the best chance of success.

5.5 The production and implementation of the EMP would minimise the potential for the new development to have a permanent adverse effect on the local bird assemblage within the site. The EMP should be prepared in-combination with the landscaping plan, to provide a mechanism by which the measures would be incorporated into the scheme design. The EMP would also provide details about the management procedures and monitoring programme necessary to ensure the habitats created and features incorporated are maintained in a favourable condition in the long term.

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7 FIGURES

Figure 1.1 Map showing the indicative Breeding Bird Survey area.

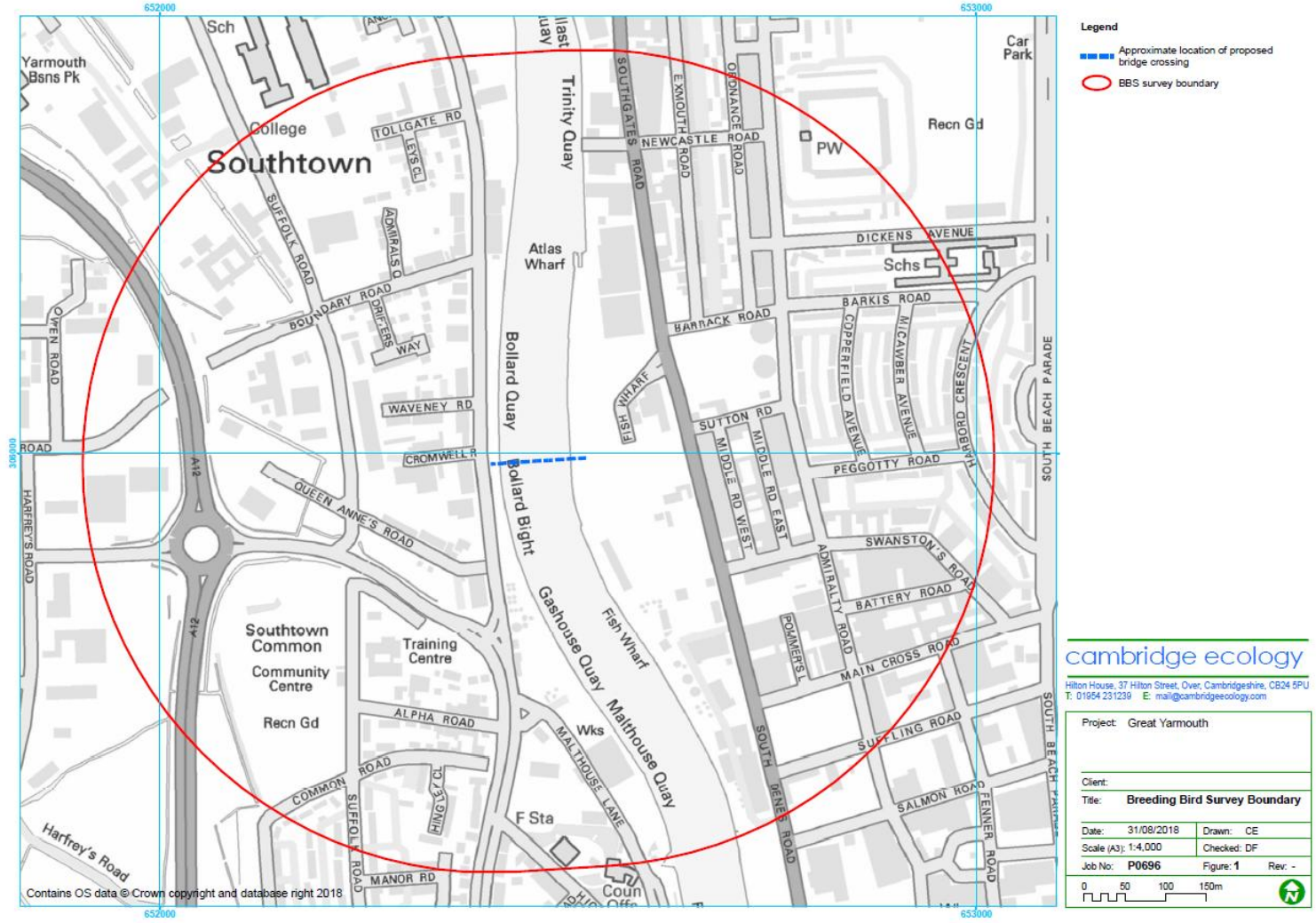


Figure 1.2 Map showing the indicative Vantage Point Survey area.

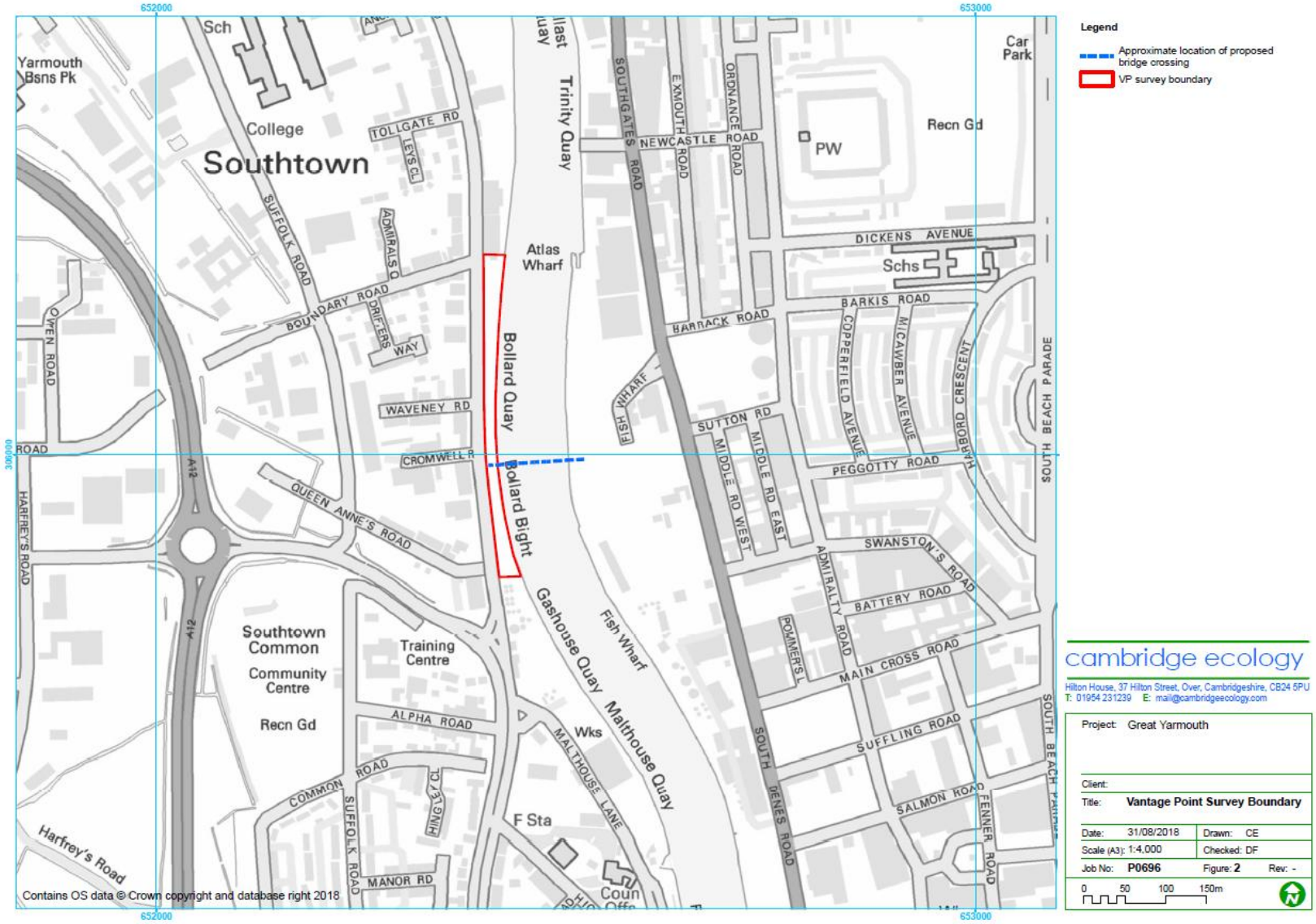
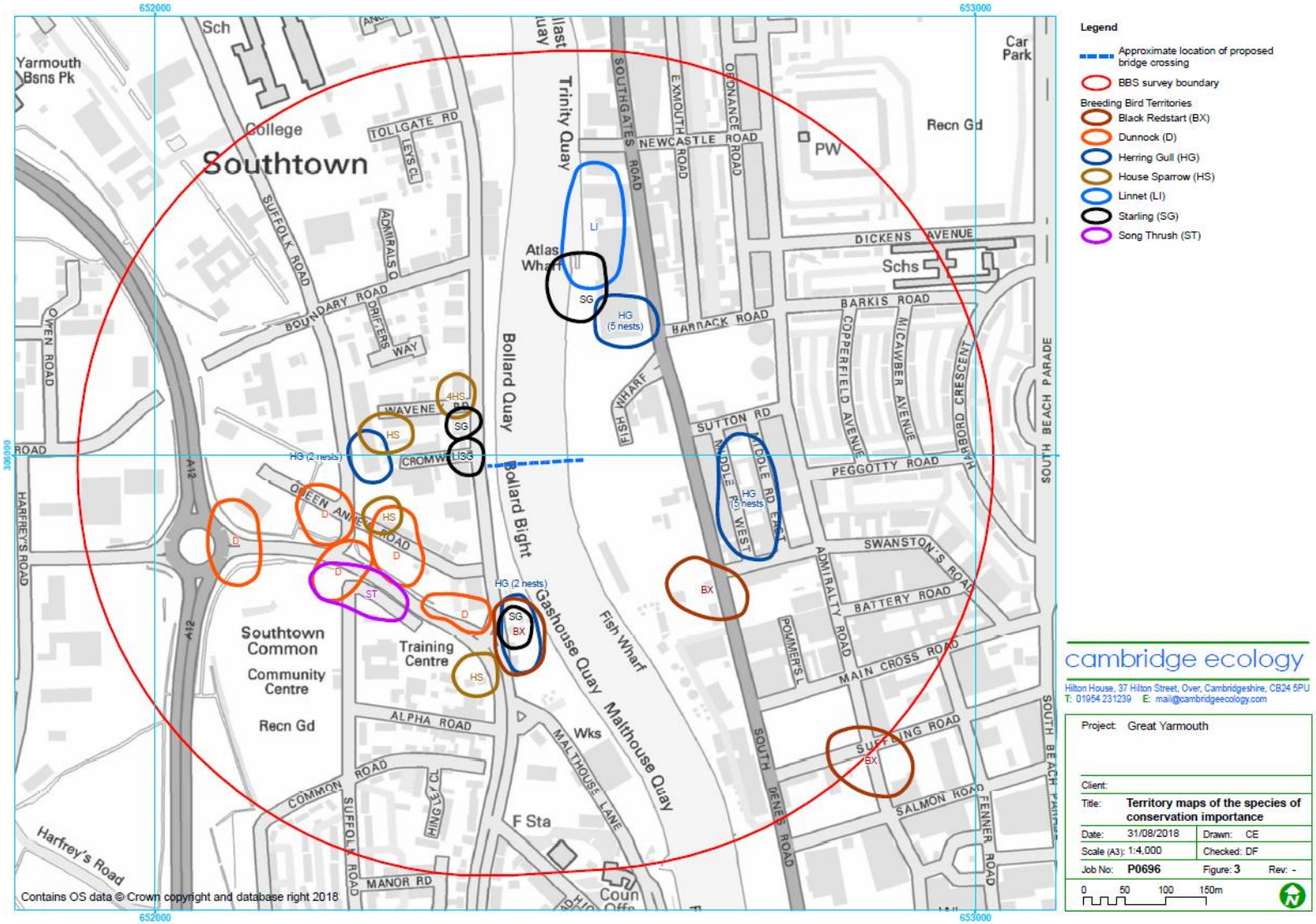


Figure 3.1: Plan showing the indicative location of breeding territories of bird species of conservation importance



8 ANNEX 8D.1

Table 7.1: Species recorded during the 2018 Breeding Bird Survey and Vantage Point Survey.

Common Name	Scientific Name
Mallard	*Anas platyrhynchos*
Cormorant	*Phalacrocorax carbo*
Sparrowhawk	*Accipiter nisus*
Moorhen	*Gallinula chloropus*
Oystercatcher	*Haematopus ostralegus*
Black-headed Gull	*Chroicocephalus ridibundus*
Lesser Black-backed Gull	*Larus fuscus*
Herring Gull	*Larus argentatus*
Woodpigeon	*Columba palumbus*
Collared Dove	*Streptopelia decaocto*
Swift	*Apus apus*
Great Spotted Woodpecker	*Dendrocopos major*
Green Woodpecker	*Picus viridis*
Kestrel	*Falco tinnunculus*
Hobby	*Falco subbuteo*
Magpie	*Pica pica*
Carrion Crow	*Corvus corone*
Blue Tit	*Cyanistes caeruleus*
Great Tit	*Parus major*
Long-tailed Tit	*Aegithalos caudatus*
Chiffchaff	*Phylloscopus collybita*
Reed Warbler	*Acrocephalus scirpaceus*
Blackcap	*Sylvia atricapilla*
Wren	*Troglodytes troglodytes*
Starling	*Sturnus vulgaris*
Blackbird	*Turdus merula*
Song Thrush	*Turdus philomelos*
Robin	*Erithacus rubecula*
Black Redstart	*Phoenicurus ochruros*
House Sparrow	*Passer domesticus*
Dunnock	*Prunella modularis*
Pied Wagtail	*Motacilla alba*
Chaffinch	*Fringilla coelebs*
Greenfinch	*Chloris chloris*
Linnet	*Linaria cannabina*
Goldfinch	*Carduelis carduelis*
Feral Pigeon	*Columba livia domestica*

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8E: Protected Species Survey Report

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ("APFP")

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GREAT YARMOUTH THIRD RIVER CROSSING

Protected Species Survey Report

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GREAT YARMOUTH THIRD RIVER CROSSING

Protected Species Survey Report

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GREAT YARMOUTH THIRD RIVER CROSSING

Protected Species Survey Report

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CONTENTS

TABLES

This report was prepared by WSP for the account of the Applicant, in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

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1. INTRODUCTION

1.1. PROJECT BACKGROUND

1.1.1. WSP (formerly Mouchel) was commissioned by 'the Applicant' (Norfolk County Council) to undertake water vole and bat surveys for the Great Yarmouth Third River Crossing project, in order to assess the likely effects of the Project on these species. These surveys were recommended as part of a Preliminary Ecological Appraisal, Appendix 8B.

1.2. THE SITE

1.2.1. The Great Yarmouth Third River Crossing will be located in the centre of Great Yarmouth. It will cross the River Yare linking William Adams Way on the west side of the river to the A1243 South Denes Road on the east side. The area through which the scheme passes comprises mostly urbanised land, with small areas of vegetation present in the form of gardens, allotments and Southtown Common Recreation Ground. This is hereafter referred to as the 'Project Site'.

1.3. OBJECTIVES

1.3.1. The proposed river crossing construction requires building demolition and the removal of vegetation, as well as the modification and/or destruction of water courses and adjacent bank habitats.

1.3.2. Water vole surveys were undertaken to identify whether water voles are present, to provide an estimate of the population size and to assess the effect of these activities on water voles.

1.3.3. Similarly, bat surveys sought to identify which bat species are present, how bats use habitats within the site and whether bat roosts are present and likely to be affected by the proposals.

1.3.4. The following activities were undertaken:

- A review of bat and water vole records within 2 km of the Project Site from the local ecological data centre;
- A preliminary ecological assessment to identify suitable features within the Project Site that may be used by water voles as well as features suitable for roosting bats and features that provide suitable habitat for foraging and commuting;
- Field survey to search for evidence of water vole in suitable habitats within the Project Site; and,
- Walked transects to identify the locations of important bat foraging and commuting habitats.

2. METHODOLOGY

2.1. DESK STUDY

SPECIES RECORDS

2.1.1. In 2016, the Norfolk Biodiversity Information Service (NBIS) was consulted to obtain bat and water vole records within 2 km of the Project Site from the last 10 years. This was undertaken as part of an earlier stage assessment.

2.1.2. The Multi-Agency Geographic Information for the Countryside (MAGIC) service was also used to obtain records of water vole and bat licences granted within this area.

2.2. PRELIMINARY ECOLOGICAL ASSESSMENT

WATER VOLE ASSESSMENT

2.2.1. Surveys performed by Mouchel Limited for the Applicant in 2016 (Ref. 8E.1), identified two watercourses that have the potential to support water voles. These watercourses are the two ditches associated with the A47 (previously the A12) at the western extent of the Project Site.

BAT ASSESSMENT

2.2.2. Surveys performed by Mouchel Limited for the Applicant in 2016 (Ref. 8E.1) identified six built structures as having potential to support roosting bats. In 2017, these structures and all others within the Project Site were re-assessed using the assessment criteria as prescribed in the Bat Conservation Trust's (BCT) *Bat Surveys for Professional Ecologists - Good Practice Guidelines* (Ref. 8E.2) to determine whether the structures remained in the same condition. In total, thirteen built structures were assessed for their potential to support roosting bats.

2.2.3. Each structure was inspected from ground level to look for features that bats could use for roosting (Potential Roost Features or 'PRFs') such as damaged brickwork, missing mortar, missing roof tiles, damaged barge boards and loose guttering. Using guidance from Collins (2016) (Ref. 8E.2), the structures were identified as having negligible, low, moderate or high suitability to support roosting bats (see Table 8E.1).

Table 8E.1 - Assessment criteria for structures which could support roosting bats

Suitability	Roosting Habitat Description
Negligible	Negligible habitat features on site likely to be used by bats.
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats.
Moderate	A structure with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status.

Suitability	Roosting Habitat Description
High	A structure with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.

2.2.4. Using guidance from Collins (2016) (Ref. 8E.2) the habitats within the Project Site were identified as having either Negligible, Low, Moderate or High suitability habitat for bats (see Table 8E.2).

Table 8E.2 - Guidelines for assessing bat habitat on development sites

Suitability	Commuting & Foraging Habitat
Negligible	Negligible habitat features on site likely to be used by commuting or foraging bats.
Low	Habitat that could be used by small numbers of commuting bats such as gappy hedgerows or un-vegetated stream, but isolated i.e. not very well connected by other habitat to the surrounding landscape. Suitable but isolated habitat that could be used by small numbers of foraging bats such as a lone tree (not in a parkland situation) or a patch of scrub.
Moderate	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water.
High	Continuous, high-quality habitat that is well connected to the wider landscape that likely to be used regularly by commuting bats such as river valleys, streams, hedgerows, lines of trees and woodland edge. High-quality habitat that is well connected to the wider landscape that is likely to be used regularly by foraging bats such broadleaved woodland, tree-lined watercourses and grazed parkland. Site is close to and connected to known roosts.

2.3. FIELD SURVEYS

WATER VOLE SURVEYS

2.3.1. A survey was undertaken in August 2017 to search for evidence of water vole. The areas surveyed for water voles are shown in Appendix A.

2.3.2. The surveys followed standard methods described in The Water Vole Mitigation Handbook (2016) (Ref. 8E.3) and were undertaken under suitable conditions by experienced surveyors. The surveys were carried out during the water vole breeding season (March to October in south-east England), which is an optimal survey time for this species.

2.3.3. Where accessible, the banks of the watercourses were surveyed from within the channel. Surveyors systematically searched along each bank and any evidence of water vole was recorded when found. Where surveyors were unable to access the watercourse channel, evidence was searched for from the top of the banks, using binoculars as required.

BAT ACTIVITY SURVEYS

2.3.4. The following surveys, based on recommended methods published in Bat Conservation Trust Guidelines (Collins, 2016) (Ref. 8E.2), were carried out in August 2017.

2.3.5. Two walked transects routes were designed to cover the west and east side of River Yare. The routes covered the majority of the Project Site and incorporated all assessed built structures as well as adjacent habitats that may be used by bats for foraging and commuting. These transects are shown in Appendix B of this report.

2.3.6. Bat activity surveys are undertaken in order to observe, listen for, record bats in flight away from their roost, commuting, feeding or socialising at dusk and dawn. Hand-held Batbox Duet detectors and a Song Meter SM4BAT FS recorder were used. During these walked transects, surveyors walked at a constant speed, recording information on any bats seen or heard on detectors. Information recorded included bat species, behaviour, flight direction, number of bats and number of passes. Surveyors stopped at pre-determined “listening points” along each transect for 3-5 minutes to record bat activity at a single location. Each walked transect was undertaken by two experienced ecologists.

2.3.7. Sounds recorded with the Song Meter SM4BAT FS during the surveys were analysed using AnalookW software to confirm the species of bats recorded and their activity. In case of doubt on the species, a bat calls guide British Bat Calls: A Guide to Species Identification (Ref. 8E.4) was used to help the identification. Bat activity levels were assessed in terms of the number of bat passes occurring.

2.4. ASSESSMENT OF CONSERVATION IMPORTANCE

2.4.1. The conservation importance of water vole and bats was assessed using the Chartered Institute for Ecology and Environmental Management’s Guidelines on Ecological Impact Assessment (EcIA) in the UK and Ireland (Ref. 8E.5).

2.4.2. The importance of bat roosts and commuting and foraging habitat was evaluated based on the rarity, distribution, species and numbers of bats recorded and the way they use the Project Site.

3. RESULTS

3.1. DESK STUDY

SPECIES RECORDS

3.1.1. The desk study identified no granted EPS licences for bats and water vole within 2 km of the Project Site (see Table 8E.3).

3.1.2. The Norfolk Biodiversity Information Service (NBIS) returned thirteen records of bat species within 2 km of the Project Site (see Table 8E.3) and fourteen records of water vole (see Table 8E.4).

Table 8E.3 - Records of bats within 2km of the Third River Crossing

Species	Date	Number of Records	Distance from Project Site
Common pipistrelle (Pipistrellus pipistrellus)	June 2015	5	~2km south-west
Soprano pipistrelle (Pipistrellus pygmaeus)	May 2015	1	~2km south-west
Nathusis' Pipistrelle (Pipistrellus nathusii)	May 2015	2	~2km south-west
Serotine (Eptesicus serotinus)	May 2015	1	~2km south-west
Daubenton's bat (Myotis daubentonii)	May 2015	1	~2km south-west
Noctule (Nyctalus noctula)	May 2015	3	~2km south-west
Brown long-eared bat (Plecotus auritus)	May 2015	1	~2km south-west

Table 8E.4 - Records of water voles within 2km of the Third River Crossing

Date	Number of Records	Location	Distance from Scheme
26/04/2011	1	TG512075	~2km north-west
18/12/2012	1	TG504059	~2km west
17/07/1968	1	TG5204	-
01/05/2009	1	TG519060	~600m west
2007	1	TG5133106699	~1.5km north-west
05/06/2008	5	TG520057	~300m south-west
1997	1	TG518078	~2km north

3.2. PRELIMINARY ECOLOGICAL ASSESSMENT

WATER VOLES

3.2.1. The two watercourses associated with the A47 were assessed for their suitability to support water voles. The two watercourses were wet ditches with areas of open water and thickly vegetated banks. The north ditch banks are covered by common nettle *Uritca dioica*, bramble *Rubus fruticosa*, great willowherb *Epilobium hirsutum*, dog rose *Rosa canina* and creeping thistle *Cirsium arvense*. The southern ditch is of similar species composition, but additionally supports field bindweed *Convolvulus arvensis* and hogweed *Heracleum sphondylium*. Both ditches were approximately 1m in depth and heavily silted.

BATS

3.2.2. Thirteen structures were assessed for their suitability to support roosting bats. Table 8E.5 shows the details of the assessment such as building type, features present and BCT category.

3.2.3. Foraging habitats such as open water, domestic gardens and allotments within the Project Site were found to be fragmented and unconnected. This foraging habitat is considered to be of low suitability for use by foraging and commuting bats.

Table 8E.5 - Structures with features which could support roosting bats

Structure	Structure Type	Distance	Features	Roost Suitability
B1	Brick built disused public house	Within footprint	Some lifted roof tiles Gaps around boarded up window fittings present Missing mortar on roof corner	Low
B2	South Denes Car Centre – corrugated metal workshop and brick car sales room	Within footprint	Slightly lifted roof apex	Negligible
B3	Sutton Road residential property	Within footprint	-	Negligible
B4	Industrial brick building south of Sutton Road	Within footprint	Missing mortar in walls Missing tiles on roof	Low
B5	Brick building on edge of docks	Within footprint	No access	No access
B6	Industrial building with three hipped asbestos roofs	Within footprint	Several small gaps in middle roof ridge	Low
T1	Terrace at west end of Queen Anne's Road	Within footprint	-	Low
T2	Terrace centre of Queen Anne's Road	Within footprint	Several small gaps in roof Cracked tile at roof apex	Low
T3	Terrace at east end of Queen Anne's Road	Within footprint	-	Low
T4	Terrace on Southdown Road	Within footprint	Slipped tiles on roof of number 181	Low
T5	Terrace south of Cromwell Road	Within footprint	Small gaps and cracks in roof	Low

Structure	Structure Type	Distance	Features	Roost Suitability
T6	Terrace north of Cromwell Road	Within footprint	-	Low
T7	Terrace south of Waveney Road	Within footprint	-	Low

3.3. FIELD SURVEYS

WATER VOLE SURVEYS

3.3.1. During the August 2017 survey, only the ditch south of William Adams Way was surveyed due to safety concerns in accessing the northern ditch. Evidence of water vole activity was found and is summarised in Table 8E.6.

Table 8E.6 - Water vole survey results

Location	Record type
TG52139 05869	Feeding remains, cut stems
TG52139 05869	5 droppings
TG52127 05872	1 dropping
TG52120 05866	Several droppings and feeding remains

BAT ACTIVITY SURVEYS

3.3.2. Two transects were undertaken in July and August 2017. The routes of the transects are shown in Figure 8.3 (presented in ES Volume III: Figures (document reference 6.3)). Survey details and weather conditions are shown in Table 8E.7.

Table 8E.7 - Survey type, date and weather conditions for both transects

Transect Number	Survey Records	Survey 1
1	Survey Type and Date	Dusk Transect 31.07.17
	Weather Conditions	20ºC, dry, CC 2/8, BF 1/8
2	Survey Type and Date	Dusk Transect 01.08.17
	Weather Conditions	17ºC, dry, CC 5/8, BF 0/8

*CC= Cloud Cover; BF= Beaufort scale.

TRANSECT 1

3.3.3. No bats were recorded along Transect 1. This is likely due to the absence of vegetation and high levels of artificial lighting.

TRANSECT 2

3.3.4. One species of bat was recorded along Transect 2: common pipistrelle *Pipistrellus pipistrellus*.

3.3.5. Four bat passes were recorded commuting along the northern edge of Southtown Common, where it meets William Adams Way. No foraging activity was recorded.

4. DISCUSSION AND EVALUATION

4.1. WATER VOLES

4.1.1. The survey work undertaken has confirmed the presence of water vole within the Project Site, with feeding remains and water vole droppings being found. However, due to limitations in the survey methodology, it is not possible at this time to estimate the population density of water voles in the Project Site.

4.2. BAT ROOSTS

4.2.1. All structures assessed were given a low potential of supporting a bat roost. The low level of bat activity recorded during the transect surveys suggests that the likelihood of a roost being present within the Project Site is low.

4.3. COMMUTING AND FORAGING BATS

4.3.1. The activity surveys showed that one species of bat uses the Project Site for commuting and/or foraging.

4.3.2. Only one species of bat was recorded; the common pipistrelle. This species was observed commuting along the northern edge of Southtown Common Recreation Ground. This area contains mature trees, shrubs and open grassland as well as being subject to lower levels of artificial lighting.

4.3.3. The field survey showed that the bat population within the Project Site consists of a low number of a single bat species. The Project Site is assessed as being of importance only within the zone of influence of the proposed scheme for conservation of foraging and commuting bats.

5. CONCLUSION

5.1. OVERVIEW – WATER VOLES

5.1.1. The water vole is protected within the UK from capture, killing, injury and disturbance and their places of shelter protected from damage, having access blocked or destruction, under the Wildlife and Countryside Act 1981 (as amended) (Ref. 8E.6). It is the client's responsibility to apply for a development licence through Natural England for activities that would constitute an offence under these legislations.

5.1.2. Two watercourses will be affected by the proposed scheme for the Great Yarmouth Third River Crossing. The proposed Scheme has the potential to result in negative impacts on water vole, including the damage and/or disturbance of water vole burrows along the length of the proposed scheme, which would constitute an offence under English legislation.

5.1.3. Accordingly, water voles have been considered during the design phase with as much of the banks are being retained and protected as reasonably possible. Where the proposals are likely to result in the loss, damage or disturbance of water vole habitats, it is likely that a licence will be required from Natural England in order to facilitate the works. A licence to disturb water vole may be required for works within 10m of a burrow, even if the burrow itself is retained.

5.1.4. Any licence application will likely include the requirement for a detailed mitigation strategy to avoid and/or minimise impacts on water vole. These may include measures such as careful timing of works, temporary displacement of water voles and provision of new areas of suitable habitat etc.

5.1.5. Update surveys will be undertaken once a final design has been produced to allow an accurate assessment of the impacts on water voles and inform any licence application which may be required. Surveys will also be undertaken prior to the commencement of construction works to check for the presence of any new burrows which may be affected.

5.2. OVERVIEW – BATS

5.2.1. All species of bats within the UK are protected from killing, injury and disturbance and their roosts protected from damage or destruction under the Conservation of Habitats and Species Regulations 2010 (Ref. 8E.7). Their places of rest and shelter are also protected from disturbance and obstruction under the Wildlife and Countryside Act 1981 (as amended) (Ref. 8E.6). It is the applicant's responsibility to apply for a development licence through Natural England for activities that would constitute an offence under these legislations.

5.2.2. Several structures will be demolished during the construction of the Great Yarmouth Third River Crossing. It is unlikely that bats use these structures as roosts due to the high levels of disturbance from human activities taking place within the structures and high levels of artificial lighting as well as the structures not being well connected to more suitable foraging habitat. However, the possibility of bats using these structures cannot be entirely ruled out and internal inspections will be undertaken for any structures that are to be removed prior to construction beginning.

6. LIMITATIONS

6.1. WATER VOLE

6.1.1. It was not possible for surveyors to enter the channel of the water courses due to the depth making it unsafe to do so. Thick vegetation meant that only the south bank of the channel south of William Adams Way could be surveyed. Further survey work should be undertaken at a later date in order to cover the areas not yet surveyed.

6.2. BATS

6.2.1. It was not possible to assess every building from all angles due to the buildings being privately owned properties. However, as the activity surveys returned very low numbers of bats, this is not considered to be a limitation on the conclusions of this report.

6.2.2. Emergence and re-entry surveys will be undertaken at a later stage. The presence of roosts in trees within the Project Site cannot be accurately determined until these surveys are completed.

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Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8F: Water Vole Survey Report

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ("APFP")

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Tables

1 Introduction

1.1 Project Background

1.1.1 The Great Yarmouth Third River Crossing (the Scheme) involves the construction, operation and maintenance of a new crossing of the River Yare in Great Yarmouth. The Scheme consists of a new dual carriageway road, including a road bridge across the river, linking the A47 at Harfrey's Roundabout on the western side of the river to the A1243 South Denes Road on the eastern side. The area through which the Scheme would pass largely comprises urbanised land, with small areas of vegetation in the form of gardens and allotments. Watercourses are present on the west side of the river running parallel to the A47 and William Adams Way as well as within the industrial area boarded by the A47 and William Adams Way. The location of the Scheme is shown in Site Location Plan included in Figure 2.1 of Volume III of the Environmental Statement (ES) (document reference 6.3).

1.1.2 The proposed river crossing construction will require the modification and/or destruction of some watercourses and adjacent bank habitats.

1.2 Ecological Background

1.2.1 A Preliminary Ecological Appraisal of the Project Site was undertaken in September 2016 (Technical Appendix 8B) (Ref. 8F.1). This was updated in July 2018 (Technical Appendix 8C) (Ref. 8F.2) after the survey boundary was amended to include the roundabout which intersects the A47 and William Adams Way and section of the A47 stretching to the north and south. A desk study identified 14 records of water vole *Arvicola amphibius* within 2 km of the Project Site, the most recent of which was from December 2012. Watercourses within the Project Site were assessed for their suitability to support water vole broadly in line with methodology provided in standard guidance (Ref. 8F.3). The surveys were carried out in 2017 (Technical Appendix 8E) (Ref. 8F.4). These surveys, however, were limited by access constraints such that only the watercourse bordering Southtown Common Recreation Ground was surveyed. Three findings of water vole droppings and two recordings of feeding remains were made at the eastern-most section of this watercourse. Further surveys of the remaining watercourses were recommended.

1.2.2 This report presents the findings of the subsequent surveys for water voles. The watercourses surveyed are shown in Figure 8F.1 of Volume III of the ES (document reference 6.3) and are referred to in this report as the Survey Area.

1.3 Brief and Objectives

1.3.1 Water vole surveys undertaken in accordance with good practice guidance (Ref. 8F.3) addressed the following objective:

- To establish whether water voles are present or likely to be absent from the Survey Area.

2 Methods

2.1 Overview

2.1.1 To establish whether water voles were present or likely to be absent a survey was carried out in accordance with current good practice guidance (Ref. 8F.3). This survey comprised one survey visit to each watercourse to search for water vole field signs.

2.2 Water Vole Survey

2.2.1 A Survey Area including all watercourses identified during the extended Phase 1 habitat survey within the Principal Application Site was surveyed for signs of water voles (Figure 8F.1). Watercourses are labelled WC1-WC6.

2.2.2 All survey visits were carried out within the appropriate season for water vole survey (late April to early October). Each survey visit comprised three elements as follows:

- A walked survey of the entire length of the watercourses within the Survey Area during which a thorough visual inspection of the banks and immediate vicinity of each watercourse, searching for water voles or their field signs, was undertaken. Water vole field signs include faeces, latrines, feeding stations, burrows, 'lawns', nests, footprints and runways in vegetation;
- Recording of habitat variables and features relevant to water voles, for example, habitat type, shore/bank substrate, bordering land use, vegetation, degree of disturbance, bank profile, water depth; and
- Recording of field signs or evidence of other wildlife, such as otter *Lutra lutra*, mink *Neovison vison* or brown rat *Rattus norvegicus*.

2.3 Dates of Survey and Personnel

2.3.1 The water vole survey was undertaken by a competent surveyor with 12 years' experience of ecological survey, including extensive water vole survey experience, and a strong understanding of the ecology of water voles and the ability to identify their field signs.

2.3.2 Surveys were completed between 8th and 19th of September 2018.

2.4 Notes and Limitations

2.4.1 The survey sought only to establish whether water voles may be at risk from the Scheme, and to inform as to whether further measures in relation to

water voles may be necessary. Water vole survey guidance recommends that to enable complete information on water voles to be obtained such as may be required to advise on the need for a licence application, two surveys within the appropriate season (late April to early October) are required. Further surveys are therefore recommended closer to the time of construction. For the purposes of this assessment, one survey visit is sufficient.

2.4.2 The northern bank of the watercourse which borders Southtown Common Recreation Ground was inaccessible and banks could not be examined thoroughly because of the presence of impenetrable vegetation covering the northern bank and deep water preventing the watercourse being crossed.

2.4.3 The sections of the watercourses bordering the A47, which continue beyond the Principal Application Site boundary, could not be accessed safely because of steep banks above deep water. This meant that surveys could not be carried out within the section of watercourses immediately south of the Principal Application Site (Figure 8F.2).

3 Results and Evaluation

3.1 Overview

3.1.1 Evidence of water voles, predominantly droppings, was recorded along the banks of watercourses WC1, WC2 and WC3. One recording of feeding remains was made along WC1. Evidence of burrows was limited, with a single possible burrow identified along the banks of WC1 and another on WC4.

3.2 Survey Findings

3.2.1 The watercourses surveyed comprised a series of drainage ditches running parallel with the A47 and William Adams Way within the Survey Area, and a connected watercourse flowing through the industrial estate north-east of the A47/William Adams Way roundabout. Watercourses WC1, WC2 and WC3 were linked and can be considered a single continuous watercourse. WC4 and WC5 are also linked, while WC6 appears isolated. All watercourses surveyed are hydrologically linked. However, at the time of survey, culverts linking watercourses were significantly silted to the point of preventing full connectivity.

Watercourse 1 (WC1)

3.2.2 WC1 comprised three distinct sections:

- The western section bordering the A47, which was substantially shaded by small shrubs. The western bank of this section is shallow with no ground vegetation. The eastern bank is steep, and covered in dense scrub, becoming gently sloping where it reaches the water. In this section water depth is shallow, 2-5cm, over muddy sediment, and less than 0.5m wide with no emergent vegetation. Water flow is static to sluggish. This section of the watercourse provides poor habitat for water voles.
- WC1 becomes wider at the point where it splits to the north and west (Figure 8F.1). The northern arm is 2m wide and 1.5-2m deep over silt. No emergent vegetation is present and water flow is static to sluggish. The banks of this section are suitable for use by water vole. The eastern bank is steeply angled and covered in herbaceous vegetation 40-60cm high, while the western bank is flat and densely covered with herbaceous vegetation. Three records of water vole droppings were noted, with multiple droppings at each location. Evidence of water vole feeding was also confirmed.

3.2.3 The eastern section of WC1 is over 2m wide and 0.5-1m deep over a silt substrate dominated by rotting vegetation. Dense emergent vegetation, including reed mace *Typha latifolia* and common reed *Phragmites australis*

occur adjacent to a heavily shaded bank to the south under a canopy of trees and a flat bank to the north covered in dense herbaceous vegetation. The habitat on the northern bank is a continuation of that on the eastern bank of the section of WC1, described in 3.2.2 above, and provides suitable habitat for water vole.

Watercourse 2 (WC2)

3.2.4 WC2 is a continuation of WC1, linked to it via a culvert which passes under Queen Anne's Road. The watercourse comprises two sections as follows:

- To the south the WC2 passes through a caravan sales area. At this point the watercourse has steep, well-managed banks. The western bank is covered with hardstanding and gravel and is not suitable for use by water vole. The eastern bank is vegetated with short-cropped grass that is regularly managed. This bank is of moderate suitability for water voles. The watercourse, which is 1-2m wide and approximately 0.5-1.0m deep, contains dense emergent vegetation dominated by branched bur-reed *Sparganium erectum*. Water vole evidence was recorded on the eastern bank (Figure 8F.2), in the form of a possible water vole burrow and water vole droppings at a single location.
- The northern section of WC2 passes through a densely wooded area to an open area further west. In this section the watercourse is 2m wide and 0.5-1.0m wide, with banks that vary from shallow to steeply sloped. Under the canopy the water is static to sluggish in flow rate. The bankside vegetation on both sides is dense and dominated by woody species, with no significant herbaceous vegetation, and of poor suitability for water vole. In the open area the watercourse is filled with emergent vegetation, with herbaceous vegetation on the banks. Possible water vole droppings were recorded on floating debris.

Watercourse 3 (WC3)

3.2.5 WC3 was not originally identified during preliminary survey work. The watercourse is not continuous, as it is dry for the majority of its length. However, shallow pools of water occur in places. The watercourse is heavily shaded by trees which have prevented the growth of herbaceous vegetation on the banks. This watercourse was assessed as of poor suitability for water voles.

Watercourse 4 (WC4)

3.2.6 Running adjacent to Southtown Common Recreation Ground, WC4 is slow-flowing, 2-5m wide and 1-2m deep with banks that vary in slope from shallow to steep. For its length the watercourse is dominated by dense reed mace *Typha latifolia*, common reed *Phragmites australis* and reed sweet grass *Glyceria maxima*. The north-western bank is densely vegetated with scrub and was inaccessible during the survey (Figure 8F.2). As the watercourse

extends south beyond the red line boundary it becomes increasingly deep. The majority of the watercourse is of moderate to good suitability to support water voles and one occurrence of water vole droppings and one water vole burrow were recorded on the eastern bank.

Watercourse 5 (WC5)

3.2.7 This watercourse runs parallel to the western edge of the A47. The banks of WC5 are steep and support a mixture of vegetation, including areas of tall herbaceous vegetation as well as immature trees, notably grey willow *Salix cinerea*. Water flow is static to sluggish, and the watercourse is 1-2m wide and 0.5-1.0m deep. WC5 is densely vegetated with common reed and reed mace. Water is not continuous along the length of the watercourse, which contains some dry sections - in particular, areas where grey willow is present, and some areas where water forms pools. Beyond the Principal Application Site to the south the watercourse becomes increasingly deep. Although no evidence of water vole was found here, WC5 is of moderate suitability to support water voles and is directly connected to WC4 where water voles were confirmed to be present.

Watercourse 6 (WC6)

3.2.8 This watercourse is predominantly dry for its entire length, although some areas of saturated mud are present. Pools of water occur at a single location. Lack of water may be a result of the dry summer in 2018. WC6 is heavily shaded by bankside trees. In its current condition WC6 is of low suitability for water voles, but if it were to re-emerge as a watercourse then it would provide moderate suitability for water voles.

3.3 Summary of Results

3.3.1 The survey confirmed water vole presence within the Survey Area. Water vole evidence is summarised in Table 3.1 below.

Table 3.1: Summary of Survey Findings

Watercourse	Date	Description of Evidence Present (see Figure 8E.2)
WC1	18/09/2018	Water vole droppings: three separate recordings of multiple water vole droppings (recording 2, 3 and 4). Feeding remains: 8-10cm lengths of grass cut at a 45° angle at the end (recording 4a).
WC2	18/09/2018	Water vole droppings: a single recording of multiple water vole droppings on floating debris (recording 5).

Watercourse	Date	Description of Evidence Present (see Figure 8E.2)
		Water vole burrow: a single recording of a water vole burrow (recording 8).
WC3	18/09/2018	No evidence of water vole.
WC4	18/09/2018	Water vole droppings: three separate recordings of multiple water vole droppings (recording 11, 13, and 14). Water vole burrow: a single recording of a water vole burrow (recording 12).
WC5	19/09/2018	No evidence of water vole.
WC6	19/09/2018	No evidence of water vole.

3.3.2 Field signs of other mammals were also recorded during the surveys. Droppings and prints of muntjac deer *Muntiacus reevesi* were recorded on the banks of WC1 (recording 1, Figure 8F.2) and WC3. A sighting of a field vole *Microtus agrestis* was recorded at WC2 (recording 9, Figure 8F.2). Along all watercourses, burrows of other unidentified mammals were observed.

3.4 Implications for the Scheme

Overview

3.4.1 Water voles are protected from killing, injury and disturbance under UK legislation; in addition, planning policy affords further protection within the planning system, as described below. As water voles have been confirmed to be present within the Principal Application Site, appropriate avoidance and/or mitigation measures should be included within the Scheme.

Legal Compliance

3.4.2 Water voles are fully protected under The Wildlife and Countryside Act (1981) (as amended) (Ref. 8F.5), meaning it is an offence to kill, injure or take this species, damage or destroy places of rest or shelter, or disturb this species whilst it is occupying a place of rest or shelter.

3.4.3 Water voles are listed as a Species of Principal Importance (SPI) for the Conservation of Biodiversity in England, in accordance with Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (Ref. 8F.6). Under Section 40 of the NERC Act (2006) public bodies (including local planning authorities) have a duty to have regard for the conservation of SPI when carrying out their functions, including determining planning applications.

Planning Policy Compliance

3.4.4 Planning policy on transport network Nationally Significant Infrastructure Projects (NSIPs) is contained in the National Policy Statement for National Networks (NPS NN) (Department for Transport, 2014) (Ref. 8F.7). Guidance specifically in relation to ecology and nature conservation is provided within paragraphs 3.2 – 3.5, 4.15 – 4.21, 4.22 – 4.25, and 5.25 – 5.38 of the NPS NN. Paragraphs 5.20-25 and 5.31-38 are relevant to water voles, and are fully detailed in Chapter 8: Nature Conservation of the ES.

3.4.5 At the national level the National Planning Policy Framework (2019) (NPPF) (Ref. 8F.8) forms the basis for planning system decisions with respect to conserving and enhancing the natural environment, including water vole. The NPPF in its relevance to ecology is fully documented in Chapter 8: Nature Conservation of the ES. The Office of the Deputy Prime Minister (ODPM) circular 06/2005 (Ref. 8F.9) also provides supplementary guidance, including confirmation that *"the presence of a protected species is a material consideration when a planning authority is considering a development proposal"'* (Para 98).

Other Guidance

3.4.6 Water voles are a priority species in the Norfolk Biodiversity Action Plan (Ref. 8F.10).

4 Conclusion

4.1.1 Water voles were confirmed to be present within the Principal Application Site. Evidence of their presence was found within or around watercourses WC1, WC2 and WC4, principally in the form of water vole droppings, though two burrows and one feeding location were also identified.

4.1.2 The suitability of habitats within the Principal Application Site to support water vole was variable. Some watercourses had partially dried and large sections significantly shaded by trees and dense scrub, preventing habitat suitable for use by water voles to develop. There is connectivity between the watercourses, indicating the potential for water voles to spread across the Principal Application Site where and when conditions are suitable.

4.1.3 Sections of watercourses WC3 and WC5 outside the Principal Application Site were unable to be surveyed safely. The omission of survey information from these areas does not affect the validity of the survey findings for the purpose of this report as here we seek to identify presence/absence of water voles within the survey area and not to identify population.

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Ref. 8F.10: Norfolk Biodiversity Partnership (2002). Norfolk Biodiversity Action Plan – Water Vole Species Action Plan.

Annex 8F.1: Indicative Species List for Riparian Planting

Common Name	Latin Name
Reeds/Grasses	
Reed canary grass	*Phalaris arundinacea*
Common reed	*Phragmites australis*
Reed sweet grass	*Glyceria maxima*
Meadow grasses	*Poa trivalis, P. pratensis*
Cocksfoot	*Dactylis glomerata*
Sweet grasses	*Glyceria fluitans, G. notata*
False oat-grass	*Arrhenatherum elatius*
Tufted hair-grass	*Deschampsia caespitosa*
Sweet vernal-grass	*Anthoxanthum odoratum*
Yorkshire fog	*Holcus lanatus*
Creeping soft grass	*H. mollis*
Creeping bent	*Agrostis stolonifera*
Timothy	*Phleum pratense*
Marsh foxtail	*Alopecurus geniculatus*
Meadow foxtail	*A. pratensis*
Purple moor-grass	*Molinia caerulea*
Rushes	
Hard rush	*Juncus inflexus*
Soft rush	*J. effusus*
Conglomerated rush	*J. conglomeratus*
Sharp-flowered rush	*J. acutiflorus*
Jointed rush	*J. articulatus*
Sedges	
Greater tussock sedge	*Carex paniculata*
False fox-sedge	*C. otrubae Podp.*

Common Name	Latin Name
Hairy sedge	*C. hirta*
Bottle sedge	*C. rostrate*
Pendulous sedge	*C. pendula*
Black sedge	*C. nigra*
Greater pond-sedge	*C. riparia*
Water Plants	
Branched bur-reed	*Sparganium erectum*
Unbranched bur-reed	*S. emersum*
Common water-plantain	*Alisma plantago-aquatica*
Flowering rush	*Butomus umbellatus*
Broad-leaved pondweed	*Potamogetum natans*
Hornwort	*Ceratophyllum demersum*
Yellow flag iris	*Iris pseudacorus*
Bogbean	*Menyanthes trifoliata*
Pond lilies	*Nymphoides peltata, Nuphar lutea, Nymphaea alba*
Bulrush	*Schoenoplectus lacustris*
Water crowfoots	*Ranunculus peltatus, R. aquatilis, R. penicillatus,*
Watercress	*Nasturtium officinale*
Wetland / Riparian edge plants	
Bistort	*Polygonum amphibium*
Marsh marigold	*Caltha palustris*
Celery-leaved buttercup	*Ranunculus sceleratus*
Lesser spearwort	*R. flammula*
Greater spearwort	*R. lingua*
Cuckoo flower	*Cardamine pratensis*
Meadowsweet	*Filipendula ulmaria*
Water avens	*Geum rivale*

Common Name	Latin Name
Purple loosestrife	*Lythrum salicaria*
Fools watercress	*Apium nodiforum*
Angelica	*Angelica sylvestris*
Marsh bedstraw	*Galium palustre*
Water forget-me-not	*Myosotis scorpioides*
Water mint	*Mentha aquatica*
Brooklime	*Veronica beccabunga*
Marsh valerian	*Valeriana officinalis*
Marsh sowthistle	*Sonchus palustris*
Water figwort	*Scrophularia auriculata*
Gypsywort	*Lycopus europaeus*

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8G: Preliminary Bat Roost Report

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JDEcology

Great Yarmouth Third River Crossing

Bat Roost Assessment Report

Prepared by JDEcology
on behalf of WSP

February 2019

Great Yarmouth Third River Crossing – Preliminary Bat Roost Assessment Report

The contents of this report have been produced with due consideration of current best practice guidance, including the Charted Institute of Ecology and Environmental Management's Guidelines for Ecological Report Writing (CIEEM, 2017) and Bat Surveys for Professional Ecologists: Good Practice Guidelines (Collins, 2016).

Survey data within this report is valid for a maximum of 18 months from the date of the first survey. After this period an updated site visit will be required to determine a new ecological baseline.

This report has been compiled by Jonathan Durward, BSc (Hons) CEnv MCIEEM.

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JDEcology is a trading name of JD Ecology Ltd whose registered office is as above registered in England under Company number 7722393. Company VAT registration number 218629492.

CONTENTS

1. SUMMARY

1.1 JDEcology was commissioned by WSP in September 2018 to carry out a Bat Roost Assessment of buildings and structures in the vicinity of the River Yare, Great Yarmouth. The aim of the survey was to inform and support a Development Consent Order for the proposed Great Yarmouth Third River Crossing. The proposed development will result in the demolition of 33 buildings, including residential properties, industrial units and outbuildings (Appendix E).

1.2 This report details the methodologies used to assess and evaluate any likely ecological impacts on bats as a result of the proposed bridge crossing. The results of the ecological survey work are presented and discussed before recommendations are made for further surveys that may be required.

1.3 Of the 33 buildings surveyed, twenty-two properties have been classified as having *low potential* to support roosting bats, and three properties and eight outbuildings have been classified as having *negligible potential*, (Collins, 2016).

1.4 External areas of twenty-two of the buildings due to be demolished contain features with potential to support roosting bats, and any future destruction of those areas will adversely impact bat roosts if present. All bat roosts are protected by law whether they are in occupation or not.

1.5 Further species-specific survey (encompassing a single dusk emergence or dawn re-entry survey between May and August inclusive) is recommended to ascertain if bat roosts are present within the buildings, including identifying species that may be present, numbers, and the location of any roosts. This data has been captured in the Outline Code of Construction Practice (CoCP) (document reference 6.16).

2. INTRODUCTION

2.1 Background

2.1.1 JDEcology was commissioned by WSP in September 2018 to carry out a preliminary bat roost assessment of buildings and structures in the vicinity of the River Yare, Great Yarmouth. The aim of the survey was to inform and support a Development Consent Order for the proposed Great Yarmouth Third River Crossing.

2.1.2 This report details the survey methodologies used to determine the presence or likely absence of bats within the properties and structures. Results from the data search and findings of the survey work are then presented and discussed in order to evaluate likely ecological impacts on bats as a result of the proposed development. Recommendations are made for further surveys where required.

2.2 Site Location and Description

2.2.1 The Principal Application Site consists of a number of buildings and structures located in the centre of Great Yarmouth, Norfolk, between the A47 at Harfrey's roundabout on the western side of the River Yare and South Denes Road on the eastern side of the river. Figure 2.1 shows the locations of the areas surveyed; with details of the specific buildings surveyed set out in Section 5.

Figure 2.1: Location of Survey Areas

3. LEGISLATION

3.1 Environment and Biodiversity

3.1.1 Planning policy on transport network Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to ecology and nature conservation, is contained in the Overarching National Policy Statement (NPS) for National Networks (Department for Transport, 2014). This is fully detailed in Chapter 8: Nature Conservation.

3.1.2 Under the National Planning Policy Framework (NPPF, 2018), local planning authorities should aim to conserve and enhance the natural environment when determining planning applications. Local planning authorities also have an obligation to seek opportunities to further enhance the conservation status of Species and Habitats of Principle Importance.

3.1.3 Species and Habitats of Principal Importance for the conservation of biodiversity in England (JNCC, 2009) are covered under Section 41 of the Natural Environmental and Rural Communities (NERC) Act (2006). Species and habitats listed within Section 41 need to be taken into consideration by a public body when performing any of its functions, such as assessing planning applications.

3.1.4 Bat species listed within Section 41 include Barbastelle *Barbastella barbastellus*, Bechstein's *Myotis bechsteinii*, Noctule *Nyctalus noctula*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Brown Long-eared *Plecotus auritus*, Greater Horseshoe *Rhinolophus ferrumequinum*, and Lesser Horseshoe *Rhinolophus hipposideros*.

3.2 Wildlife

3.2.1 Bats within the UK (all species) are afforded protection under the EU Conservation of Habitats and Species Regulations 2017, as well as under the UK Wildlife and Countryside Act 1981 (as amended) and the Countryside Rights of Way Act 2000. It is an offence to:

- Deliberately or recklessly capture, injure or kill any wild animal of a European protected species;
- Deliberately or recklessly disturb any such animal;
- Damage or destroy their breeding site or resting place; and
- Keep, transport, sell or exchange, or offer for sale or exchange, any live or dead animal, or any part of, or anything derived from these species.

3.2.2 Disturbance of European protected species constitutes any activity which is likely to:

- Impair their ability to survive, to breed or reproduce, or to rear or nurture their young; OR in the case of animals of a hibernating or migratory species, to hibernate or migrate; and
- To significantly affect the local distribution or abundance of the species to which they belong.

4. SURVEY METHODOLOGY

4.1 Desk Study

4.1.1 A data search for bat records within a 5km radius of the Principal Application Site was requested from Norfolk Biodiversity Information Service in October 2016 by Mouchel, whom has shared the records for the purpose of this report. Only records within the last 15 years are considered to be relevant.

4.1.2 Multi-Agency Geographic Information for the Countryside (MAGIC) was accessed in November 2018 to locate any existing European Protected Species (EPS) mitigation licences within 5km of the Principal Application Site. MAGIC was also accessed to locate any statutory designated areas within the same search radius with bats as a qualifying feature.

4.2 Site Visit and Surveyor Qualifications

4.2.1 A site visit was carried out the week commencing 19th November 2018 by Mr Jonathan Durward BSc (Hons) CEnv MCIEEM, an ecologist with 18 years' experience within professional ecological consultancy, and Miss Rachel Bates BSc (Hons) ACIEEM, an ecologist with over seven years' professional experience. Both surveyors hold a Natural England Class 2 bat survey licence (2016-11967-CLS-CLS and 2016-23730-CLS-CLS respectively) as a minimum for the purpose of this survey.

4.2.2 Weather conditions at the time of the inspections were overcast and cold, with 100% cloud cover, extended periods of light to moderate rain, temperatures averaging 8°C, and a gentle to moderate breeze (8-18 mph).

4.3 Preliminary Bat Roost Assessment

4.3.1 Buildings were subject to an internal and external inspection to determine their potential to support roosting bats. The inspections were carried out in accordance with current best practice guidance (Collins, 2016). Ladders, close focusing binoculars, a high-powered torch, and an endoscope were used to identify and assess any potential roost features and to look for evidence of roosting bats.

4.3.2 Potential roost features on a building may include raised or missing roof tiles, ridge tiles, lead flashing or hanging tiles, and gaps under soffit boxing or within brickwork (this list is not conclusive). Evidence of bats and their roosts include the presence of droppings, stain or grease marks, feeding remains, or the bats themselves.

4.3.3 Buildings and the quality of on-site habitats were then categorised based on the classification criteria in 'Bat Surveys for Professional Ecologists' (Collins, 2016). Classification criteria is presented below:

- **Negligible:** structures with features unlikely to be used by roosting bats. Habitats on site unlikely to be used by foraging or commuting bats.
- **Low:** a structure with one or more potential roost sites that may be utilised by opportunistic bats but are not suitable for use on a regular basis or by a large number of bats. Habitat could be used by a small number of foraging or commuting bats.
- **Moderate:** a structure or tree with one or more potential roost sites that may be utilised on a regular basis but unlikely to support a roost of high conservation status. Continuous habitat that provides good connectivity within the wider landscape and offers foraging opportunities.

- **High:** a tree or structure with one or more potential roost sites suitable for use by a larger number of bats on a regular basis and for longer periods of time. Continuous high-quality habitat that is well connected within the wider landscape and offers high-quality foraging habitat. The site is close to and connected to known roosts.

4.4 Survey Limitations

4.4.1 The gap in the rendering between 150 Southtown Road and the adjacent property could not be inspected in close detail due to the presence of an additional single storey extension.

4.4.2 Voids above the two-storey extensions in 149, 150, 151, 152 Southtown Road could not be inspected as there was no access hatch. There was no access into the loft conversion of 149 Southtown Road.

4.4.3 The tenant of number 15 refused access, the roof void of number 18 could not be accessed as the latch key wasn't available, and the tenants of 17 and 19 were not at home, so no internal inspections were carried out at these properties.

4.4.4 There was no access to 13 and 14 Queen Anne's Road, and an internal inspection of the outbuildings at 11 Cromwell Road and 16 Queen Anne's Road could not be carried out as access could not be gained.

4.4.5 A dusk emergence or dawn re-entry survey of the above buildings will be undertaken to fill any gaps in the inspection survey data, to be captured in the Outline Code of Construction Practice.

4.4.6 Emergence surveys will not be undertaken of 13 and 14 Queen Anne's Road and the outbuildings at 11 Cromwell Road and 16 Queen Anne's Road, as there are no external access points or features present with bat roosting potential.

5. SURVEY RESULTS

5.1 Desk Study

Statutory Designated Areas

5.1.1 There are no statutory designated sites present within the 2 km of the Principal Application Site (defined as the Broad Study Area in Chapter 8: Nature Conservation) which have been designated with bats as a qualifying feature.

Bat Records

5.1.2 Seven species of bat have been recorded as present within 5km of the Principal Application Site, all recorded during 2015 as part of the Norfolk Bat Survey project. The species are; Serotine *Eptesicus serotinus*, Noctule *Nyctalus noctula*, Nathusius' Pipistrelle *Pipistrellus nathusii*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Common Pipistrelle *Pipistrellus pipistrellus*, Daubenton's *Myotis daubentonii*, and Brown Long-eared *Plecotus auritus*.

5.1.3 There are no records of any bat roosts within the 2km search radius.

5.1.4 No European Protected Species mitigation licences for bats have been granted within 5km of the survey area. It should be noted that MAGIC has limited records of granted licence applications post-2016.

5.2 Bat Roost Assessment

5.2.1 Full descriptions of the buildings inspected are presented in the Appendices as follows - Appendix A1: Southtown Road; Appendix B1: Queen Anne's Road; Appendix C1: Cromwell Road; and Appendix D1: Industrial Units on Suffolk Road and South Denes Car Centre. Photographs of the building inspections are provided in Appendices A2, B2, C2 and D2.

General Building Descriptions

Southtown Road

5.2.2 The terraced properties of Southtown Road are two-storey residential dwellings constructed of brick, with pitched roofs of cement-based roof tiles, and central brick chimneys. To the rear of each property is a two-storey extension with a sloping roof also of cement-based roof tiles. There is no soffit boxing or bargeboards on any of the main buildings or the extensions. The internal roof voids are approximately 6m wide by 8m long.

Cromwell Road

5.2.3 The two-storey detached property at Cromwell Road is of brick construction with pitched roofs constructed of cement-based roof tiles. There are two lofts that are lined with breathable membrane and single storey extensions to the front and the rear of the property.

Queen Anne's Road

5.2.4 The smaller terraced properties of Queen Anne's Road are two-storey residential dwellings constructed of brick, with pitched roofs of red clay roof tiles and central brick chimneys. There is no soffit boxing or bargeboards on any of the properties. The internal roof voids are approximately 4m wide by 6m long.

Suffolk Road

5.2.5 Four large brick-built industrial units with corrugated asbestos pitched roofs and plastic skylights. No soffit boxing is present. To the rear of two of the units are single-storey flat-roofed extensions in good condition.

South Denes Car Centre

5.2.6 Two-storey brick-built, flat-roofed industrial unit adjoined to a single-skin corrugated metal roofed car showroom. No fascia, bargeboards or soffit boxing present.

Footbridge

5.2.7 The footbridge running over William Adams Way is of a simple metal construction with no gaps between joints or cavities beneath or to the side of the footbridge. The footbridge has *negligible potential* to support roosting bats. No further survey or mitigation measures are required for this structure.

5.3 Summary of Building Inspections

5.3.1 Of the 33 buildings surveyed, twenty-two have been classified as having *low potential* to support roosting bats and eleven have been classified as having *negligible potential*, including eight outbuildings (Collins, 2016). Table 5.1 below provides a summary of the building inspections along with a classification of their roosting potential.

Table 5.1: Summary of Building Inspections

Property	Potential Roost Features	Bat Roost Potential
148 Southtown Road	Raised lead flashing around the chimney. No obvious access points into the roof void.	Low
149 Southtown Road	Crevices underneath fascia boarding. No obvious access points into the roof void.	Low
Shed at 149 Southtown Road	Tight-fitting clay roof tiles and well cemented gable ends.	Negligible
150 Southtown Road	Raised lead flashing and a gap in rendering between the extensions. No obvious access points into the roof void.	Low
151 Southtown Road	Raised roof tiles. No obvious access points into the roof void.	Low
Shed at 151 Southtown Road	Flat roof of bitumastic roofing felt. Internal walls and ceiling clad in soft boarding.	Negligible
152 Southtown Road	Raised roof tiles. No obvious access points into the roof void.	Low
153 Southtown Road	Raised roof tiles. No obvious access points into the roof void.	Low
Outbuilding at 153 Southtown Road	Shallow, sloping roof of tight-fitting cement-based roof tiles and tight-fitting fascia boarding.	Negligible
154 Southtown Road	Gaps between roof tiles and in the cement along the ridge. No obvious access points into the roof void.	Low
155 Southtown Road	Raised lead flashing. No obvious access points into the roof void.	Low

Property	Potential Roost Features	Bat Roost Potential
156 Southtown Road	Raised lead flashing around the chimney and loose lead flashing on the extension. No obvious access points into the roof void.	Low
Garage at 156 Southtown Road	Pitched roof and walls of corrugated sheet metal. Although there were multiple crevices underneath raised sheets, the roof and walls were single skin and so provided no cavities, and any crevices were exposed to the elements.	Negligible
11 Cromwell Road	Raised and missing roof tiles, and crevices underneath fascia boarding. No obvious access points into the roof void.	Low
Shed at 11 Cromwell Road	Breezeblock and brick construction with a timber-framed pitched roof of clay tiles. The roof and ridge tiles were tight fitting and there was no soffit boxing. Timber fascia boarding on two of the elevations was tight fitting and the gable ends were well sealed and rendered.	Negligible
Garage at 11 Cromwell Road	Garage constructed of brick and breezeblock. The pitched roof of a corrugated cement-based material was tight fitting with the roof ends well cemented at the gables.	Negligible
13 Queen Anne's Road	No external features and no obvious access points into the roof void.	Negligible
14 Queen Anne's Road	No external features and no obvious access points into the roof void.	Negligible
15 Queen Anne's Road	Air vents offer potential access into the roof void. No obvious access points into the roof void.	Low
16 Queen Anne's Road	Raised roof tiles and raised lead flashing around the chimney. No obvious access points into the roof void.	Low
Outbuilding at 16 Queen Anne's Road	Breezeblock construction, with a flat roof of lead-based material and tight-fitting plastic fascia boards.	Negligible
17 Queen Anne's Road	Air vents offer potential access into the roof void.	Low
18 Queen Anne's Road	Raised roof tiles and gaps in the cement at the ridge. No obvious access points into the roof void.	Low
19 Queen Anne's Road	Raised roof tiles beneath the skylight windows. No obvious access points into the roof void.	Low
20 Queen Anne's Road	Raised roof tiles. No obvious access points into the roof void.	Low

Property	Potential Roost Features	Bat Roost Potential
21 Queen Anne's Road	Raised roof tiles. No obvious access points into the roof void.	Low
22 Queen Anne's Road	Raised roof tiles, particularly below the ridge. No obvious access points into the roof void.	Low
Shed at 22 Queen Anne's Road	Wooden garden shed with a pitched roof of bitumastic roofing felt but no internal void and no features	Negligible
Units 10, 11, 12, and 13 Suffolk Road	Crevices and gaps between external cladding, the roof ends, and the brickwork. No internal roof voids.	Low
South Denes Car Centre	No external features and no suitable roof void.	Negligible

5.4 Habitat Assessment

5.4.1 Opposite the properties of Queen Anne's Road are a series of allotments and a nature area, with additional allotments and a tree line to the north separates the gardens from the adjacent industrial buildings. Southtown Common is just 125m to the south-west and Kingsgate Community Church is 120m to the west. Taking the urban setting into consideration, habitat suitability is considered to be of *moderate value* for foraging and commuting bats.

5.4.2 Although only approximately 130m further north of Southtown Common, habitat suitability within the vicinity of Southtown Road, Suffolk Road and Cromwell Road is considered to be of *low value* for foraging and commuting bats. Most of the gardens are vegetated but there is limited available habitat further north and connectivity is more fragmented, with tree cover only available for short distances along Cromwell Road and to the south-east of the properties on Southtown Road, and limited foraging opportunities.

5.4.3 South Denes Car Centre is situated in an industrial urban landscape with no habitat suitable for foraging or commuting bats. Habitat suitability is therefore considered to be of *negligible value*.

6. DISCUSSION and RECOMMENDATIONS

6.1 Development Proposals

6.1.1 The Scheme proposals are for a new bridge to link the A47 at Harfrey's roundabout on the western side of the River Yare with South Denes Road. The proposed development will result in the demolition of 33 buildings, including residential properties, industrial units and outbuildings.

6.2 Summary

6.2.1 Of the 33 buildings surveyed, twenty-two have been classified as having *low potential* to support roosting bats and eleven have been classified as having *negligible potential*, including eight outbuildings (Collins, 2016).

6.2.2 External areas of twenty-two of the buildings due for demolition, contain features with potential to support roosting bats, and any future destruction of those areas will adversely impact bat roosts if present. All bat roosts are protected by European and UK legislation whether they are in occupation or not, and demolition may result in the destruction of bats roosts.

6.2.3 Buildings classified as having negligible bat roost potential contain no potential roost features and so need no further survey. Buildings classified as having low bat roost potential offer limited potential to support roosts of opportunistic bats of the more common species associated with urban environments.

6.3 Recommendations for Further Survey

6.3.1 Further survey is recommended for all twenty-two buildings classified as having low potential to support roosting bats, in order to determine their presence or likely absence. The survey should consist of a minimum of one activity survey, comprising a dusk emergence or dawn re-entry survey, to be completed between the optimal survey months of May-August inclusive in line with good practice guidelines (Collins, 2016).

6.3.2 If the presence of roosting bats is confirmed, additional survey work will be required to provide further information to support an application for a European Protected Species mitigation licence from Natural England, which would allow works to be carried out that might otherwise be unlawful.

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Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8H: Detailed Arboricultural Report

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ("APFP")

APFP regulation Number: 5(2)(a)

Planning Inspectorate Reference Number: TR010043

Author: Norfolk County Council

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Glossary of Abbreviations and Defined Terms

Term	Definition
Ancient Semi-Natural Woodland	An area of ancient woodland where the vegetation is made up of trees and shrubs native to the site and which have predominately arisen from natural regeneration.
Ancient Tree	A tree that has passed beyond maturity and is old, or aged, in comparison with trees of the same species. Characterised by biological, cultural or aesthetic features of interest.
Ancient Woodland	Any wooded area that has been continuously wooded since 1600 AD.
Arboricultural Method Statement	A methodology for the implementation of any aspect of development which is within the root protection area, or has the capacity to adversely affect, any retained tree.
Arboriculturist	A person who has, through relevant education, training or experience, gained expertise in the field of trees in relation to construction.
Construction Exclusion Zone	An area within which all site clearance and construction activities, access and storage of materials are prohibited.
Crown	The upper part of a tree, measured from the lowest branch, including all branches and foliage.
Notable Tree	A tree that is very large but might not qualify as ancient or veteran.
Plantation on Ancient Woodland Site	An area of ancient woodland where the former native tree cover has been felled and replaced by planted trees, usually of species not native to the site.
Scheme	The Great Yarmouth Third River Crossing project for which the Applicant seeks development consent.
Root Protection Area	Layout design tool indicating the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's vitality.
Veteran Tree	A tree that has the biological or aesthetic characteristics of an ancient tree but is not ancient in years compared with others of the same species.

1 Introduction

1.1 Introduction

1.1.1 This arboricultural report is compliant with British Standard BS 5837:2012 *Trees in relation to design, demolition and construction – Recommendations (Ref 8H.1)*, and includes a tree survey schedule, arboricultural impact assessment, Arboricultural Method Statement, and a tree protection plan.

1.1.2 The purpose of this report is to identify all trees which may reasonably be affected by the Scheme, to assess the direct and indirect impact of the Scheme upon those trees, and to identify protection measures that would be necessary to ensure the long-term wellbeing of trees which are to be retained.

1.2 Validity Period

1.2.1 Trees are dynamic organisms which are influenced by a variety of environmental variables and whose health and condition can rapidly change. As a result of this any recommendations made within this report are valid for a period of 24 months from the date of issue.

1.3 Limitations

1.3.1 This report in no way constitutes a health and safety survey. Where concerns for tree health and safety exist the necessary and appropriate tree inspections should be carried out.

1.4 Description of the Scheme

1.4.1 Chapter 2 of Volume I of the Environmental Statement (ES) (document reference 6.1) provides a full description of the Scheme, and is accompanied by the General Arrangement Plan (document reference 2.2). Both documents should be read alongside this appendix, as a detailed project description is not provided in this document to prevent unnecessary duplication.

1.4.2 The Scheme involves the construction, operation and maintenance of a new crossing of the River Yare in Great Yarmouth. The Scheme consists of a new dual carriageway road, including a road bridge across the river, linking the A47 at Harfrey's Roundabout on the western side of the river to the A1243 South Denes Road on the eastern side. The Scheme would feature an opening span double leaf bascule (lifting) bridge across the river, involving the construction of two new 'knuckles' extending the quay wall into the river to support the bridge. The Scheme would include a bridge span

over the existing Southtown Road on the western side of the river, and a bridge span on the eastern side of the river to provide an underpass for existing businesses, enabling the new dual carriageway road to rise westwards towards the crest of the new crossing.

1.4.3 If constructed, the Scheme would comprise the following principal elements:

- A new dual carriageway road, crossing the River Yare in an east-west orientation, comprising of:
  - A new double-leaf bascule bridge providing an opening span to facilitate vessel movement within the river. This would include structures to support and accommodate the operational requirements of the bridge-opening mechanism, including counterweights below the level of the bridge deck. The bridge would be supported on driven piles;
  - New substructures, supported by driven piles, to support the double leaf bascule bridge within the existing quays either side of the river and within the river itself, requiring new permanent "knuckle" walls, creating cofferdams in the waterway to accommodate their construction;
  - A new five-arm roundabout connecting the new dual carriageway road with Suffolk Road, William Adams Way and the western end of Queen Anne's Road. Sections of the new five arm roundabout would be supported on driven piles where deep soft ground is encountered;
  - A single-span bridge over Southtown Road, with reinforced earth embankments joining that bridge to the new roundabout at William Adams Way. Southtown Road bridge and the reinforced earth embankments would be supported on driven piles;
  - A single-span bridge to provide an underpass on the eastern side of the river, with reinforced earth embankments joining that single span bridge to South Denes Road. The underpass and reinforced earth embankments would be supported on driven piles; and
  - A new signalised junction connecting the new road with A1243 South Denes Road.
- The closure of Queen Anne's Road, at its junction with Suffolk Road, and the opening of a new junction onto Southtown Road providing vehicular and pedestrian access to residential properties and the MIND Centre and Grounds at the eastern end of Queen Anne's Road;
- Revised access arrangements for existing businesses onto the local highway network;

- Dedicated provision for cyclists and pedestrians which ties into existing networks;
- Implementation of part of a flood defence scheme along Bollard Quay that is proposed to be promoted by the Environment Agency, and works to integrate with the remainder of the flood defence scheme;
- A control tower structure located immediately south of the crossing on the western side of the river. The control tower would facilitate the 24/7 operation of the opening span of the new double-leaf bascule bridge;
- A plant room located on the eastern side of the river for the operation of the opening span of the new double-leaf bascule bridge;
- The demolition of an existing footbridge on William Adams Way;
- Associated changes, modifications and/or improvements to the existing local highway network;
- Additional signage, including Variable Message Signs (VMS) at discrete locations, to assist the movement of traffic in response to network conditions and the openings / closings of the double-leaf bascule bridge;
- The relocation of existing allotments to compensate for an area to be lost as a result of the Scheme and other works, including those at the MIND Centre and Grounds; and
- New public realm, landscape, ecology and sustainable drainage measures.

1.4.4 The Scheme also includes works to facilitate the construction, operation and maintenance of the above elements including:

- Creation of temporary construction sites and accesses from the public highway;
- Provision of new utilities and services and the diversion of existing utilities;
- Provision of drainage infrastructure, lighting and landscaping;
- Demolition of a number of existing residential and commercial / business properties; and
- Provision of vessel waiting facilities to the north and south of the new crossing, either as floating pontoons or additional fendering to the existing berths, including any dredging and quay strengthening works that may be required.

2 Site Description

2.1.1 Great Yarmouth is located at the mouth of the River Yare, one of the main waterways providing access to the Norfolk Broads. The river bisects Great Yarmouth, with the town centre, seafront, industrial areas and outer harbour located on the narrow, 4km long, South Denes peninsula between the river and the sea, isolated from the rest of the town. To the south of the River Yare, Gorleston-on-Sea is just a few hundred metres away as the crow flies, but over 7km distance by road. The administrative authority is Great Yarmouth Borough Council (GYBC). Figure 8H.1 shows an aerial photograph of the Principal Application Site. Figure 8H.2 is a plan to show the location of the Principal and Satellite Application Sites.

2.1.2 A detailed description of the geology of the study area is available in Chapter 16: Geology and Soils of the Environmental Statement (document reference 6.1). The associated geological map is presented within the Contaminated Land desk study in Appendix 16C. The main characteristics of the geology of the study area are:

- Blow sand along the shore;
- Quaternary sand and gravel deposits from the North Denes Formation at the East of the Scheme Boundary;
- Quaternary clay and silt deposits from the Breydon Formation at the West and North West of the Scheme Boundary;
- Peat, also from the Breydon Formation, at the West and South West of the Scheme Boundary;
- Quaternary sand and silt deposits from the Lowestoft Till Formation and Happisburgh Glacigenic Formation at the South of the Peat Deposit;
- Underneath the Quaternary deposits, the bedrock consists of sands, gravels, silts and clays from the Crag Group.

3 Legislative Framework and Guidance

3.1 Forestry Act 1967

3.1.1 The Forestry Act 1967 sets out the requirements of a licence for the felling of growing trees and states when trees can and cannot be felled. However, there are exemptions that apply. Section 9 (4)(d) of the Act allowing developers to legally fell trees which:

"…is immediately required for the purpose of carrying out development authorised by planning permission granted or deemed to be granted under the Town and Country Planning Act 1990 or the enactments replaced by that Act".

3.1.2 The draft DCO (document reference 3.1) for this Scheme disapplies the need for a felling licence. Other exemptions are also afforded within the legislation. As such, expert advice from a suitably qualified and experienced Arboriculture or Forestry Consultant should be obtained before felling trees for the purposes of the Scheme.

Tree Preservation Orders

3.1.3 The Town and Country Planning Act 1990 (Ref 8H.2) places a duty upon local planning authorities to make provision for the preservation and planting of trees when granting permission for new development. It also affords local planning authorities with the power to make Tree Preservation Orders (TPO) where it is expedient in the interests of amenity to make provision for the preservation of trees and woodlands.

Purpose of a Tree Preservation Order

3.1.4 The purpose of a TPO is to protect specific trees, groups of trees and woodlands for the purpose of amenity. TPOs are used to protect specific trees, groups of trees and woodlands where removal would result in a significant adverse effect.

3.1.5 A TPO does not prevent the removal of trees in order to implement development. It does, however, prevent their unauthorised removal and ensures that they can be fully considered when determining whether development is appropriate and acceptable.

3.1.6 A TPO makes it a statutory offence to carry out any of the following works to trees without the formal consent of the Local Planning Authority (LPA):

- Cutting down;
- Topping;

- Lopping;
- Uprooting;
- Wilful damage; and
- Wilful destruction.

Amenity Value

3.1.7 Trees which are to be included within a TPO should exhibit a minimum level of current or future amenity value. This should be assessed by the LPA in a structured and consistent manner with Government advice making reference to the following requirements.

Visibility

3.1.8 Trees should be visible, in whole or in part, from a public place such as a road, footpath or publicly accessible land.

Value

3.1.9 Public visibility is in itself not sufficient to warrant inclusion within a TPO. Arboricultural features should also exhibit merit in terms of one or more of the following criteria:

- Size and form;
- Future potential;
- Rarity, cultural or historical value;
- Contribution to, and relationship with, the landscape; and
- Contribution to the character or appearance of a conservation area.

Other Factors

3.1.10 Other factors such as nature conservation may be considered when making a TPO but on their own would not warrant making an Order.

Conservation Areas

3.1.11 A conservation area is an area which has been designated because of its special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance (Ref 8H.3). Trees have the ability to positively contribute towards the character, appearance or general amenity of a conservation area and, if not protected by a tree preservation order, are protected by the provisions in section 211 of the Town and Country Planning Act 1990.

3.1.12 Section 211 of the Town and Country Planning Act 1990 makes it a statutory offence to carry out any of the following works to trees[1] located within a conservation area without first providing the LPA with six weeks' notice of intent:

- Cutting down;
- Topping;
- Lopping;
- Uprooting;
- Wilful damage; and
- Wilful destruction.

3.1.13 Although the LPA must normally be given six weeks' notice of intent to carry out work to trees in a conservation area, certain exemptions do exist. These include, but are not limited to, the following criteria:

- The making safe of dangerous trees where there is an immediate risk of serious harm;
- The removal of dead wood or dead trees;
- Work necessary to abate an actionable legal nuisance; and
- Where work is necessary to implement a grant of full planning consent.

3.1.14 However, under Article 56 of the draft DCO (document reference 3.1), the Applicant will have the ability to undertake the above-mentioned works to trees identified in the Tree Preservation Orders and Conservation Area Tree Plans (document reference 2.8) without an offence being caused.

Natural Environment and Rural Communities Act 2006

3.1.15 Section 40 of the Natural Environment and Rural Communities Act 2006 places a duty on local authorities and government departments to have

[1] Except for trees whose stem diameter at 1.5 metres (m) above ground level:

- does not exceed 75mm; or
- has a stem diameter of 100mm of less and is to be removed for the sole purpose of improving the growth of other trees (e.g. thinning as part of forestry operations).

regard for the conservation of biodiversity when exercising their normal functions.

3.1.16 Biodiversity comprises all living things including animals, plants, fungi and micro-organisms, and includes the communities and habitats that they form. Trees form integral elements of the natural environment either due to rarity (e.g. Common Juniper (Juniperus communis)), as part of an important habitat (e.g. ancient woodland) or because they directly support another species (e.g. a bat roost or nesting bird). Even widespread, common or non-native tree species are important due to their positive contribution towards a sustainable natural environment.

3.1.17 Development activities must be undertaken with due regard for trees and their biodiversity value. Trees should be retained wherever practicable and opportunities taken to maintain and enhance their environmental contribution.

Health and Safety at Work etc. Act 1974

3.1.18 The Health and Safety at Work etc. Act 1974 is the primary piece of legislation covering occupational health and safety in Great Britain. It places duties upon employers to ensure that they conduct their business activities with due regard for the safety of employees and members of the public.

3.1.19 Development activities should be undertaken with due regard to health and safety. This applies not only to those engaged in the pruning, felling or planting of trees but also extends to ensuring that trees are not damaged to the point whereby they become unsafe. Potentially hazardous trees should also be identified and subsequently made safe.

Trees on Third-Party Land

3.1.20 Under Common Law any roots or branches which cross a property boundary and encroach onto neighbouring land are deemed to be a nuisance. They are deemed to be a nuisance as they have the potential to affect the owner/occupier's reasonable enjoyment of their land. This nuisance may be legally abated by the land owner or occupier cutting back encroaching roots or branches to the edge of their property if they so desire.

3.1.21 However, when abating a nuisance in this manner the owner/occupier must ensure that they are aware of and/or adhere to the following requirements:

- There is no duty to give notice to the tree owner although it would be considered courteous to do so;
- Unless otherwise agreed with the tree owner all work must be undertaken without trespass onto the neighbouring property;

- All arisings remain the property of the tree owner and should be both offered back and only disposed of with their permission; and
- A duty of care is owed to the landowner at all times meaning that all work should be undertaken with reasonable skill and in accordance with any relevant best practice guidance.

3.1.22 The potential for future nuisance must be considered when undertaking new tree planting with due regard given to the likely effects of encroaching roots and branches on neighbouring land. The possibility of direct physical damage to boundary walls and fences should be avoided by allowing sufficient room for future growth and movement due to wind.

3.2 Planning Policy

3.2.1 National and local planning policies of specific relevance to this report are outlined below.

National Policy

National Planning Policy Statement for National Networks

3.2.2 The National Policy Statement for National Networks (NPS NN) (Ref 8H.5) also includes relevant guidance in chapter 5: Generic impacts. Paragraph 5.32 of this chapter supports the NPPF by stating:

"*The Secretary of State should not grant development consent for any development that would result in the loss or deterioration of irreplaceable habitats including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss.*"

3.2.3 Paragraph 5.32 of the NPS NN further states that in instances where such trees would be affected by the proposed development then the applicant should either provide proposals for their conservation or give reasons for their loss.

National Planning Policy Framework

3.2.4 The National Planning Policy Framework (NPPF) (Ref 8H.4) includes relevant guidance in Chapter 15: Conserving and Enhancing the Natural Environment. Guidance provided includes:

- Paragraph 170(b) recognises the economic and other benefits that trees and woodlands provide and the fact that they should be considered as part of a planning decision;

- Paragraph 175(c) identifies the principle that *'development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons and a suitable compensation strategy exists'.*

The Town and Country Planning Act

3.2.5 The Town and Country Planning Act 1990 (Ref 8H.2) places a duty upon LPAs to make provision for the preservation and planting of trees when granting permission for new development. It also affords local planning authorities with the power to make TPOs where it is expedient in the interests of amenity to make provision for the preservation of trees and woodlands.

Other Guidance

3.2.6 Other guidance of specific relevance to this report is outlined below.

British Standard BS 5837:2012

3.2.7 British Standard BS 5837:2012 (Ref 8H.1) provides recommendations and guidance on the relationship between trees and design, demolition and construction processes. It sets out principles and procedures to be applied to achieve a harmonious and sustainable relationship between trees and structures, and is applicable whether or not planning consent is required.

Ancient Woodland and Veteran Trees: Protecting them from Development

3.2.8 The Forestry Commission and Natural England published guidance (known as 'standing advice') on 13 October 2014 (Ref 8H.6). Standing advice is a material planning consideration. This means it should be considered when making decisions on relevant planning applications and used to provide information for the protection of veteran trees from development. This guidance was subsequently updated on 05 November 2018 and advises the following:

- A buffer zone of semi-natural habitat should be left of at least 15m between any development and ancient woodland.

- A buffer zone should be left between any veteran, ancient or aged tree and proposed development of at least 15 times the diameter of its stem or 5m from the edge of its canopy, whichever is the greater.

4 Baseline Data Collection

4.1 Study Area

4.1.1 The Study Area for this report has been defined as all land within, and up to 15m beyond, the Application Site, as identified in DCO document reference 2.8.

4.1.2 This has been identified as the maximum area within which trees may be directly influenced by the Scheme and its associated demolition, construction or operational activities and accounts for the root protection areas of trees growing within and immediately outside the boundary of the Scheme.

4.1.3 For the small parcels of land that were not part of the walkover survey in October 2018 a desk-based review of tree features within these parcels was undertaken. The review showed that no additional trees were within the Application Site. However, three poor quality mature conifers are within 15m of the Application Site on Suffolk Road. It is not considered that the roots of these trees pose a significant constraint to the Scheme or be impacted during delivery of the Scheme.

4.2 Method of Baseline Data Collection

4.2.1 Baseline data collection has been undertaken with reference to British Standard BS 5837:2012 (Ref 8H.1).

4.2.2 Baseline data collection has been undertaken using the following data sources:

- An arboricultural desk study; and
- A walkover survey of all arboricultural features within the study area.

Desk Study

4.2.3 A desk study has been undertaken as a means of identifying any statutory and non-statutory constraints which may apply to arboricultural features within the Study Area. The desk-based review has considered the following sources.

TPOs and Conservation Areas

4.2.4 GYBC is responsible for implementing any legal controls imposed through TPOs and conservation areas within the study area. The statutory status of trees within the conservation areas was checked online with GYBC using their interactive map (Ref 8H.7) on 26 February 2019. The statutory status and location of trees within the TPO area was confirmed via email received

from GYBC on 30 October 2018 and shown on document reference 2.8: TPOs and Conservation Areas.

Notable, Ancient and Veteran Trees

4.2.5 The presence of locally notable, ancient and veteran trees within the study area was checked using the Woodland Trust's Ancient Tree Inventory (Ref 8H.8) on 10 September 2018.

Ancient Woodland

4.2.6 The presence of ancient woodlands within the study area was checked using Natural England's Multi Agency Geographical Information for the Countryside (MAGIC) (Ref 8H.9) map on 10 September 2018.

Site Visit / Surveys

4.2.7 A walkover survey of all arboricultural features within the study area was undertaken on 23 and 24 October 2018. The survey was undertaken by a suitably qualified Arboricultural Consultant.

4.2.8 The survey was undertaken in accordance with British Standard BS 5837:2012 (Ref 8H.1) (with Ordinance Survey Master Map forming the base mapping). The tree survey was undertaken in accordance with the following criteria:

- Trees have been recorded as groups or woodlands where this has been deemed appropriate. Groups have been recorded on the basis that they form distinct arboricultural features either aerodynamically, visually or because they contain trees of similar cultural and biodiversity value.
- Hedges have been recorded where these form substantial internal or boundary features or where they contribute meaningfully to the landscape character of the local area.
- The trees have been inspected using the Visual Tree Assessment methodology as purported by Mattheck and Breoler (2006) (Ref 8H.10).
- The tree survey was carried out from ground level only.
- No tissue samples were taken nor was any internal investigation of the subject trees undertaken.
- Tree heights and canopy spreads have been estimated to the nearest 1m.

4.2.9 Stem diameters have been measured in accordance with Annex C of BS 5837:2012 (Ref 8H.1). Diameters of single stem trees on level ground have been measured at 1.5m above ground level. The diameters of other

commonly encountered stems have been measured where most appropriate and this is recorded within the schedule.

4.2.10 The combined stem diameters for multi-stemmed trees have been calculated in accordance with BS 5837:2012 (Ref 8H.1), notably paragraph 4.6.1. Root protection areas are calculated as an area equivalent to a circle with a radius 12 times the stem diameter.

Notes and Limitations

4.2.11 The arboricultural survey data is of a preliminary nature and has been collected during a brief walkover survey. Only defects visible from the ground have been noted and each individual feature may not have been inspected closely due to access difficulties, the presence of dense ivy or vegetation, or safety constraints. Safety related features have been recorded on the basis that the arboricultural features will be subject to a normal programme of tree hazard assessment and only those features which materially affect the quality of the feature or pose a real and immediate safety concern have been recorded.

4.2.12 Arboricultural survey data is typically valid for a period of two years unless otherwise stated. Significant environmental events (such as extreme weather conditions) or changes to the Application Site may render it invalid within a shorter timescale.

4.2.13 Records held on the Ancient Tree Inventory are collected on a voluntary basis, therefore the absence of records does not demonstrate the absence of ancient, veteran or notable trees but may simply indicate a gap in recording coverage.

4.2.14 Whilst arboricultural surveys are not seasonally limited it is the case that certain pests and diseases may be more or less evident at different times of the year. This is especially true of certain wood decaying fungi such as the Giant Polypore (*Meripilus giganteus*) where fruiting bodies are short-lived, and the early stages of root decay may not result in other identifiable symptoms. Walkover survey data is therefore based upon observations made at the time of the site visit and may be subject to change should further or more detailed inspections be undertaken.

4.2.15 The survey has only been undertaken from land within the client's ownership, from public land or from areas where formal access has been arranged.

4.2.16 The position of arboricultural features not recorded on a topographical survey has been estimated using aerial photography. The position and extent of these features should be regarded as approximate only.

5 Baseline Conditions

5.1 Desk Study

5.1.1 The desk study confirmed the presence of arboricultural features within the Application Site to be afforded statutory protection. These include a TPO and three conservation areas.

Tree Preservation Orders

5.1.2 The arboricultural features listed in Table 5.1 have been identified as being afforded statutory protection by virtue of a TPO. A copy of the 'map' included within Schedule 12 of the draft DCO (document reference 3.1) and which identifies the location of the protected features is included within document reference 2.8.

Table 5.1: Arboricultural Features covered by a TPO

Arboricultural Survey Reference Number	TPO Name	TPO Reference Number	TPO Schedule Description
G38	TPO No.7 2005	G3	Consisting of sycamore, whitebeam and poplar.
G39	TPO No.7 2005	G1, G2	Consisting of sycamore and whitebeam

5.1.3 TPO No.7 2005 is located on a plot of land between the east of Gapton Hall Retail Park and Gapton Hall Road. Within this TPO two groups of trees have been identified.

5.1.4 Of the two groups of trees, G38 is situated to the southern end of the surveyed area and consists of a group of mature poplars with maximum height of 12m and a stem diameter ranging from 220 and 430 mm. The other tree group, G39, consists of sycamore and white beam with a stem diameter ranging from 110 to 320 mm and a maximum height of 7 m.

Conservation Areas

5.1.5 GYBC state on their website: "There are no standard criteria by which an area is designated (as a conservation area). They may form groups of buildings, open spaces, trees, historic street patterns, village greens or features of historic or archaeological interest. It is the character of areas rather than individual buildings that these conservation areas seek to enhance."

5.1.6 The arboricultural features listed in Table 5.2 have been identified as being afforded statutory protection by virtue of their location within a designated conservation area.

5.1.7 A plan showing the location and extent of the conservation areas(s) is included within document reference 2.8.

Table 5.2: Arboricultural Features Located within a Conservation Area

Reference Number	Conservation Area Name
G40 (Part)	Conservation Area No.3 – Hall Quay & South Quay
Site: T52, T53, T54, T55, T56, T57, T58, T59, T60, G44 Study: T51, T52, G42	Conservation Area No.5 – Nicholas & Northgate Street (Laughing Image Corner)
T45, T46, T47, T48, T49, T50, G41	Conservation Area No.5 – Nicholas & Northgate Street (Fullers Hill)

5.1.8 Partially within Conservation Area No.3 – Hall Quay & South Quay, is the site known as The Tolhouse. The section within this conservation area is located to the west of Tolhouse Street. The group of trees, G40, consists of sycamore with a maximum height of 14 metres and maximum diameter of 350mm. This group of trees is located within the study area, across the Application Site.

5.1.9 Two Satellite Application Sites are located within Conservation Area No.5 – St. Nicholas and Northgate Street. The first is the Laughing Image Corner site. Of this Site, only the area to the south of Rampart Road falls within the boundary of the conservation area (in which all relevant arboricultural features identified were located). Species include three Whitebeam (T57, T57, T59) with a height range of 6 to 11 m; three Ash (T53, T55, T56) with a maximum height of 9 m; two unidentified ornamental trees (T58, T60) which stand at 5 m; and a Corsican pine (T54). The group of trees, G44, is a group of three Elder trees located on the car park boundary. These show signs of being previously coppiced with a current maximum height of 3.5m. The three remaining arboricultural features are located within the Study Area, either on or outside of the Satellite Application Site boundary.

5.1.10 The second Site, Fullers Hill, is wholly located within Conservation Area No.5. Tree species within the Satellite Application Site consist of sycamore (T46, T49) of similar size with a maximum height of 9 meters and maximum diameter of 340mm; birch (T45, T48) with heights of 12m and 14m and diameter range of 210mm to 300mm; one silver maple (T47) with a height of 12m and diameter of 380mm; and a six meter tall cherry with a diameter of 370mm.

5.2 Site Visit / Survey

5.2.1 A total of 130 arboricultural features were surveyed, details of which are provided within the Arboricultural Survey Schedule included in Annex B of this report. A summary of the surveyed features, including their category[2] and designation, is provided in Table 5.3.

Table 5.3: Summary of Surveyed Arboricultural Features

BS 5837:2012 Category	Quality	Trees	Tree Group	Woodlands	Hedges
A	High	2	-	-	-
B	Moderate	37	7	1	2
C	Low	36	40	4	1
Total		**75**	**47**	**5**	**3**

Sub-categories

5.2.2 The value associated with each arboricultural feature is defined by its sub-category. Sub-categories vary depending upon the overall quality of the arboricultural feature, carry equal weight, do not influence retention priority and are simply included to indicate the primary value(s) associated with each surveyed item. The sub-categories assigned to each arboricultural feature are identified within the Arboricultural Survey Schedule included in Annex B of this report.

5.2.3 Table 5.4 to Table 5.6 below define the sub-categories associated with high, moderate and low quality arboricultural features.

[2] Categories are assigned based upon the criteria described within British Standard BS 5837:2012 Table 1.

Table 5.4: Sub-categories Associated with High Quality 'Category A' Arboricultural Features

Sub-category	Area of Value	Estimated Remaining Life Expectancy (years)	Description
1	Arboricultural	>40	Trees that are of particularly good examples of their species (e.g. notable specimens), especially if rare or unusual; or those that are essential components of groups, or of formal or semi-formal arboricultural features (e.g. the dominant and/or principle trees within an avenue).
2	Landscape	>40	Trees, groups, or woodlands of particular visual importance as arboricultural and/or landscape features.
3	Cultural	>40	Trees, groups or woodlands of significant conservation, historical, commemorative or other value (e.g. ancient trees, veteran trees and ancient woodland).

Table 5.5: Sub-categories Associated with Moderate Quality 'Category B' Arboricultural Features

Sub-category	Area of Value	Estimated Remaining Life Expectancy (years)	Description
1	Arboricultural	>20	Trees that might be included in category A but are downgraded because of impaired condition (e.g. the presence of significant though remediable defects including unsympathetic past management and storm damage), such that they are unlikely to be suitable for retention beyond 40 years; or trees lacking the special quality necessary to merit category A designation.
2	Landscape	>20	Trees present in numbers, usually as groups or woodlands, such that they attract a higher collective rating than they might as individuals; or trees occurring as collectives but situated so as to make little visual contribution to the wider locality.

Sub-category	Area of Value	Estimated Remaining Life Expectancy (years)	Description
3	Cultural	>20	Trees with material conservation or other cultural value.

Table 5.6: Sub-categories Associated with Low Quality 'Category C' Arboricultural Features

Sub-category	Area of Value	Estimated Remaining Life Expectancy (years)	Description
1	Arboricultural	>10	Unremarkable trees of very limited merit or such impaired condition that they do not qualify in higher categories.
2	Landscape	>10	Trees present in groups or woodlands, but without this conferring on them significantly greater collective landscape value; and/or trees offering low or only temporary/transient landscape benefits.
3	Cultural	>10	Trees with no material conservation or other cultural value.

High Quality Arboricultural Features

5.2.4 A total of two high quality arboricultural features were recorded during the walkover survey. Both trees are good examples of mature trees for their species. Tree T5 is located on the Site boundary, on the edge of a car park to the east of the A47, north of Harfrey's roundabout. Tree T12 falls within the study area, located in the north-eastern corner of a site known as Southtown Common.

5.2.5 Tree T5 is a late mature weeping willow with a girth of 670mm and height of 11m, which stands in a prominent position within a well-maintained car park of a private business. Tree T12 is a noteworthy specimen of a late mature weeping willow with a girth of 760mm, a height of 24m, and an average crown spread of 7m.

5.2.6 Both trees have been assessed as warranting category A inclusion due to having a notable sized girth and that they are living beyond that considered typical of the species. For this reason, tree T5 can therefore be deemed a veteran tree and T12 a notable tree. Although these trees are not currently

recorded on the Woodland Trust's Ancient Tree Hunt Interactive Map, both trees should be considered as an ancient tree in regard to this Scheme.

Moderate Quality Arboricultural Features

5.2.7 The moderate quality category B arboricultural features consist of 37 trees, seven tree groups, one woodland and two hedges.

5.2.8 Of the moderate quality category B trees, 25 trees have an estimated life expectancy of more than 20 years. Of these, 16 are in good physiological and structural condition; eight are in good to fair condition physiologically and structurally; and one is in fair structural, but poor physiological condition.

5.2.9 Of the 16 trees in good physiological and structural condition, three beech trees (T8, T9, T10) and one willow T11 are located within the Study Area of the Principal Application Site, all in the north-eastern corner of Southtown Common. Tree T15 is a sweet cherry located within the Site, outside the boundary to Southtown Common close to the north-eastern entrance. Three cherry trees (T32, T34, T36) and one ray wood ash (T38) are located on a plot of land to the south of TPO No.7 2005 Satellite Application Site. Within the Study Area of the Satellite Application Site located to the south of Fullers Hill, this site contains one silver maple (T47) and one cherry (T50). Located at the Laughing Image Corner Satellite Application Site, a Scots pine (T51) is located within the study area, as are two whitebeam (T52, T57) and a Corsican pine (T54). All these trees are located at the southern end of the Site within the vicinity of the eastern side of the roundabout. More centrally, a second whitebeam (T59) is found.

5.2.10 The eight trees of good to fair condition are predominantly sycamore (T35, T37, T39, T42, T43, T49), with one hawthorn (T26) and one ray wood ash (T33). Three of the sycamores (T35, T37, T39) and the ray wood ash (T33) are located to the south of TPO No.7 2005 Satellite Application Site; two sycamores (T42, T43) are within the study area opposite the Salvation Army Hall, outside of the Conservation Area No.3 Satellite Application Site; and the final sycamore (T49) is located within the Study Area south of Fullers Hill Satellite Application Site. Also, within this Study Area is the sycamore (T46) which was found to be in fair structural but poor physiological condition. The Hawthorn (T26) is located within the Principal Application Site boundary on the western side of Southtown Road, north of the intersection with William Adams Way and Beccles Road.

5.2.11 The remaining 12 category B trees all have a life expectancy of more than 10 years. Within the north-eastern corner of Southtown Common, located in the Study Area of the Principal Application Site, a line of Lombardy Poplars (T13, T16, T17, T18) and one Poplar (T14) have a good physiological and structural condition. Three sycamores (T24, T27, T28) are in fair physiological and structural condition, and located on the eastern side of Southtown Road near the intersection with William Adams Way and Beccles

Road. A sycamore (T44) is within the Satellite Application Site study area opposite the Salvation Army Hall, outside of Conservation Area No.3. Two ornamental trees of unknown species (T58, T60) are in good structural and physiological condition, located within the Site at Laughing Image Corner Satellite Application Site. The final tree to consider is a whitebeam (T71) in fair physiological and structural condition. This tree is located within the Satellite Application Site on the north side of the A47 and western side of the entrance to Vauxhall Holiday Park Satellite Application Site.

5.2.12 Of the seven tree groups, three (G21, G22, G27) are located around the north-eastern corner of Southtown Common Principal Application Site. All three groups are in good physiological and structural condition. Group G21 consists of holly, sycamore and oak trees and elder bush. Group G22 is predominantly alder and G27 is a row of holly.

5.2.13 A group of sycamore (G36) is located centrally in a block of land between Queen Ann's Road, William Adams Road and Southtown Road within the Principal Application Site. This group is in good physiological and fair structural condition, consisting of multi-stems which show signs of previous pruning. Due to lack of access, all features are an approximate assessment.

5.2.14 Another group of sycamore (G40) is located within Conservation Area No.3 at the Salvation Army Satellite Application Site. Access to these trees was not possible. Visually, it appears these trees have previously been pollarded and located within a tarmacked area.

5.2.15 At the Vauxhall Holiday Park Satellite Application Site, tree group G49 consists of rowan in fair physiological and good structural condition.

5.2.16 Tree group G26 is located within the Principal Application Site, running along the boundary of a business unit and backing onto a row of residential properties on Queen Anne's Road. In fair physiological and structural condition, the dominant species is cypress, with the occasional Corsican pine and one sycamore.

5.2.17 The woodland W6 demonstrates the characteristics of a native broadleaf woodland, consisting of ash, birch, cherry and poplar. This woodland is located on the eastern edge of Southtown Common within the Study Area of the Principal Application Site.

5.2.18 Two hedgerows (H2, H3) form the boundary to a private business located within the Principal Application Site. These hedges are well maintained cypress in good structural and physiological condition. Technical Appendix 8A (document reference 6.2), titled Preliminary Ecological Appraisal Report categorised hedgerows within the scheme as having a low ecological value. For this reason, these hedgerows are deemed not important under The Hedgerow Regulations (1997) (Ref 8H.13).

Low Quality Arboricultural Features

5.2.19 Located within the Vauxhall Holiday Park Satellite Application Site, the low-quality category C trees consist predominantly of poplar (T61, T62, T63, T64, T65, T66, T67, T70, T74, T76, T77, T78) with a few Lombardy poplars (T68, T69, T72 and one cypress tree (T73). Trees T68, to T78 are located along the boundary of the holiday park on the eastern side of the entrance. Trees T61 to T67 are located on the boundary of the holiday on the western side of the entrance. The poplar tree (T78) has a tag identifying it as a "David Bellamy Conservation Award" tree. Also, within this Satellite Application Site are tree groups G48 of unknown species, G50 consisting of semi-mature rowan, and two groups of poplar (G51, G52).

5.2.20 At the Laughing Image Corner Satellite Application Site, three ash trees (T53, T55, T56), and one group of elder (G44) are located within the Site. The group of elder (G43) is located within the Study Area. Each group are located within the boundary to the car park and consist of three trees in fair physiological and structural condition that show signs of previously being coppiced. Tree group (G42), also a group of rowans, is located just outside of the Study Area. All arboricultural features identified are located within Conservation Area No.5.

5.2.21 The Fuller Hill Satellite Application Site contains two birch trees (T45, T48) in good physiological and structural condition, and one group (G41) consisting of sycamore, hawthorn and elder. Access to this group of trees was not possible.

5.2.22 Gapton Hall Retail Park is the location of the Satellite Application Site that also contains TPO No.7 2005. The two tree groups that fall within the TPO location are G38 and G39. The third tree group found at this location is G37. This group was not accessible, located behind a maintained hawthorn hedge on the south side of Purley Court and consisted of a young group of willow. Also within the site boundary is a cherry (T40) and within the Study Area, a whitebeam (T41).

5.2.23 The north end of the Satellite Application Site located south of Harfrey's Roundabout had limited access due to a deep dike. The southern end of the group of trees (G2) was assessed from a position of safety within a layby on the A47, the northern section was extrapolated from a drive-by. From this, a mix of native species including birch, alder, beech, willow, hazel coppice, cherry, Rowan and hawthorn were identified. The southern section (G1), was assessed from a public footpath that was accessible from Burgh Road. The dominant species in this group of trees was cherry and goat willow, with alder, oak and hawthorn also present.

5.2.24 The remaining category C arboricultural features are located within the Principal Application Site, identified in the Landscaping Plans (document reference 2.9).

5.2.25 A laburnum tree (T29) is located outside the Scheme Boundary, on the boundary of a petrol station travelling north on Southtown Road bordering on the edge of the Principal Application Site.

5.2.26 Two trees (T30, T31) are located on the eastern side of the River Yare behind West Quay/Hewett's Wharf. Despite growing in a confined space behind a fence, this cherry tree (T31) appeared to be in good physiological and structural condition. The species of the second tree could not be identified and was found to be growing into a metal fence and girdling a telegraph pole.

5.2.27 A sweet chestnut (T4) is a multi-stemmed tree located in a road verge in the western side of the A47 within the Principal Application Site and footprint of the footbridge north of Harfrey's roundabout. A Eucalypt tree (T25) in fair physiological and poor structural condition, and group of alder trees (G25) were ran along the edge of a block of council owned land viewed from the service road accessible from Queen Anne's Road for the rear of a row of properties off Southtown Road.

5.2.28 South of Harfrey's roundabout, running along the western edge of the A47 is a group of goat willow, hazel, sycamore, oak, hawthorn, birch. This group was assessed from a distance due to access restrictions. Opposite this group, on the western side of the A47, a group of willow and goat willow (G5) were growing in an apparent floodplain. This group partially falls within the Principal Application Site.

5.2.29 The tree group G8 runs between the road and Harfrey's Industrial Estate around the north-western edge of the roundabout. Due to its location, it was not possible to assess the tree group (G8) from a place of safety from the road side, and visibility from the other side was obscured by stacked storage containers. The main tree species that were visible were birch with some goat willow. The group of trees (G9) continues northwards from G8, and consists of goat willow, birch and poplar. Although visible from a short distance, again access was restricted. Opposite tree group G9, on the eastern side of the A47, the tree group G10 is located. This group consisting mainly of ash with goat willow. Again, access was not possible. Located south of tree group G10, along the edge of the A47 down towards the north-eastern side of the roundabout is tree group G11 consisting of willow and goat willow, with some alder, birch and shrub species.

5.2.30 A group of cypress (G17) is located behind hedge H3. Beside this, and behind hedgerow H2 is a tree group (G18) consisting of willow and goat willow. These groups appear to be located along a ditch.

5.2.31 The tree group G23, runs along the Principal Application Site boundary located behind a row of business units on Suffolk Road. This tree group consist of four cypress trees growing on the edge of a small private car park against a brick wall.

5.2.32 A group of coppiced sycamore (G29) growing on a relatively small patch of waste ground. These trees are young in appearance.

5.2.33 The final group of trees is a group of young cypress trees (G30) in good physiological and structural condition, located opposite business units which are accessed from Southtown Road.

5.2.34 Woodland areas identified as W4 and W7 are located within the Principal Application Site, south of Harfrey's roundabout, on the western edge of the A47. These woodland areas consist of mixture of species including ash and sycamore, horse chestnut, oak and willow. Although outside of the Principal Application Site boundary, Woodland areas W14 and W13 are within the Study Area along the northern edge of Southtown Common. These two woodland areas abut each other and are identified individually due to their differing structures. Woodland area W14 is mainly poplar, whereas woodland W13 is dominated by hawthorn with the occasional ash tree.

5.2.35 The category C low quality arboricultural features located within the Landscape and Urban Design, and the Soft Landscaping areas outlined in Landscaping Plans (document reference 2.9) have been identified for removal and will be discussed in Section 6 below.

6 Arboricultural Impact Assessment

6.1.1 The following Arboricultural Impact Assessment (AIA) evaluates the direct and indirect effects of the Scheme on existing trees and identifies the necessary mitigation measures where these are deemed appropriate.

6.2 Arboricultural Features to be Removed

Arboricultural features selected for retention and removal are identified on the Tree Protection Plans (Figures 8H.3 to 8H.10). Details of the arboricultural features to be removed are summarised in *Table 6.1: Arboricultural Features to be Removed / Sub-Divided by Type and Quality*

6.2.1 1.

Table 6.1: Arboricultural Features to be Removed / Sub-Divided by Type and Quality

BS 5837:2012 Category	Quality	Trees	Tree Group	Woodlands	Hedges
A	High	-	-	-	-
B	Moderate	T15	G22(Part), G26	-	-
C	Low	T6, T7, T19, T20, T21, T22, T23	G15, G16, G19, G20, G24, G25, G28 (Part), G31, G32, G33, G34	-	H1
U	Very Low	-	-	-	-
Total	**-**	**8**	**13**	**-**	**1**

6.2.2 Arboricultural features identified for removal and partial removal are based upon design information available at the time of writing this report. The plan used to inform this section of the report was Landscaping Plans (document reference 2.9). The below assessment may need to be revised as additional design information becomes available.

6.2.3 Removals have been identified on the basis that they are located directly within the Landscape and Urban Design, and the Soft Landscaping areas outlined in Landscaping Plans (document reference 2.9) and are all located within the Principal Application Site.

6.2.4 Implementation of the Scheme will not require the removal of the two high quality category A arboricultural features identified during the walkover

survey as veteran (T5) or notable (T12) trees. Tree T5 is in a prominent position within a well-maintained car park of a private business on the eastern side of A47, north of Harfrey's roundabout. Tree T12 is located in the north-eastern corner of a site known as Southtown Common. Both locations are within areas marked as 'Exiting Trees' on DCO document 2.9.

6.2.5 One moderate quality tree (T15) and two moderate quality tree groups are identified for removal (G22, G26). Tree T15 is located outside the boundary to Southtown Common close to the north-eastern entrance. Of the two tree groups, G22 is a group of alders in good structural and physiological condition and a life expectancy of more than 20 years. This group is located along the northern boundary of Southtown Common. The second tree group, G26, is a group of trees in fair physiological and structural condition that run along the boundary of Suffolk Road Enterprise Park and onto the rear of a row of residential properties on Queen Anne's Road. The dominant species is cypress, with the occasional Corsican pine and one sycamore.

6.2.6 Of the low quality category C arboricultural features identified for removal, seven are trees, and 11 are tree groups and one hedge. Within an area located to the east of Kingsgate Community Centre, situated between Queen Anne's Road, Suffolk Road and William Adams Way the arboricultural features in this location include T6, T7, G16, G19 and G20. South of William Adams Way, the group of trees G15 are also identified for removal. The two trees T6 and T7 are young rowan trees in good structural and physiological condition. These two trees are growing along the boundary to the community centre. Within close proximity, on the edge of a plot of land of apparent scrubland (with no access), a group of semi-mature, multi-stemmed goat willow (G19) in good physiological and fair structural condition can be found. On the opposite edge of this plot of land, alongside William Adams Way, is tree group G20, consisting of ash and willow in fair physiological and structural condition. From this plot of land, running along the northern edge of William Adams Way eastwards towards Harfrey's roundabout is tree group G16 consisting of semi-mature willow, ash and birch of fair structural and physiological condition. Opposite tree group G16, on the south side of William Adams Way, is the location of G15, a semi-mature group of trees consisting of ash, sycamore and hawthorn. The sycamore has multiple stems ranging from 75 to 300mm.

6.2.7 To the west, using Suffolk Road Enterprise Park as a landmark, arboricultural features located in the area between Suffolk Road, Cromwell Road, Southtown Road and Queen Ann's Road include T20, T21, T22, T23, G24, G25, and G28. Tree T20 is a young sycamore in poor structural and physiological condition, located on the pavement edge near the entrance road to Suffolk Road Enterprise Park. Just inside the Suffolk Road Enterprise Park entrance, two poplars (G25) show signs of historical pruning and are in poor structural and physiological condition. On a plot of land to the

south-eastern corner of the Enterprise Park, visible through a fence, is the location of a palm tree (T23) in good structural and physiological condition.

6.2.8 To the north side of the Enterprise Park, within a private residential car park, a group of early mature cypress trees (G24) in fair structural and physiological condition are growing in an area with restricted growth. On exiting this car park, an inaccessible apple tree (T22) in fair structural and physiological condition is located along Cromwell Road.

6.2.9 South of the Enterprise Park, in the area that is located within the vicinity of Suffolk Road, Queen Anne's Road, Southtown Road, and William Adams Way, the arboricultural features identified for removal include T19, T21, G28, G31, G32, G33, G34, and H1. Tree T21 is a palm tree in good structural and physiological condition, located in the frontage of a residential property on Queen Anne's Road. The group G28 is a long strip of trees along the northern edge of William Adams Way, surveyed from a position of safety. Tree group G28 consists of a mixture of semi-mature native broadleaves, namely ash, alder, sycamore, birch and goat willow in fair structural and physiological condition. It was noted that some trees within this group contained dense ivy. The most western section of this tree group is likely to be retained. All other arboricultural features are located on the south side of William Adams Way.

6.2.10 Set back from the road, an early mature hedge (H1) consists of mostly hawthorn with some hazel in good structural and physiological condition. Between this hedge and the road are T19 and G31. Tree T19 is a semi-mature, multi-stemmed (at 0.5m) lime tree in good structural and physiological condition. The group of trees (G31) consists of predominantly early mature ash with an alder and sycamore, all in good structural and physiological condition. Moving east along William Adams Way, the next group of trees (G32) is a group of early mature sycamore in fair structural and good physiological condition. After this is a group of early mature poplar (G33) in good structural and physiological condition, and finally, a group of young sycamore (G34) in fair structural and good physiological condition.

6.3 Tree Pruning Requirements

6.3.1 Due to the nature, extent and design stage of the Scheme it has not been possible to identify whether any individual trees or branches will need to be pruned. Any requirement for such work will generally only become apparent once a contractor has been appointed and spatial working requirements are known during detailed design.

6.3.2 The requirement for a schedule of pruning work is therefore included as part of an Arboricultural Method Statement in Annex A of this report and shall also detail a process to deal with any ad-hoc tree work requirements that may arise during the construction of the Scheme.

6.4 Soft Landscaping Areas to be Protected

6.4.1 This Scheme would include hard and soft landscaping in locations known as requiring mitigation for identified environmental effects, and to enhance the setting of the Scheme so that is fully integrated into the wider townscape. The proposals are shown on Landscaping Plans (document reference 2.9).

6.4.2 It is the case that the use of heavy construction machinery can damage the structure of soils thereby making them an unsuitable medium within which to plant trees and shrubs. Preventing damage to soils is possible by ensuring that areas are fenced off and out of bounds to construction activities or by ensuring that topsoil is stripped, stored and subsequently replaced once construction is completed. In some instances, it may also be possible to use areas for certain activities during construction and then mitigate any damage using a programme of suitable cultivation and soil improvement works.

6.4.3 Areas identified for structural landscape planting are identified in Landscaping Plans (document reference 2.9). Although within the boundary of the Scheme, it is not possible at this stage to identify whether they require protection as the land-use requirements of the contractor are unknown. Only once the land-uses associated with construction of the Scheme have been determined can a decision be made as to whether landscaping areas should be protected or whether other methods such as soil stripping or remediation can be reasonably undertaken. The approach to landscaping should be submitted to the county planning authority by the undertaker for approval in writing, following consultation with GYBC, as secured by the draft DCO (document reference 3.1) under Requirement 6.

6.4.4 To meet the recommended standards outlined in Section 6.1 of BS 5837:2012 (Ref 8H.1), the provisions of information relating to the protection of retained trees within future tree planting areas shall be included in an Arboricultural Method Statement to be submitted for approval prior to commencement of works, as prescribed in the Outline CoCP (document reference 6.16). The soft-landscaping section of Annex A below outlines an approach to be considered within an Arboricultural Method Statement.

6.5 Potential Arboricultural Impacts

Arboricultural Features to be Removed

6.5.1 Arboricultural features identified for removal are of moderate B to low C categories. The B category arboricultural features include T15, G22 and G26. Arboricultural features T15 and G22 are located close to the Application Site boundary and contribute to the screening of Southtown Common. Tree group G26 currently provides screening between residential properties and Suffolk Road Enterprise Park.

6.5.2 These moderate quality trees should be regarded as having sufficient value to have material consideration through the planning process within this Scheme.

6.5.3 All remaining arboricultural features which will be removed in whole, or in part, are low quality features. These lack any special significance either arboriculturally, culturally or as prominent landscape features.

Potentially Damaging Activities

6.5.4 Work carried within the Application Site will need to take into account arboricultural features that are identified for retention and that fall within the 15m buffer. In the process of delivering this Scheme, there may be potentially damaging activities to these arboricultural features. It is possible to avoid adverse impacts to tree roots through the exclusion of construction activities from within root protection areas. Appropriate protection measures to be considered in an Arboricultural Method Statement are outlined in Annex A of this document.

6.5.5 Damaging activities may occur through the following activities:

- Excavation;
- Soil levelling changes; and
- Soil compaction.

Mitigation Planting

6.5.6 The Scheme includes Landscaping Plans (document reference 2.9), to be secured through the provision of a landscaping scheme. This includes partial replacement of arboricultural features to be removed through new tree and shrub planting. These measures will provide longer-term mitigation for these impacts insofar as once established, new planting will have the capacity to effectively replace any low-quality hedging or tree groups which may be lost.

6.5.7 For category B moderate quality arboricultural features, although it is possible to mitigate for the loss of these arboricultural features, it is not possible to secure trees of the same standard within one lifetime. There will be some short-term residual adverse effects associated with the loss of moderate quality trees. However, the introduction of new feature trees into the local area has the potential to mitigate this loss over the medium to long term, i.e. once they become established, start to mature, and attain a reasonable size.

6.5.8 For low quality category C arboricultural features, the proposed landscape mitigation planting has the potential to mitigate this loss in the short term, particularly in cases where the mitigation planting is achieved in advance of

proposed tree removal. The loss of these trees, tree groups and hedgerows will therefore have little impact on the overall quality and extent of the baseline tree population nor will it adversely impact on the overall character of the local landscape.

6.6 Tree Protection Plan

6.6.1 The above and below ground constraints associated with retained arboricultural features are identified in the Tree Protection Plans (Figures 8H.3 to 8H.10). These account for the physical and physiological requirements of each tree, tree group, wooded area and hedge and include their root protection area, crown spread and stem location.

6.6.2 All tree protection measures have been specified by a suitably qualified and experienced arboriculturist, and are fit for the purpose of excluding construction activities from the root protection areas and canopies of retained trees.

6.6.3 Additional specification relating to the proposed tree protection measures for the trees on the Tree Protection Plan is included in Annex A of this report.

6.7 Arboricultural Method Statement

6.7.1 As outlined in Section 6.1 of BS 5837:2012 (Ref 8H.1), an Arboricultural Method Statement should adopt a precautionary approach to tree protection and should address any activities which have the potential to cause damage to retained trees.

6.7.2 Due to the Scheme currently being at design stage, the type, location and extent of the tree protection measures which will be required to safeguard retained trees is based on current available information. This information has been used to inform an outline Arboricultural Method Statement. Once more detailed design information becomes available and the contractor's working requirements are known, the outline Arboricultural Method Statement may need updating.

6.7.3 For the purposes of this report an outline Arboricultural Method Statement has been compiled and is included within **Annex A**. This outline method statement describes in principle the tree protection measures which have been identified as suitable for the Scheme at this stage. A more refined and accurate Arboricultural Method Statement will be required to support the detailed design and construction phases. The detailed Arboricultural Method Statement will be submitted for approval prior to commencement of works, as prescribed in the Outline CoCP (document reference 6.16

7 References

Ref 8H.1: The British Standards Institute (2012). BS5837:2012 Trees in relation to design, demolition and construction – Recommendations, London: BSI Standards Limited.

Ref 8H.2: UK Parliament (1990). Town and Country Planning Act 1990, Norwich: TSO.

Ref 8H.3: Ministry of Housing, Communities & Local Government (2014). Guidance: Conserving and enhancing the historic environment - What is a conservation area? [Online].

Ref 8H.4: Ministry of Housing, Communities & Local Government (2019). National Planning Policy Framework, London: HM Stationary Office.

Ref 8H.5: Department for Transport (2014). National Policy Statement for National Networks. National Policy Statement for National Networks, London: HM Stationary Office.

Ref 8H.6: Forestry Commission and Natural England (2018) Ancient Woodland and Veteran Trees: Protecting them from Development [Online].

Ref 8H.7: Great Yarmouth Borough Council (2019). Great Yarmouth Borough Council: Conservation Areas [Online].

Ref 8H.8: Woodland Trust (2018). Ancient Tree Inventory [Online].

Ref 8H.9: Defra (2018). MAGIC: Interactive mapping at your fingertips [Online].

Ref 8H.10: Mattheck, C. & Breoler, H. (2006). The body language of trees, Norwich: The Stationary Office.

Ref 8H.11: The British Standards Institute (2010). BS 3998:2010 Tree work - Recommendations, London: BSI.

Ref 8H.12: NHBC (2019). National House Building Council Standards [Online].

Ref 8H.13: UK Parliament (1997). The Hedgerow Act 1997, Norwich: TSO.

Annex A – Arboricultural Method Statement

Purpose

A.1.1 The purpose of this Arboricultural Method Statement is to provide a summary of the tree protection measures which must be adopted in order to ensure the sustainable preservation of retained trees. The measures described are deemed to be appropriate given the scale, intensity and proximity of development to nearby trees.

Tree Surgery

A.1.3 Once design for the Scheme has been confirmed all tree pruning work shall adhere to British Standard BS 3998:2010 (Ref 8H.11) paragraphs 7.2.4, 7.2.5, Table 1 and Figure 2.

A.1.4 The statutory protection afforded by the Wildlife and Countryside Act 1981 (Amended) and Countryside and Rights of Way Act 2000 (Amended) will also be adhered to. Where there is evidence that bats or nesting birds are present then specialist advice will be obtained prior to the commencement of work.

A.1.5 All operations shall be carefully carried out to avoid damage to the trees being treated or neighbouring trees. No trees to be retained shall be used for anchorage or winching purposes.

A.1.6 Should the requirement for a tree felling or pruning arise then the following process shall be applied:

- Any specification shall be technically approved by an arboriculturist; and
- Written approval shall be obtained from the Local Planning Authority prior to implementation of the work.

Clay Soils

A.1.7 The presence of a clay element within the soil is significant in terms of both tree protection and foundation design. Clay soils can experience substantial volume changes when vegetation extracts moisture from the ground, and they are also prone to compaction when wet. On this basis it is essential that all recommended tree protection measures are implemented in full and are not relaxed at any point throughout the normal course of delivering this scheme. Any foundations should also be designed in accordance with the recommendations contained within Chapter 4.2 of the National House Building Council Standards (2019) (Ref 8H.12) and should account for the possibility of both subsidence and heave.

Tree Protection Fencing

Purpose

A.1.8 To protect retained trees including their stems, crowns, rooting areas and the soil within which they grow.

General Requirements

A.1.9 Tree protection fencing should be specified by an arboriculturist.

A.1.10 Tree protection fencing will be used to prevent access to the root protection areas of retained trees. In all instances the following specification will be strictly adhered to:

- The area to the rear of the tree protection fencing shall be considered to form a Construction Exclusion Zone. No construction activities, storage of materials, or pedestrian or vehicular access shall take place within this area;
- All-weather notices will be attached to the tree protection fencing at suitable intervals and shall include suitably sized informative text containing the following statement ‘Tree Protection Fencing – Construction Exclusion Zone – No Access’; and
- Regular daily checks will be carried out by an appointed person to ensure that all tree protection fencing is still in place and functioning; any damage will be rectified without delay.

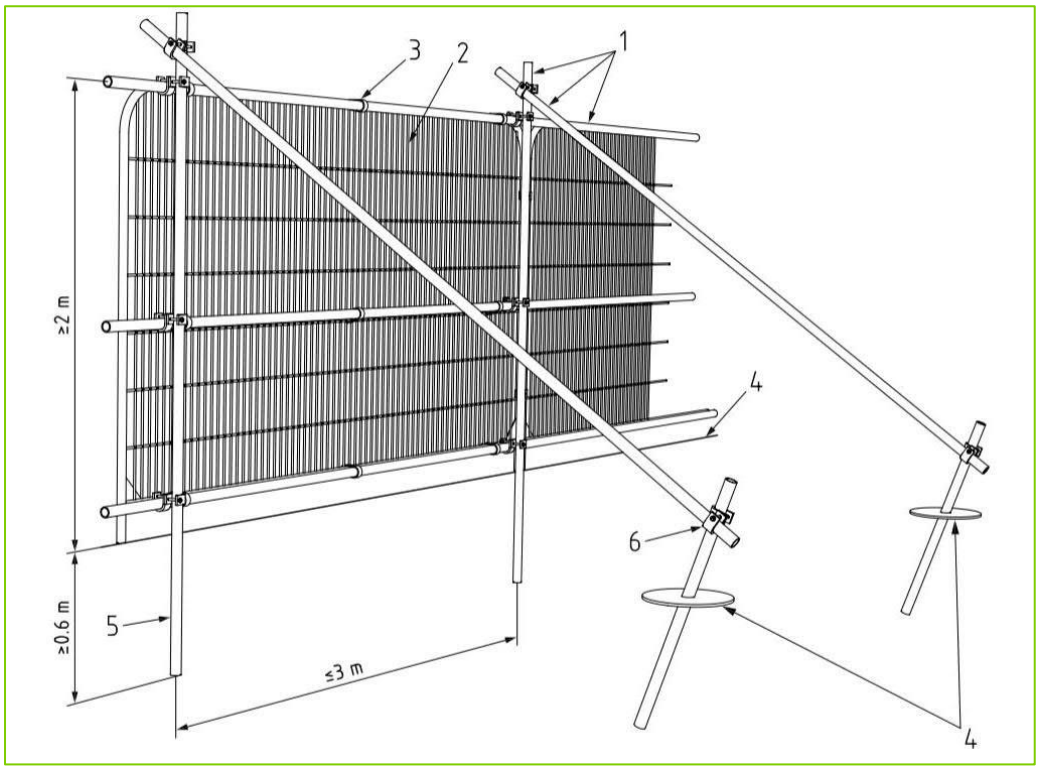
Timing

- Tree protective fencing shall be erected prior to any works onsite including site clearance, ground work, or the importation of plant and materials; and
- Once erected tree protection fencing shall remain in-situ until all construction activities are complete.

Specification for Fencing

- Tree protection fencing shall be fit for the purpose of excluding construction activity and appropriate for the degree and proximity of work taking place. An example of the type of tree protection fencing which may be required is included in Plate 8H.1.

Plate A1.1: Default Specification for Tree Protection Fencing



Key:

1. Standard scaffold poles.
2. Heavy gauge 2m tall galvanised tube and welded mesh infill panels.
3. Panels secured to uprights and cross-members with wire ties.
4. Ground level.
5. Uprights driven into the ground until secure (minimum depth 0.6m).
6. Standard scaffold clamps.

Ground Protection

Purpose

A.1.11 To provide construction access within root protection areas whilst preventing access to underlying soil and roots.

General Requirements

A.1.12 Ground protection shall be employed within the root protection areas shown on the Tree Protection Plan(s) (Figures 8H.3 to 8H.10). In all instances the following specification will be strictly adhered to:

- Unless otherwise stated within this report ground protection shall remain in-situ until all construction activities are complete.

- Regular daily checks will be carried out by an appointed person to ensure that ground protection is still in place and functioning; any damage will be rectified without delay.

Timing

A.1.13 Ground protection shall be in-situ prior to any works onsite including demolition, ground work or the importation of plant and materials.

Specification

A.1.14 Ground protection shall be sufficiently robust to prevent damage or disturbance of the underlying soil. In order to accord with BS 5837:2012 (Ref 8H.1) ground protection shall comply with the following specification.

Areas of Unmade Ground

A.1.15 For pedestrian only access ground protection measures shall include a single thickness of scaffold boards placed on top of 100mm depth of compression resistant material (e.g. woodchip) laid onto a geotextile membrane.

A.1.16 For pedestrian activities and plant up to 2 tonnes in weight proprietary interlinked ground protection boards will be used and placed on top of 150mm depth of compression resistant material (e.g. woodchip) laid onto a geotextile membrane.

A.1.17 For wheeled or tracked equipment exceeding 2 tonnes in weight a structural engineer will design an alternative system. This may include the use of temporary cellular confinement systems, reinforced concrete slabs or track board systems details of which are to be approved before construction commences.

Areas of Existing Hard Surfacing

A.1.18 Areas of existing hard surfacing identified for use as ground protection shall not be removed during site clearance and shall be retained throughout the construction period.

A.1.19 Areas of existing hard surfacing shall be assessed by an engineer to ensure that they are sufficient to prevent damage or disturbance to the underlying soil. A precautionary approach to any anticipated loadings should be adopted.

A.1.20 In instances where the engineer identifies existing surfacing as inadequate then a specification for additional protection must be provided and any requirements actioned onsite.

Precautions outside Construction Exclusion Zone

A.1.21 In all instances the following tree protection measures will be adopted during any site clearance or construction activities undertaken immediately outside, or in proximity to, the root protection area of any retained tree:

- Oil, bitumen, cement or other material likely to be injurious to a tree will not be stored or mixed within 10m of any stem unless contained within a bunded structure. Concrete mixing will not be carried out within 10m of a tree unless undertaken within a bunded container. Any spillage shall be immediately reported to the project arboriculturist who will determine what mitigation is required.

- Fires will not be lit nearer than five metres from the limit of any crown spread; will be down-wind of any tree and will be prevented from becoming so large as to cause damage to any nearby tree.

- Notice boards, telephone cables or other services will not be attached to any part of any tree. Trees to be retained will not be used as anchors for equipment used to remove stumps, roots, other trees or for any other purposes.

- Care will be exercised when using cranes or similar equipment near the spread of the canopy of a tree.

- It is essential that allowance be made for the slope of the ground so that damaging materials such as concrete washings, mortar or diesel oil cannot run towards trees.

Soft-Landscaping Operations

Purpose

A.1.22 To avoid damage to trees during the implementation of soft landscaping activities.

Design

A.1.23 The root protection areas of retained trees are identified on the Tree Protection Plans (Figures 8H.3 to 8H.10). All soft landscaping activities will conform to the following specification where they take place within the root protection area of any retained tree.

Timing

A.1.24 No works will be carried out if the soil moisture is of a level likely to allow compaction to occur.

Specification

General Requirements

A.1.25 Only pedestrian operated machinery up to a gross weight of 50kg shall be used.

A.1.25 All pedestrian operated machinery shall utilise low ground pressure tyres.

A.1.26 Landscaping works shall be undertaken out only when the soil is dry and friable and soil moisture is at a level whereby compaction is unlikely to occur.

Soil Preparation

A.1.27 Herbicide applications shall be restricted to the use of translocated products such as glyphosate. These will be applied according to the manufacturer's instructions and drift onto non-target plants avoided.

A.1.28 Existing vegetation will be removed by hand. Turf may be removed using a mechanical turf stripper where necessary.

A.1.29 Compacted areas of soil will be broken up by using hand tools only.

A.1.30 There shall be no excavation or lowering of soil levels.

A.1.31 Depressions may be levelled through infilling with a maximum depth of 150mm of loosely compressed good quality topsoil or other porous material.

Grass Seeding, Wildflower Seeding and Turfing

A.1.32 Soil shall be cultivated to a depth of no more than 25mm.

Planting

A.1.33 Bare root seedlings, transplants, whips and feathered trees shall be notch planted.

A.1.34 Container grown shrubs, feathered trees, and standard trees shall be planted into individual pits.

A.1.35 In no circumstances shall planting take place into cultivated beds or trenches.

A.1.36 All planting pits shall be excavated with due care for underlying tree roots and using hand tools only.

A.1.37 In instances where tree roots are found within the planting pit then roots less than 25mm in diameter may be severed using a sharp tool such as a saw or secateurs. The cut should be as small as possible and must avoid leaving a ragged end. Roots over 25mm diameter may only be cut on the advice of an

arboriculturist. If roots over 50mm are encountered, or groups of roots over 25mm, then the planting pit will be backfilled and moved to an alternative location.

Annex B – Arboricultural Survey Schedule

Table B1.1: BS 5837: 2012 Arboricultural Survey Schedule Explanatory Notes

Key:					
Reference Number:	Individual reference number				
Type:	T - Tree	G - Group	W - Woodland	H - Hedge	
Species:	Species listed by common name				
Height:	Overall height (m)				
Diameter:	Stem diameter (mm) calculated in accordance with BS 5837:2012 paragraph 4.6.1. An average stem diameter is provided for groups, woodlands and hedges. * Denotes an estimated stem diameter				
No. of Stems:	Number of stems (individual trees only)				
N, E, S, W:	Crown spread taken at each cardinal point (m)				
LCH:	Lowest crown height (m)				
LBH:	Height of lowest significant branch (m)				
Age Class:	Young: < 1/3rd estimated life expectancy	Semi-mature: 1/3rd to 2/3rd estimated life expectancy	Mature: > 2/3rd estimated life expectancy	Veteran: a tree which exists significantly beyond its normal life expectancy	
Physiological Condition:	Good	Fair	Poor	Dead	
Structural Condition:	Good	Fair	Poor		
Estimated Remaining Contribution:	>10 years	10+ years	20+ years	40+ years	
Category:	BS 5837:2012 Category: A, B, C, U	BS 5837:2012 Sub-category: 1, 2, 3			
RPA Radius:	The radius of the circular root protection area associated with the tree as measured from the centre of the stem (m).				

Table B1.2: BS 5837: 2012 Arboricultural Survey Schedule

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
72	T	Lombardy Poplar	15			700			3	2	2	2	5	2	Mature (Late)	Good	Fair	10+	C	2	-	8	221.7			RET
62	T	Poplar	18			610			4	4	6	6	2	4	Mature (Late)	Fair	Fair	10+	C	2	-	7	168.4			RET
33	T	Raywood Ash	6			200			3	4	3	0	1	1	Mature (Early)	Good	Fair	20+	B	2	Competing for light with the cherries, resulting in tree increasingly leaning	2	18.1		TPO	RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
12	T	Weeping Willow	24			760			7	7	7	7	2	4	Mature (Late)	Good	Good	40+	A	1	Between A and B cat. Very nice specimen of weeping willow. Crack going from floor to 1m above ground. Some graffiti.	9	261.3			RET
34	T	Cherry	8			390			5	4	1	4	1	2	Mature (Early)	Good	Good	20+	B	2	-	5	68.8		TPO	RET
39	T	Sycamore	8			230			2	2	2	2	2	2	Mature (Early)	Fair	Good	20+	B	2	Leaves fallen. couldn't properly assess whether sycamore or silver maple.	3	23.9			RET
77	T	Poplar	7			700			2	2	3	3	2	2	Mature (Late)	Fair	Poor	10+	C	2	Appears pollarded	8	221.7			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
71	T	Whitebeam	7			145			2	3	2	2	2	2	Semi-Mature	Fair	Fair	10+	B	2	-	2	9.5			RET
78	T	Poplar	7			700			2	2	3	3	2	2	Mature (Late)	Fair	Poor	10+	C	3	David Bellamy conservation award tree	8	221.7			RET
63	T	Poplar	8			290			4	2	2	4	2	2	Mature (Early)	Fair	Fair	10+	C	2	Lean at about 30 degrees posing danger to adjacent trailer in adverse weather conditions	3	38.1			RET
17	T	Lombardy Poplar	23			760			2	2	2	2	5	3	Mature (Late)	Good	Good	10+	B	2	-	9	261.3			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
53	T	Ash	7			200			3	3	3	3	2	3	Semi-Mature	Good	Good	10+	C	2	-	2	18.1			RET
16	T	Lombardy Poplar	23			760			2	2	2	2	5	3	Mature (Late)	Good	Good	10+	B	2	-	9	261.3			RET
21	T	Other/Unknown	6			260			1	1	1	1	3	3	Mature (Early)	Good	Good	10+	C	1	Palm tree	3	30.6			REM
70	T	Poplar	15			500			3	3	2	3	3	3	Mature (Late)	Good	Fair	10+	C	2	No proper leader	6	113.1			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
5	T	Weeping Willow	11			670			6	7	7	4	2	1	Mature (Late)	Good	Good	20+	A	3	A prominent tree sites within a vet's car park. Signs of previous management. Side of tree overhanging fence line is competing with other vegetation	8	203.1	Notable		RET
4	T	Sweet Chestnut	7			750	750	750	2	2	2	2	0	0	Semi-Mature	Good	Good	10+	C	2	Multi stem tree in road verge.	9	254.5			RET
75	T	Lombardy Poplar	15			700			3	2	2	2	5	2	Mature (Late)	Good	Fair	10+	C	2	-	8	221.7			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
61	T	Poplar	16			560			4	4	6	6	2	4	Mature (Early)	Fair	Fair	10+	C	2	-	7	141.9			RET
8	T	Beech	12			360			4	4	4	4	2	3	Mature (Early)	Good	Good	20+	B	2	-	4	58.6			RET
64	T	Poplar	18			690			6	5	7	6	3	4	Mature (Late)	Fair	Fair	10+	C	2	-	8	215.4			RET
7	T	Rowan	4			105			1	1	1	1	1	1	Young	Good	Good	10+	C	2	-	1	5.0			REM
24	T	Sycamore	7			220			2	2	2	1	0	0	Mature (Early)	Fair	Fair	10+	B	2	On raised walkway, growing out of concrete	3	21.9			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
30	T	Unknown	5			190			3	2	3	1	1	1	Mature (Early)	Good	Poor	10+	C	2	Trunk of tree growing into metal fence and girdling telegraph pole	2	16.3			RET
9	T	Beech	12			360			4	4	4	4	2	3	Mature (Early)	Good	Good	20+	B	2	-	4	58.6			RET
37	T	Sycamore	8			200			2	2	2	2	2	2	Mature (Early)	Fair	Good	20+	B	2	Leaves fallen. Couldn't properly assess whether sycamore or silver maple.	2	18.1			RET
50	T	Cherry	6			370			3	3	3	3	1	2	Mature (Early)	Good	Good	20+	B	2	-	4	61.9		Conservation Area	RET
19	T	Lime	7			630	27	41	4	6	4	5	1	1	Semi-Mature	Good	Good	10+	C	2	Multi stem from 0.5m	8	179.6			REM

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
59	T	Whitebeam	11			400			4	4	4	4	4	2	Mature (Early)	Good	Good	20+	B	2	-	5	72.4		Conservation Area	RET
32	T	Cherry	8			310			1	3	4	4	1	1	Mature (Early)	Good	Good	20+	B	2	Diameter measured at 1m due to low branching	4	43.5		TPO	RET
36	T	Cherry	8			370			4	4	3	4	2	2	Mature (Early)	Good	Good	20+	B	2	-	4	61.9		TPO	RET
47	T	Silver Maple	12			380			6	3	5	4	5	4	Mature (Early)	Good	Good	20+	B	2	-	5	65.3			RET
27	T	Sycamore	6			250			3	3	3	1	0	0	Mature (Early)	Fair	Fair	10+	B	2	Epicormic growths	3	28.3			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
43	T	Sycamore	13			460			3	3	3	3	4	3	Mature (Late)	Good	Fair	20+	B	1	-	6	95.7			RET
52	T	Whitebeam	6			400			2	2	2	2	2	2	Mature (Early)	Good	Good	20+	B	2	-	5	72.4		Conservation Area	RET
29	T	Laburnum	5			260			0	2	1	2	2	1	Semi-Mature	Fair	Poor	10+	C	2	Signs of recent construction of concrete base within root protection area	3	30.6			RET
67	T	Poplar	12			470			6	9	1	4	2	3	Mature (Late)	Fair	Fair	10+	C	2	-	6	99.9			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
31	T	Cherry	7			200			2	2	2	2	3	3	Young	Good	Good	10+	C	0	Growing in confined space behind fence, no access for measurements	2	18.1			RET
28	T	Sycamore	9			350			3	3	3	1	3	3	Mature (Early)	Fair	Fair	10+	B	2	-	4	55.4			RET
76	T	Poplar	15			500			3	3	2	3	3	3	Mature (Late)	Good	Fair	10+	C	2	No proper leader	6	113.1			RET
10	T	Beech	12			360			4	4	4	4	2	3	Mature (Early)	Good	Good	20+	B	2	-	4	58.6			RET
38	T	Raywood Ash	6			200			5	5	5	4	1	2	Mature (Early)	Good	Good	20+	B	2	-	2	18.1		TPO	RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
14	T	Poplar	20			470			4	2	4	4	4	4	Mature (Late)	Good	Good	10+	B	0	-	6	99.9			RET
49	T	Sycamore	9			340			4	4	4	4	5	2	Mature (Early)	Fair	Fair	20+	B	1	-	4	52.3			RET
35	T	Sycamore	8			250			3	3	3	4	2	2	Mature (Early)	Fair	Fair	20+	B	1	Minor dead wood. TPO No.7 2005	3	28.3		TPO	RET
54	T	Corsican Pine	16			500			3	3	3	3	4	5	Mature (Late)	Good	Good	20+	B	2	-	6	113.1		Conservation Area	RET
55	T	Ash	9			310			3	3	3	3	2	3	Semi-Mature	Good	Good	10+	C	2	-	4	43.5			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
58	T	Unknown	5			170			2	2	2	2	2	2	Semi-Mature	Good	Good	10+	B	2	Ornamental minor dead branches	2	13.1		Conservation Area	RET
26	T	Hawthorn	8			300			2	2	2	2	2	1	Mature (Late)	Fair	Fair	20+	B	1	Previously managed. Growing in private property.	4	40.7			RET
23	T	Other/Unknown	6			260			1	1	1	1	3	3	Mature (Early)	Good	Good	10+	C	1	Palm tree	3	30.6			REM
22	T	Apple	6			210			2	2	2	2	0	0	Mature (Early)	Fair	Fair	10+	C	2	Fruiting. Ivy infested no access to measure diameter.	3	20.0			REM
74	T	Poplar	15			500			3	3	2	3	3	3	Mature (Late)	Good	Fair	10+	C	2	No proper leader	6	113.1			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
44	T	Sycamore	17			620			5	5	6	6	4	4	Mature (Late)	Good	Good	10+	B	2	-	7	173.9			RET
41	T	Whitebeam	5			200			1	1	1	1	3	2	Semi-Mature	Fair	Good	10+	C	2	-	2	18.1			RET
42	T	Sycamore	14			510			5	5	5	5	4	2	Mature (Late)	Fair	Fair	20+	B	1	-	6	117.7			RET
45	T	Birch	12			210			2	2	3	2	4	4	Mature (Early)	Good	Good	10+	C	2	Epicormic shoots at 1.5m	3	20.0		Conservation Area	RET
56	T	Ash	7			200			3	3	3	3	2	3	Semi-Mature	Good	Good	10+	C	2	-	2	18.1			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
25	T	Eucalyptus	12			230			1	2	1	1	3	3	Mature (Early)	Fair	Poor	10+	C	2	Notify council about phone line and potential trunk breakage due to horizontal depression in trunk	3	23.9			RET
18	T	Lombardy Poplar	23			760			2	2	2	2	5	3	Mature (Late)	Good	Good	10+	B	2	-	9	261.3			RET
66	T	Poplar	12			470			4	9	6	6	2	3	Mature (Late)	Fair	Fair	10+	C	2	-	6	99.9			RET
69	T	Lombardy Poplar	15			700			3	2	2	2	5	2	Mature (Late)	Good	Fair	10+	C	2	-	8	221.7			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
6	T	Rowan	4			110			1	1	1	1	1	1	Young	Good	Good	10+	C	2	-	1	5.5			REM
46	T	Sycamore	8			300			4	4	4	4	5	2	Mature (Early)	Poor	Fair	20+	B	1	-	4	40.7			RET
11	T	Willow	26			1010			6	6	6	6	2	2	Mature (Late)	Good	Good	20+	B	2	Could be A cat. Very nice willow	12	461.5			RET
20	T	Sycamore	4			100			1	1	1	1	0	0	Young	Poor	Poor	10+	C	2	Growing in metal fence line	1	4.5			REM
60	T	Unknown	5			170			2	2	2	2	2	2	Semi-Mature	Good	Good	10+	B	2	Ornamental minor dead branches	2	13.1		Conservation Area	RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
65	T	Poplar	8			290			4	2	2	4	2	2	Mature (Early)	Fair	Fair	10+	C	2	Lean at about 30 degrees posing danger to adjacent trailer in adverse weather conditions	3	38.1			RET
68	T	Lombardy Poplar	15			700			3	2	2	2	5	2	Mature (Late)	Good	Fair	10+	C	2	-	8	221.7			RET
13	T	Lombardy Poplar	23			810			3	3	3	3	5	3	Mature (Late)	Good	Good	10+	B	2	-	10	296.9			RET
73	T	Cypress	14			250	210	350	3	3	3	3	0	0	Mature (Late)	Good	Fair	10+	C	2	Multi stemmed	3	28.3			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
40	T	Cherry	6			190			2	2	2	2	2	2	Young	Good	Good	10+	C	1	-	2	16.3			RET
48	T	Birch	14			300			2	2	3	2	4	4	Mature (Early)	Good	Good	10+	C	2	Signs of previous management to remove lower branching	4	40.7		Conservation Area	RET
57	T	Whitebeam	6			290			2	2	2	2	2	3	Mature (Early)	Good	Good	20+	B	2	-	3	38.1		Conservation Area	RET
51	T	Scots Pine	9			200			2	2	2	2	3	4	Young	Good	Good	20+	B	2	Two stems	2	18.1		Conservation Area	RET
15	T	Sweet Chestnut	8			410			3	3	3	3	0	0	Mature (Late)	Good	Good	20+	B	2	-	5	76.1			REM

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
25	G	Poplar	16			450			5	5	5	5	0	2	Mature (Late)	Poor	Poor	10+	C	2	2 poorly managed popular with major wounds from historical pruning and cracks	5	91.6			REM
49	G	Rowan	5			200			1	1	1	1	2	2	Semi-Mature	Fair	Good	10+	B	2	-	2	18.1			RET
17	G	Cypress	9			200			2	2	2	2	0	0	Mature (Early)	Good	Good	10+	C	2	-	2	18.1			RET
5	G	Willow	7			75			1	1	1	1	0	0	Young	Good	Good	10+	C	2	In a floodplain, no access to survey safely	1	2.5			RET
50	G	Rowan	5			230			1	1	1	1	0	0	Semi-Mature	Good	Fair	10+	C	2	-	3	23.9			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
42	G	Elder	3			80			1	1	1	1	0	0	Mature (Late)	Fair	Fair	10+	C	1	3 trees on car park boundary, previously coppiced	1	2.9		Conservation Area	RET
40	G	Sycamore	14			350			5	5	6	6	2	3	Mature (Early)	Fair	Fair	20+	B	2	Previously pollarded. Within a conservation area. Poor growing conditions (tarmac). No access (fencing)	4	55.4		Conservation Area	RET
32	G	Sycamore	7			200			3	3	3	3	1	1	Mature (Early)	Good	Fair	10+	C	2	-	2	18.1			REM
11	G	See Notes	5	0	9	200	0	200	1	1	1	1	0	0	Semi-Mature	Fair	Fair	10+	C	2	Mix of native species including willow, goat willow, some alder, birch and shrub species.	2	18.1			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
52	G	Poplar	17			500	45	50	3	3	3	3	3	3	Mature (Late)	Good	Good	10+	C	2	-	6	113.1			RET
6	W	See Notes	16			350			4	4	4	4	0	0	Mature (Late)	Good	Good	20+	B	2	Woodland. Part of parkland. mix of native woodland broadleaf species. (ash, birch, cherry, poplar)	4	55.4			RET
10	G	Ash	12	0	13	250	75	250	2	2	2	2	0	0	Mature (Early)	Fair	Fair	10+	C	2	Mainly ash and goat willow. No access due to high barbed wire fencing. Goes along a ditch containing water.	3	28.3			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
7	W	See Notes	5			200			2	2	2	2	0	0	Semi-Mature	Good	Good	10+	C	2	Mixture of species including ash and sycamore, horse chestnut, oak and willow	2	18.1			RET
41	G	Sycamore	9			310			3	3	3	3	3	2	Mature (Early)	Fair	Fair	10+	C	1	No access. Group also contains hawthorn and elder.	4	43.5			RET
34	G	Sycamore	6			200	15	200	2	2	2	2	2	2	Young	Good	Fair	10+	C	2	No access - barbed wire	2	18.1			REM
29	G	Sycamore	4			75			1	1	1	1	0	0	Young	Fair	Fair	10+	C	2	Sycamore coppice. Appear to be opportunistic on patch of waste ground	1	2.5			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
43	G	Elder	4			90			1	1	1	1	0	0	Mature (Late)	Fair	Fair	10+	C	1	3 trees on car park boundary, previously coppiced	1	3.7		Conservation Area	RET
47	G	See Notes	5			150			1	1	1	1	2	1	Young	Good	Good	10+	C	2	Trees look good. Mix of cherry and copper beech and ornamental shrubs.	2	10.2			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
28	G	See Notes	14	0	16	200	75	300	2	2	2	2	0	0	Semi-Mature	Fair	Fair	10+	C	2	Partial removal of western section. Mixture of native broadleaves, namely ash, alder, sycamore, birch, goat willow. No access due to narrow verge. Surveyed from bridge and other side of road. Heavy ivy infestation on some trees.	2	18.1			RET
4	W	See Notes	5			200			2	2	2	2	0	0	Semi-Mature	Good	Good	10+	C	2	Mixture of species including ash and sycamore, horse chestnut, oak and willow	2	18.1			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
46	G	Maple	4	4	5	150	120	190	2	2	2	2	2	2	Young	Good	Good	10+	C	2	Norway Maple and cherry mix	2	10.2			RET
8	G	See Notes	13	0	14	250	75	300	2	2	2	2	0	0	Semi-Mature	Good	Good	10+	C	2	No access due to storage containers on one side and highway on other. Predominantly birch trees, some goat willow and alder.	3	28.3			RET
37	G	Willow	3	0	3	100	0	100	1	1	1	1	0	0	Young	Good	Fair	10+	C	2	Willow sighted behind a hawthorn hedge. Rowan individual	1	4.5			RET
36	G	Sycamore	16			600	250	650	4	4	4	4	1	1	Mature (Late)	Good	Fair	20+	B	2	Multiple stems, some growing in braces. previously pruned. No access	7	162.9			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
18	G	Willow	7			150			2	2	2	2	0	0	Semi-Mature	Fair	Fair	10+	C	2	Willow and goat willow lining a ditch	2	10.2			RET
39	G	Sycamore	6	3	7	200	110	320	2	2	2	2	3	3	Semi-Mature	Fair	Fair	10+	C	2	Sycamore and white beam. White beam C, sycamore B/C	2	18.1		TPO	RET
1	G	Cherry	8	0	8	200	75	465	2	2	2	2	0	0	Young	Good	Fair	10+	C	2	Dominant species is cherry, second dominant goat willow. Other species include willow, alder, oak, hawthorn	2	18.1			RET
38	G	Poplar	12	6	12	200	220	430	4	4	4	4	2	2	Mature (Early)	Good	Fair	10+	C	2	Slight lean towards highway	2	18.1		TPO	RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
33	G	Lombardy Poplar	16			450			2				0	0	Mature (Early)	Good	Good	10+	C	2	Lombardy, sycamore undergrowth, young ash	5	91.6			REM
27	G	Holly	5			210			2	2	2	2	2	1	Mature (Early)	Good	Good	20+	B	2	Row of holly	3	20.0			RET
23	G	Cypress	9	8	9	500	300	500	5	5	5	5	2	0	Mature (Late)	Fair	Fair	10+	C	2	Group of 4 trees growing against a brick wall on edge of private car park	6	113.1			RET
20	G	Ash	8	0	12	200	75	200	2	2	2	2	0	0	Semi-Mature	Fair	Fair	10+	C	2	No access - verge too narrow and water on other side. Mixture of ash and willow and shrub species.	2	18.1			REM

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
12	G	Other/Unknown	4			170			1	1	1	1	2	2	Young	Good	Good	10+	C	2	No access as in the centre of a busy roundabout	2	13.1			RET
51	G	Poplar	17			500	45	50	3	3	3	3	3	3	Mature (Late)	Good	Good	10+	C	2	-	6	113.1			RET
14	W	Poplar	15			490			4	4	4	4	2	3	Mature (Late)	Good	Good	10+	C	2	-	6	108.6			RET
44	G	Elder	4			90			1	1	1	1	0	0	Mature (Late)	Fair	Fair	10+	C	1	3 trees on car park boundary, previously coppiced	1	3.7		Conservation Area	RET
45	G	Poplar	8			250	180	310	3	2	2	2	2	2	Semi-Mature	Fair	Fair	10+	C	2	Leaning	3	28.3			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
26	G	Cypress	16			550			3	3	3	3	1	0	Mature (Late)	Fair	Fair	10+	B	2	A line of unmanaged trees consisting of cypress as dominant also Corsican pine, sycamore (1)	7	136.9			REM
9	G	See Notes	12	0	12	250	75	250	1	1	1	1	0	0	Semi-Mature	Fair	Fair	10+	C	2	Mixed natives - namely goat willow, birch, poplar. No direct access as barbed fencing on one side and highway on the other.	3	28.3			RET
24	G	Cypress	9			330			3	3	0	3	2	2	Mature (Early)	Fair	Fair	<10	C	2	Growing in a tree coffin against a wall with no space for branches to grow on one side	4	49.3			REM

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
22	G	Alder	10			400			4	2	2	2	1	2	Mature (Early)	Good	Good	20+	B	2	Partial removal likely	5	72.4			RET
21	G	See Notes	16			435			6	6	6	6	0	0	Mature (Early)	Good	Good	20+	B	2	Holly, sycamore, oak trees. elder bush	5	85.6			RET
15	G	See Notes	5			200			2	3	3	3	0	0	Semi-Mature	Fair	Fair	10+	C	2	Mixture of ash sycamore hawthorn. Sycamore has multiple stems ranging from 75 to 300mm	2	18.1			REM
35	G	Alder	7			100			1	1	1	1	2	1	Young	Fair	Fair	10+	C	2	No access to council property.	1	4.5			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
19	G	Goat Willow	3			75	0	75	1	1	1	1	0	0	Semi-Mature	Good	Fair	10+	C	2	No access. Multi stemmed	1	2.5			REM
13	W	Hawthorn	5			100	75	120	2	2	2	2	0	0	Semi-Mature	Good	Good	10+	C	2	Two ash individuals (350 mm)	1	4.5			RET
16	G	Willow	5	0		200	7.5		2	2	2	2	0	0	Semi-Mature	Fair	Fair	10+	C	2	Mixture of willow ash, birch with understory of dog wood and rosehips. Surveyed from opposite side of road - a place of safety	2	18.1			REM
31	G	Ash	6	0	6	300	0	310	2	3	2	2	0	0	Mature (Early)	Good	Good	10+	C	2	Ash and one alder and sycamore	4	40.7			REM

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
30	G	Cypress	7			250			2	2	2	2	0	0	Young	Good	Good	10+	C	1	Surrounded by tarmac	3	28.3			RET
48	G	Unknown	5			110			1	1	1	1	0	0	Semi-Mature	Fair	Fair	10+	C	2	-	1	5.5			RET
3	G	See Notes	9	0	10	75	75	200	1	1	1	1	0	0	Semi-Mature	Good	Good	10+	C	2	Species include goat willow, hazel, sycamore, oak, hawthorn, birch,	1	2.5			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
2	G	See Notes	7	0	8	75	75	350	1	1	1	1	0	0	Mature (Early)	Fair	Fair	10+	C	2	Mix of native species including birch, alder, beech, willow, hazel coppice, cherry, Rowan, hawthorn. Only surveyed from paved area of layby due to safety, remaining section was extrapolated from a drive by.	1	2.5			RET
1	H	Hawthorn	4			120			1	1	1	1	0	0	Mature (Early)	Good	Good	10+	C	2	Hedge mostly hawthorn some hazel	1	6.5			REM
3	H	Cypress	4			75			1	1	1	1	0	0	Mature (Early)	Good	Good	20+	B	2	-	1	2.5			RET

Tree No	Type	Species	Height (m)	Minimum Height (m)	Maximum Height (m)	Stem Diameter (mm)	Minimum Diameter (mm)	Maximum Diameter (mm)	N	E	S	W	LCH	LBH	Age Class	Physiological Condition	Structural Condition	Estimated Remaining Contribution	Category	Sub-Category	Notes and Preliminary Management Recommendations	RPA Radius (m)	RPA Area (m^2)	Statutory Status	Environmental Status	Retain/Remove
2	H	Cypress	4			75			1	1	1	1	0	0	Mature (Early)	Good	Good	20+	B	2	-	1	2.5			RET

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 8I: Benthic and Fish Ecology Report

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ("APFP")

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Great Yarmouth Third River Crossing — Benthic Survey

WSP

APEM Ref: P00002732

March 2019

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Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1.0	06.02.2019 – 01.03.2019	All	All	Document Creation	CA, SP, TW
1.1	01.03.2019	All	All	Review	DH
2.0	28/03/2019	Figure 1	4	Figure replaced with updated Order Limits	CA
2.0	28/03/2019	Figure 6	17	Figure replaced with updated Order Limits	CA
2.0	28/03/2019	Figure 7	20	Figure replaced with updated Order Limits	CA
2.0	28/03/2019	Figure 10	28	Figure replaced with updated Order Limits	CA
2.0	28/03/2019	3.1.4	5	Opening paragraph added to detail consultations on survey design	CA
2.0	28/03/2019	3.1.6	5	Changes made to clarify how constraints were mitigated	CA
2.0	28/03/2019	3.1.10	9	Changes made to explain that the delay to sample sieving is unlikely to have any effect on the sample integrity	CA
2.0	08/04/2019	3.1.3	3	Potential for R02 to fall within the impact area discussed.	CA
2.0	08/04/2019	4.3	16	Potential for R02 to fall within the impact area discussed.	CA
2.0	08/04/2019	All	All	Review of all changes made under v2.0	DH

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1. Executive Summary

The biology of a section of the Yare estuary, downstream of Great Yarmouth was characterized by an environmental survey, completed in January 2019, as part of an environmental impact assessment for a proposed crossing (the Scheme). The survey included *in situ* records, grab samples, wall scrapes, quadrats and trawls.

The habitats in the footprint of the Scheme comprised a narrow marine inlet bounded by artificial walls, with shallow clay and mixed sediment in the bed of the inlet. The mid intertidal region of the walls was colonised by fucoid barnacle mosaics typical of moderate exposure shores. The subtidal sediments included oligochaete and cirratulid communities of varying richness, grading into mixed substratum habitats with barnacles and other epibiota.

Trawl samples recorded mainly brown shrimp, with lower numbers of gobies, shore crabs and mysids and occasional commercially important flatfish. No rare or declining species were found.

Several non-native species were recorded, including large numbers of the barnacle *Austrominius modestus* and a northward range extension for the Manila clam (*Ruditapes philippinarum*).

It is recommended that the Scheme ensures that there is no restriction of passage for migratory fish and that care is taken to avoid transport of sediment and other materials, which may assist the spread of non-native species, from the site to areas outside the estuary.

2. Introduction

2.1 Background

APEM Ltd. was commissioned to undertake a series of marine ecology site characterisation surveys to provide a robust dataset to inform an Environmental Impact Assessment for proposed infrastructure developments at Great Yarmouth. This report presents intertidal and subtidal environmental data obtained from the survey conducted in January 2019.

2.2 Survey objectives

The primary objective of the survey was to provide a robust biological baseline data set and to characterise the subtidal and intertidal benthic communities in the region of the River Yare that may be impacted by the developments. Data on certain physicochemical parameters were also collected in order to help interpret the biological communities but contaminant data were not acquired as these were collected under a different element of the overall scope of works associated with the Scheme. Surveys were conducted using industry standard, repeatable methodologies to ensure comparability with studies elsewhere or future studies in the region. Benthic macrobiota communities were assessed through grab sampling, whilst larger epibenthic invertebrates and fish were assessed from trawl samples. Intertidal fouling communities on the walls were examined through quadrats and wall scrape samples. Samples were analysed to provide data on the flora and fauna, sediment types and habitats within the study area.

3. Methodology

3.1 Survey methods

3.1.1 Health and Safety

Prior to mobilisation, APEM reviewed the Health & Safety (H&S) requirements of the benthic ecology surveys for the Scheme in conjunction with the vessel suppliers. Appropriate Risk Assessments were undertaken and accompanying method statements were produced prior to commencement of the surveys. All survey staff were made aware of the Risk Assessments, appropriate PPE, COSHH forms, incident handling and reporting procedures, responsibilities, contact details and staff details, including training and certification. A Dynamic Field Risk Assessment form was used to update risks as necessary throughout the survey. The purpose of the Dynamic Risk Assessment form was to cover any risks perceived on-site that were not covered by the original assessment or that had been introduced since the production of the assessment (e.g. due to changes in weather conditions). For this survey this included covering the additional risks of the snow that occurred during the survey period.

At the start of each working day, a Tool-Box Talk was held in which details of the day's survey operations were discussed and Health and Safety aspects reiterated, including any information that introduced additional H&S concerns for that day (e.g. weather conditions, passing vessels, access to wall, trawl and grab haulage). At the end of the survey day, a wrap up meeting was also held during which any issues encountered could be highlighted and discussed. All surveyors had the power to issue a 'Stop the Job' order if they deemed that continued operations may introduce a H&S risk. Surveyors were likewise encouraged to highlight any concerns to the ship's captain or other qualified person at the earliest opportunity.

3.1.2 Biosecurity

The potential for spreading non-native species was assessed in the risk assessment for this work and suggested biosecurity measures were implemented following this review.

Rigorous biosecurity measures were employed throughout the survey work. All survey equipment had been cleaned and thoroughly dried following its previous use. Prior to deployment in this survey, it was checked to ensure that it was clean. Following use in this survey, it was likewise cleaned and left to dry.

At each wall sampling site, the community was assessed prior to sampling to investigate the potential presence of non-native species. When the wall samples were taken, particular care was taken to ensure that these were taken in such a manner that they did not pose a risk of accidental spread (e.g. through fragmentation of macroalgae).

3.1.3 Survey design

To establish a comprehensive baseline, sampling was undertaken in all major habitats present within the immediate footprint of the Scheme.

In order to sample benthic communities and sediments, six benthic grab stations were established in the primary impact area for the Scheme. These impact stations were termed G01-G06. For comparative purposes, two reference grab stations were also established (RG01 and RG02), one upstream and one downstream of the Scheme, respectively.

The wall fouling communities were assessed at four stations within the primary impact area (S01-S04) and two reference sites (RS01 and RS02). The walls were assessed at upper shore level in the algal zone.

To gain an understanding of the potential use of the estuary by fish and of epifaunal invertebrates, four trawl stations were established: two parallel trawls within the primary impact area, and two reference sites, one upstream and one downstream of The Scheme.

The distribution of sampling stations is shown in Figure 1, with further detail of those in the primary impact area shown in Figure 6. All sampling positions are provided in Appendix 2 .

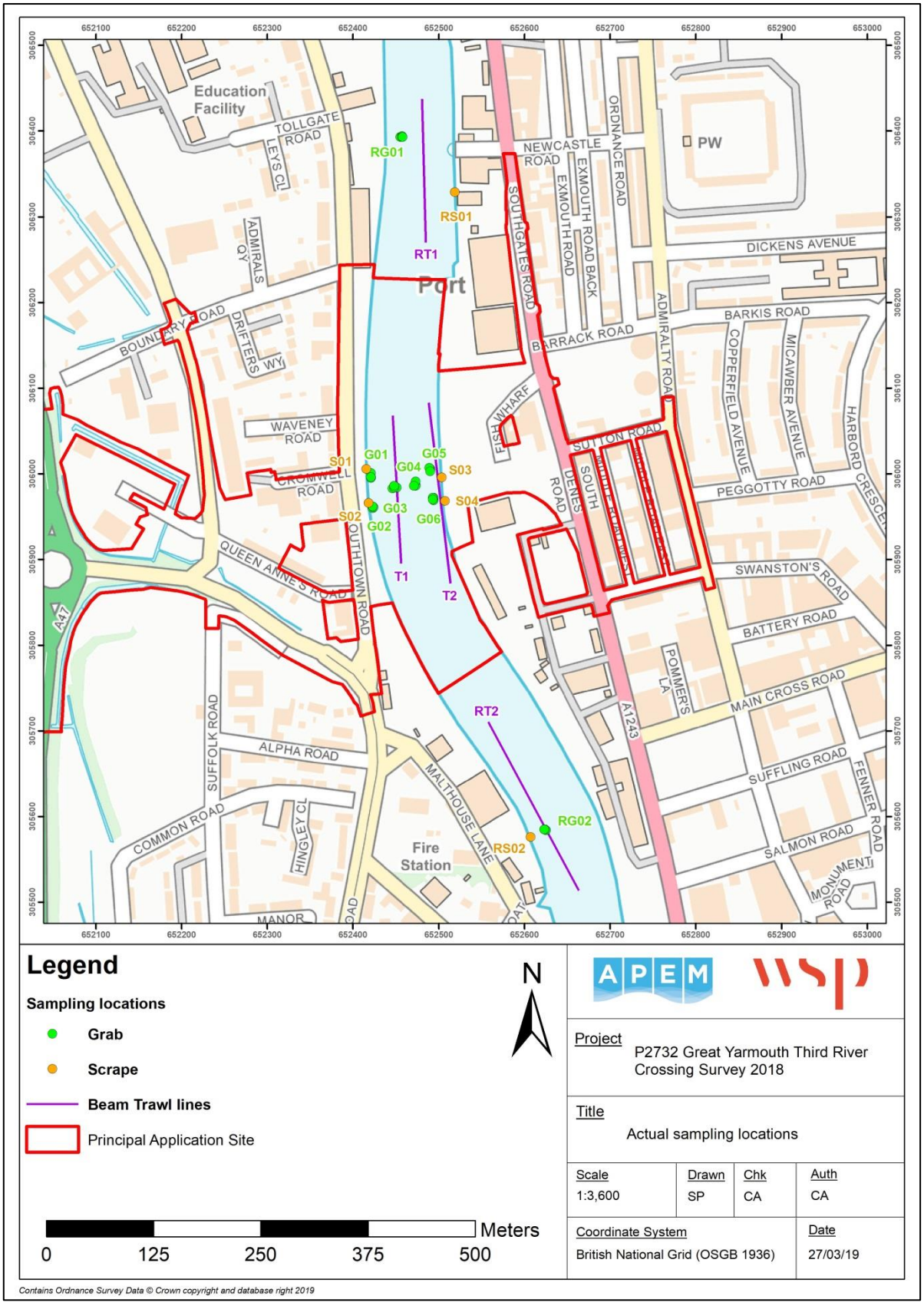

Figure 1. Distribution of all sampling stations at Great Yarmouth

3.1.4 Survey permissions and notifications

Prior to the survey the Environment Agency (EA), Natural England (NE) and the Marine Management Organisation (MMO) were consulted over the proposed survey design and sampling methodologies. Comments received by them were incorporated into the sampling design or field protocols where necessary.

A number of permissions and notifications were required before sampling occurred.

A dispensation for the use of an undersized trawl mesh (for Council Regulation 850/98 use of undersized nets) and for the retention of undersized fish was obtained from the Marine Management Organisation (MMO) and a letter of derogation was obtained from the Eastern Inshore Fisheries Commission (Eastern IFCA). As a condition of their agreement, the Eastern IFCA requested that a copy of the trawl data be made available to them. An FR2 form (application for authorisation to use fishing instruments other than rod and line in England) was also submitted to the Environment Agency (EA), although, since the trawl sampling was not intending to catch any freshwater fish this was regarded by the EA as for notification only. The benthic sampling works were exempt from a MMO Marine Licence.

Notification was made to the Statutory Harbour Authority (Peel Ports) prior to the survey; they issued and disseminated a Notice to Mariners detailing the planned survey activities.

3.1.5 Survey timings

The survey was conducted on 30th and 31st January 2019. These dates were chosen to coincide with vessel availability and suitable neap tides, providing increased duration of slack water in an effort to minimise the impact of water currents on the sampling operations (see also Section 3.1.6 – Survey constraints). The tide times for each survey day are provided in Table 1 below.

Table 1. Tide times for the survey dates

Date	Time (GMT)	Tidal Height (m)
30/01/2019	04:24	4.48
	10:57	1.04
	17:17	2.29
	23:22	1.26
31/01/2019	05:40	2.47
	12:05	1.09
	18:19	2.36
	-	-

3.1.6 Survey constraints

The main constraints of the surveys related to the tides which had the potential to affect the surveys in three main ways.

Since the river channel is highly modified and there is a large amount of freshwater flow, the water currents in the channel are very strong. This had the potential to drag the grab during deployment which could mean it wouldn't strike the riverbed squarely, leading to inadequate

samples or a misfire. To mitigate this and maximise the potential for the survey to be successful, the survey was scheduled for neap tides when the effect of the tide is minimised. However, grab sampling could only be undertaken in the period around slack water, which, in the River Yare, lasts for around 1-1.5 hours either side of the turn of the tide and lasts slightly longer on low tides than high tides due to the water flowing downstream resisting the incoming water. Once the grab started to drift during deployment, sampling was paused until the next slack water period.

Secondly, the strong currents prevent the build-up of finer sediments meaning it was necessary to use a Hamon grab for sampling, which in turn affected the ultimate choice of vessel for the work.

Finally. the tides also limited the period in which wall sampling was possible since the required mid-upper 'shore' level is not permanently accessible.

Prior to the survey, APEM confirmed with the Harbour Master that no vessels had been berthed at any of the berths that required access for wall sampling, or in positions that may have impacted the positioning of grab samples.

On two occasions it was necessary to pause survey operations for a period of approximately 10 minutes each to allow other vessels to pass. During these periods, the survey vessel pulled to the side of the river channel to allow uninterrupted passage by the other vessels.

3.1.7 Survey vessel and position fixing

All survey work was undertaken from the MV Sheerkhan (Figure 2) which is based in Great Yarmouth and owned and operated by Technical Marine Services Ltd.

MV Sheerkhan is a 17.5 m survey vessel with a 45 square meter deck and is classified by the UK Maritime Coastguard Authority to work up to 60 nautical miles offshore (MCA workboat code category 2). She is fitted with a Braden 15 tonne handling winch, a Spencer Carter 1 tonne split trawl winch and a Bonfiglioli 24t/m crane.

Figure 2. The survey vessel MV Sheerkhan used for the survey work. (Image reproduced by kind permission of Technical Marine Services Ltd. ©Technical Marine Services)

To calibrate the onboard dGPS system of the Sheerkhan, readings were compared to a known Ordnance Survey point, to ensure accuracy, and were calibrated in the harbour before leaving.

In order to record the position of the grab being deployed and not the vessel, the offset position of the grab was calculated before leaving port from the dGPS antenna on the wheelhouse bridge to the end of the crane arm when the grab was deployed. A heading output was derived from the dGPS system that provides vessel orientation and the deployment position is calculated using simple trigonometry in real-time at 10Hz using Trimble HydroPRO software. The grab target positions were entered into the dGPS system prior to mobilisation and the vessel (end of crane arm) was steered to these pre-programmed sample positions.

Although there was potential for any non-perpendicularity within the water column from the vessel to affect the actual position of the grab, if this was too great then the grab would not land square with the seabed and would not obtain a valid sample. Furthermore, within the confines of outer channel of the River Yare at Great Yarmouth the water depths are so shallow that the grab did not have the opportunity to drift much. Any deviation from the recorded sampling position was therefore regarded as minimal.

Trawls were deployed over the bow of the vessel using the crane and positions were calculated using a layback technique to work out the position of the trawl relative to the vessel. The position of the trawl was recorded as the start position once it made contact with the seabed and then an end position was recorded once the required distance had been covered and the trawl left the seabed.

3.1.8 Survey staff

Since the tidal conditions in the River Yare limit sampling windows to slack waters and neap tides, a decision was made to deploy additional survey staff than would normally be required for this work. APEM provided two experienced survey staff both of whom were able to act in a 'survey lead' capacity. Technical Marine Services supplied the skipper, a deck hand and a winch operator and CMS-Geotech provided a further deck hand and a hydrographic surveyor who was responsible for position fixing and calculating offset positions. This approach meant that the sampling could be achieved within a tighter survey window (see also Section 3.1.6 Survey Constraints and Section 3.1.10 Grab sampling methods).

3.1.9 Wall sampling methods

The term wall is used here to refer to the boundary of the river channel and refers to any hard substrata including any man-made vertical structures, such as wooden jetty pilings, sheet metal, concrete or brick walls.

At each station, the general community on the wall was photographed, visually described and large, easily identified animals and algae recorded. Three replicate quadrats were used to quantitatively record the macroalgal community and other fouling taxa present. Three wall scrape samples were collected from the algal zone, according to the layout in Figure 3. , and their location recorded using a hand-held GPS in WGS84 format.

At each wall scrape sampling station, a 0.01 m^2 sample was obtained of the biotic community at approximately mid tide level, in accordance with the methodologies described by Worsfold (1998).

Using a 0.01 m^2 sampling device (Figure 4), marine growth was scraped into a bag. Samples were not sieved on board but were transferred to an appropriate container and fixed with 4% buffered formaldehyde solution in seawater. Samples were sieved on return to the laboratory over a 0.5 mm sieve.

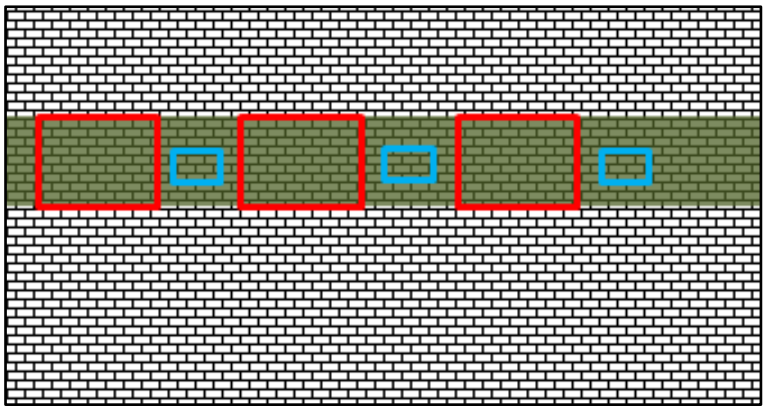

Figure 3. Example section of harbour wall indicating how the quadrat (red squares) and wall scrape samples (blue) were positioned at each station within the algal zone

Figure 4. APEM's wall scrape sampling device

3.1.10 Grab sampling methods

At each grab station, three replicate grab samples were obtained for biological analysis and an additional replicate collected for total organic carbon (TOC) and particle size analysis (PSA) (WFD UKTAG 2014).

All samples were assessed on retrieval for suitability according to standard criteria detailed in Davies *et al*. (2001) and Ware & Kenny (2011). Two grab attempts were rejected at station RG02, one due to a large cobble preventing complete closure of the jaws and the second due to insufficient volume of sediment. The third repeat attempt resulted in a successful sample. All sampling attempts at the other stations were successful.

A station log sheet was maintained providing information on all sampling attempts at each station. For each sampling attempt, the following information was recorded:

- Station number and attempt;
- Volume of the sample;
- Sample position;
- Sample description (visual assessment, with additional notes on smell etc.);
- Time of collection;
- Any obvious or notable taxa observed (e.g. Annex II species);
- Photograph of the unsieved sample.

To partially mitigate the tidal window restrictions a decision was made to not sieve the samples immediately after collection. Instead, each sample was emptied into a large, lidded crate, assessed for suitability, labelled and secured. This meant that the grab could be immediately redeployed to continue the sampling sequence and make best use of the available slack water. Samples were sieved in the periods of the tide when sampling was not possible; all were sieved on the day of collection. The Marine Monitoring Handbook (Davies *et al*., 2001) states

that sieving and preservation must be undertaken within 24 hours of sample collection. As all samples were sieved well within this time period and given the ambient temperature on the survey days (0-2°C) sample integrity was not considered compromised as a result of the delay to the sieving process. This was confirmed at analysis stage as all samples were in good condition with no evidence of degradation.

The entire retrieved grab sample was photographed prior to processing. For the PSA and TOC samples a subsample of 500-1000 ml was removed and transferred to a suitable container and the remainder of the sediment was discarded. For the macrobenthic samples field sample processing was conducted in accordance with the guidance provided in Cooper & Mason (2018), using the following steps.

1. Pour off excess water from the sample over the sieve table;
2. Photograph the sample (with identification label);
3. Measure the sample volume;
4. Wash and sieve the sample on the sieve table over a 0.5 mm mesh;
5. Transfer material to a suitable container and remove biota from the sieve mesh using forceps;
6. Preserve and label (internal and external) the sieved sample.

To facilitate sieving and to prevent damage to smaller, fragile animals, a coarse mesh sieve (5.0 mm) was used above the 0.5 mm sieve to remove any larger material.

All material retained on the sieves was fixed with 4% buffered formaldehyde solution in seawater and placed in sample containers (labelled inside and outside), following guidance in Ware & Kenny (2011) and Davies *et al.* (2001). Once the sieved sample was labelled and preserved, all apparatus and sieves were thoroughly cleaned to prevent cross-contamination before moving to the next station.

3.1.11 Trawl sampling methods

Trawl sampling was conducted at four stations, primarily to characterise larger or highly mobile epibenthos that may not be adequately sampled through grab sampling. The use of a 2m beam trawl may select against larger fish and pelagic species but for sampling epibenthos it is considered the most suitable method (Jennings *et al.*, 1999). To fully characterise fish communities, a larger trawl and regular surveys over an extended period would have been necessary, which were outside the scope of the current surveys. However, the limited fish data that were collected have also been used here.

Only start and end positions were recorded for the trawls and therefore, whilst the sampling location maps (Figure 1, Figure 6) show straight lines between these points, the actual trawl lines for samples T01 and T02 followed the curvature of the channel.

The catch of each trawl was placed into a calibrated container and the net was then checked for any remaining epibiota and fish. Sediment was rinsed away and the approximate total unsorted volume of the catch estimated. The samples were initially cleared of large debris and the total catch photographed. When there were large abundances of a particular species, subsampling was carried out for that species only. All other organisms were counted. Fish were sorted from invertebrates, divided into groups, identified to species level and counted. Fish and commercially important crustaceans were measured to the nearest millimetre using a fish board or callipers, according to the schematic below (Figure 5.).

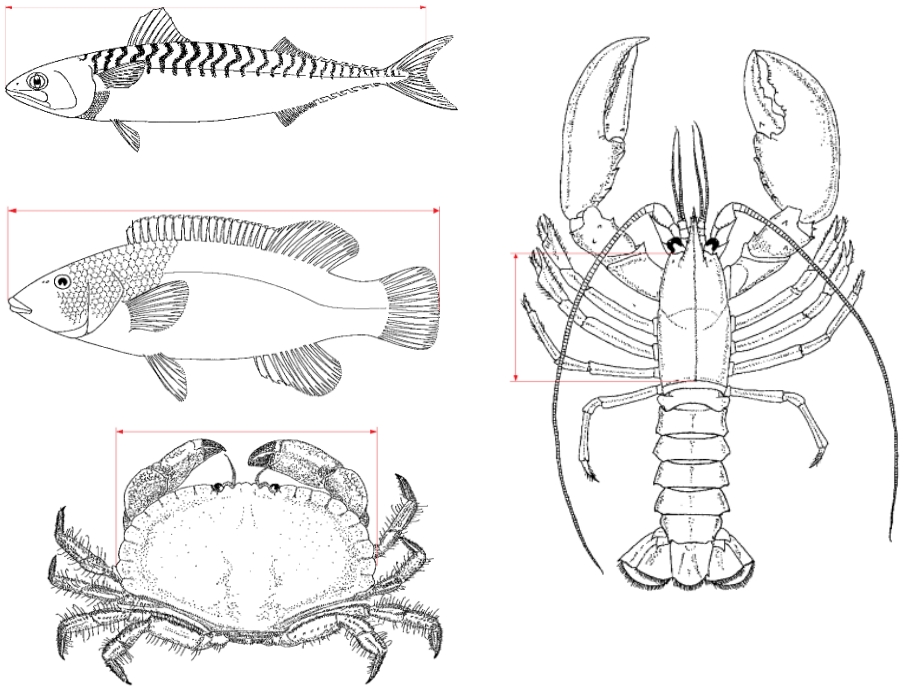

Figure 5. Schematic for points of measurement for concave tailed fish, convex tailed fish and commercially important crustacean species.

3.2 Laboratory methods

3.2.1 Biological samples

Samples were processed according to APEM's standard operating procedure for marine benthic sample analysis and in compliance with the North-east Atlantic Marine Biological Analytical Quality Control (NMBAQC) Scheme's Processing Requirement Protocol (Worsfold *et al.*, 2010).

Benthic grab and wall scrape samples were sieved in a fume cupboard over a 0.5mm mesh in accordance with WFD guidance for benthic sampling in transitional waters (WFD-UKTAG, 2014), to standardise the sizes of organisms. To improve sorting efficiency, the grab samples were also sieved through a stack of 4.0, 2.0, 1.0 and 0.5mm mesh sieves. All biota retained in the sieves were then extracted under low power microscopes, identified and enumerated, where applicable. Due to large volumes of sediment, the 0.5mm fractions were subsampled to ¼ by volume for samples G01A, G02A and G02C using a 'quarteriser' (Proudfoot *et al*., 2003).

Processing of larger species from trawl samples was conducted in the field but some specimens of taxonomically problematic taxa or those requiring microscopic identification were taken to the laboratory for confirmation or identification where required. Due to high volumes of brown shrimp (*Crangon crangon*) in trawls T01 and T02, ¼ subsamples were taken for counting and measurement of specimens. All *C. crangon* samples were returned to the laboratory to allow for accurate measurement and counting. In the laboratory, these trawl samples were also sieved through a stack of sieves with a base mesh of 1.0mm but, due to the mesh used on the trawl itself, the <4mm fractions can only be considered as qualitative.

Taxa were identified to the lowest practicable taxonomic level, using the appropriate literature (Worsfold *et al*., 2018). For certain taxonomic groups (e.g. nemerteans, nematodes, and certain oligochaetes), higher taxonomic levels were used due to the widely acknowledged lack of appropriate identification tools for these groups. Where required, specimens were also compared with material maintained within the laboratory reference collection. Fish and shrimp retained from the trawl samples were measured as described above using callipers. Nomenclature followed the World Register of Marine Species (WoRMS, 2019), except where more recent revisions were known to supersede WoRMS.

At least one lot of each taxon recorded from the surveys was set aside for inclusion in APEM's in-house reference collection. This collection acts as a permanent record of the biota recorded.

All samples were subject to internal quality assurance procedures, whereby the residues and identifications from each sample were secondarily checked by another analyst. To ensure consistency, taxonomic quality control throughout the project was conducted by the same individual. Following analysis, 10% of samples were subject to formal Analytical Quality Control (AQC) to produce pass/fail statistics.

3.2.2 Particle Size Analysis (PSA) and Total Organic Carbon (TOC)

PSA and TOC samples were analysed by Kenneth Pye Associates Limited (KPAL), in accordance with NMBAQC Guidelines for Particle Size Analysis (PSA) for Supporting Biological Analysis (Mason, 2016) to provide data over the complete particle size range allowing determination of the gravel to sand plus mud ratio. Samples were wet separated at 1.0mm to allow sieve analysis of the >1.0mm fractions; all material from the sub-1.0mm fraction was analysed via laser diffraction (size range 0.04µm to 1.0mm).

Total organic carbon (TOC) has been calculated as percentage loss on ignition (LOI). Analysis was performed on the <1 mm wet-separated fractions, which had been previously oven dried at 125 °C. Samples were then transferred to a muffle furnace and incinerated at 550°C for at least one hour, cooled in a desiccator and re-weighed. Data were converted from percentage loss on ignition to TOC using standard conversion factors (Broadbent, 1953).

3.3 Data analysis methods

3.3.1 Macrobiota

Calculation of univariate diversity indices (e.g. numbers of taxa, density, diversity, evenness) and multivariate analyses (e.g. Cluster Analysis, MDS), were carried out using PRIMER version 6.1.15 (Clarke & Warwick, 2001; Clarke & Gorley, 2006).

Before analysis, all data were checked for errors. Summary statistics were calculated and outlying values investigated to identify possible data transcription errors.

Univariate techniques

The DIVERSE component of Primer was used to calculate univariate statistics and diversity indices for each sample. In the interest of consistency, colonial taxa such as bryozoans and hydroids were included when calculating the total number of taxa, but excluded from calculating the total number of individuals and other diversity indices.

Biological diversity within a community was assessed based on taxon richness (total number of taxa present) and evenness (considers relative abundances of different taxa). The following metrics were calculated:

- **Taxon richness (*S*):** The total number of taxa in a sample.
- **Density (*N*):** The number of individuals per unit area (e.g. per square metre).
- **Shannon-Wiener Diversity Index (*H'*(log$_e$):** A widely used measure of diversity accounting for both the number of taxa present and the evenness of distribution of the taxa (Clarke & Warwick, 2001).
- **Margalef's species richness (*d*):** A measure of the number of species present for a given number of individuals.
- **Pielou's Evenness Index (*J'*):** A representation of the uniformity in distribution of individuals spread between species in a sample. The output range is from 0 to 1, with higher values indicating more evenness or more uniform distribution of individuals.
- **Simpson's Dominance Index (1-λ):** A dominance index derived from the probability of picking two individuals from a community at random that are from the same species. Simpson's dominance index ranges from 0 to 1, with higher values representing a more diverse community without dominant taxa.

Multivariate techniques

All multivariate analyses were carried out using PRIMER version 6.1.15 (Clarke & Warwick, 2001; Clarke & Gorley, 2006). Prior to calculation of Bray-Curtis similarity between macrobenthic samples, the data were square-root transformed to reduce right-skewness and down-weight the effects of a small number of numerically dominant taxa (Clarke & Warwick, 2001). The wall scrape data were predominantly composed of non-countable taxa such as algae and therefore, prior to multivariate analyses, the wall scrape abundance data were transformed to presence/absence and Jaccard similarity was used for analysis.

Cluster Analysis

Hierarchical clustering was carried out on a Bray-Curtis similarity matrix of the macrobenthic abundance data in order to visualise the biological similarity between samples. The hierarchical clustering technique compares the abundance of each taxon in each sample, with its abundance in each of the other samples. The result is a matrix of pairwise similarity indices comparing each sample with all other samples. This similarity matrix was then output diagrammatically as a dendrogram. The similarity profile (SIMPROF) test was carried out as part of the clustering routine. This permutational test distinguishes clusters of samples that cannot be statistically differentiated at the 5% significance level and identifies them on the resulting dendrogram using red lines. Black lines on the dendrogram denote samples that are statistically different from one-another at the 5% significance level.

For the wall scrape samples, the taxa were predominantly non-countable species and hierarchical cluster analysis was therefore carried out on a Jaccard similarity matrix calculated from presence/absence data.

Ordination Analyses using non-Metric Multidimensional Scaling

Non-metric multidimensional scaling (NMMDS) is an ordination method which creates a 2- or 3-dimensional 'map' or plot of the samples from the Primer resemblance matrix. The plot generated is a representation of the dissimilarity of the samples (or replicates), with distances between the replicates indicating the extent of the dissimilarity. For example, replicates that are more dissimilar are further apart on the MDS plot. No axes are present on MDS plots, as the scales and orientations of the plots are arbitrary in nature.

Each MDS plot provides a stress value which is a broad-scale indication of the usefulness of plots, with a general guide indicated below (Clarke & Warwick, 2001):

- <0.05 Almost perfect representation of rank similarities;
- 0.05 to <0.1 Good representation;
- 0.1 to <0.2 Still useful;
- 0.2 to <0.3 Should be treated with caution;
- >0.3 Little better than random points.

An MDS plot for the macrobenthic samples was created using the same Bray-Curtis similarity matrix as the hierarchical clustering process described above.

BEST Test

The BEST procedure was carried out on the macrobenthic sample data to test for any relationship between physical and biological data in the samples. This test calculates the measure of agreement between the macrobenthic Bray-Curtis similarity matrix used in the hierarchical clustering and MDS analyses and resemblance matrices generated from different variable subsets of a Euclidean distance matrix of physical variables (Clarke & Gorley, 2006). The results are presented as Spearman rank correlations (ρ).

As part of the routine, a permutational global BEST test was conducted to assess the significance of the results.

AZTI Marine Biotic Index (AMBI)

The AZTI Marine Biotic Index (AMBI) was designed to establish the ecological quality of European coasts (Borja *et al*., 2000) and has been used to assess disturbance with respect to several types of environmental impact, including dredging impacts and sand extraction (Muxika *et al*., 2005). The AMBI value is a biotic coefficient that is calculated with the following formula, based upon the relative proportions of five ecological groups (EG) to which the soft-sediment benthic species are allocated:

AMBI value = [(0 x % EGI) + (1.5 x % EGII) + (3x % EGIII) + (4.5 x % EGIV)

+ (6 x % EGV)]/100

Each species' Ecological Group is classified as below (Grall & Glémarec, 1997):

- EGI: very sensitive to organic enrichment and present under unpolluted conditions.
- EGII: indifferent to enrichment, always present in low densities with non-significant variations with time.
- EGIII: tolerant to excess organic matter enrichment; and may occur under normal

conditions; however, their populations are stimulated by organic enrichment.
- EGIV: Second-order opportunistic species, adapted to slight to pronounced unbalanced conditions.
- EGV: First-order opportunistic species, adapted to pronounced unbalanced situations.

The AMBI value can then be used to derive thresholds of site disturbance based upon the relative proportions each Ecological Groups present (Borja *et al*., 2000; Borja *et al*., 2003).

The mean AMBI value and resulting site disturbance classification calculations were made using AMBI version 5.0 (Borja *et al*., 2012) with the most up to date version of the species list (June 2017). Prior to importing the data into AMBI, some data truncation was required, including the removal of taxa considered as non-soft sediment/non-benthic, epifauna, non-invertebrate taxa and higher taxonomic levels not included in the AMBI species list, as recommended by Borja & Muxika (2005). Full data truncation details are included in Appendix 1 .

3.3.2 Particle Size Analysis

The laser and sieve data were mathematically merged to produce sediment classifications, following Folk (1954) and Blott & Pye (2012) and calculations of particle size summary parameters (percentages of mud, sand, and gravel, silt/clay ratio, sand/mud ratio, mean particle size, sorting, skewness and kurtosis, d10, d90) calculated using GRADISTAT software (Blott & Pye, 2001).

3.3.3 Biotope allocation

The data were further examined to determine the characteristic biota for each sampling station. A list of samples in each SIMPROF group identified during the hierarchical cluster analysis was compiled and the mean number of individuals of each taxon recorded in the samples assigned to each group was calculated. The resulting lists represent, in decreasing order, the numerically dominant taxa. Only the top 20 taxa are presented for each group. Separate listings were created for those taxa that were fully enumerated in the samples and those which were not countable (i.e. colonial taxa such as bryozoa and hydroids). The lists for non-countable taxa therefore represent an average of the number of samples in which each of the taxa occurred, again sorted in decreasing order. The results were then examined in tandem with the particle size data so that a biotope could be assigned following JNCC's National Marine Habitat Classification for Britain and Ireland: Version 04.05 (Connor *et al*., 2004). EUNIS codes corresponding to each biotope are also provided (JNCC 2010; Parry 2015).

4. Results

4.1 Description of site and major habitats

The benthic survey took place in the outer channel (downstream of Breydon Water) of the River Yare, Great Yarmouth, between 52.597176°N 1.7 2665°E upstream and 52.588806°N 1.728716°E downstream. The survey area was euryhaline (salinity variable but generally close to marine values) and tidal throughout. In all surveyed areas, the harbour was bound to both the east and west by artificial construction walls. In most areas, these comprised steel pilings; opposite station R1, the wall material had been recently (within the last 18 months) replaced.

At station R1, the wall comprised wooden beams mounted against a concrete wall. In most areas, the seabed was formed of clay below a sand layer, with variable mixing; at station R2, there was a higher gravel component. Along the walls of the majority of the survey area, large tyre fenders were suspended to provide protection and impact resistance during mooring.

4.2 Survey constraints, incidents, near misses and issues arising

4.2.1 Health and Safety Incidents

There were no incidents, near misses or other issues that require reporting under our Health and Safety procedures.

4.2.2 Access constraints and other issues

Access to the wall of the channel proved challenging due to size of the survey vessel and the presence of large tyre fenders along the entire length of the survey area. In an attempt to overcome this difficulty the vessel was angled perpendicular to the wall with the bow angled to allow access between the fenders. During wall sampling, surveyors were harnessed to a stable attachment point on the deck as an additional safety precaution.

Reference station RS01 was relocated from the east bank target to the opposite bank as the frontage on the East bank has been replaced within the last 18 months (Peter Woods (Skipper of the MV Sheerkahn), pers comm.) and the western bank was considered more comparable to the scrape sites within the proposed development area.

4.3 Samples obtained and processed

Grab sampling was undertaken at 8 stations, with three replicates being collected for macrobenthic analysis and one for particle size analysis at each station.

Wall sampling was completed at 6 stations, with three quadrats analysed *in situ* and three 0.01 m^2 wall scrape samples collected for subsequent laboratory analysis.

Four beam trawl samples were successfully completed: two within the primary impact zone, and two reference stations, one upstream and one downstream of the proposed development area.

As highlighted above (Section 3.1.3), there is a potential that the downstream reference station may ultimately fall within the impact area, dependent on the final placement of the small vessel waiting facility.

Samples collected at each station are listed in

Table 2 below and all sampling positions are provided in Appendix 2 .

Table 2. Samples collected at each sampling station

Sampling location	Samples collected				
	Macrobiota Grabs	PSA	Quadrats	Wall Scrape	Epibenthic / Fish Trawl
G01	✓ ✓ ✓	✓			
G02	✓ ✓ ✓	✓			
G03	✓ ✓ ✓	✓			
G04	✓ ✓ ✓	✓			
G05	✓ ✓ ✓	✓			
G06	✓ ✓ ✓	✓			
RG01	✓ ✓ ✓	✓			
RG02	✓ ✓ ✓	✓			
S01			✓ ✓ ✓	✓ ✓ ✓	
S02			✓ ✓ ✓	✓ ✓ ✓	
S03			✓ ✓ ✓	✓ ✓ ✓	
S04			✓ ✓ ✓	✓ ✓ ✓	
RS01			✓ ✓ ✓	✓ ✓ ✓	
RS02			✓ ✓ ✓	✓ ✓ ✓	
T01					✓
T02					✓
RT01					✓
RT02					✓
Total Samples	**24**	**8**	**18**	**18**	**4**

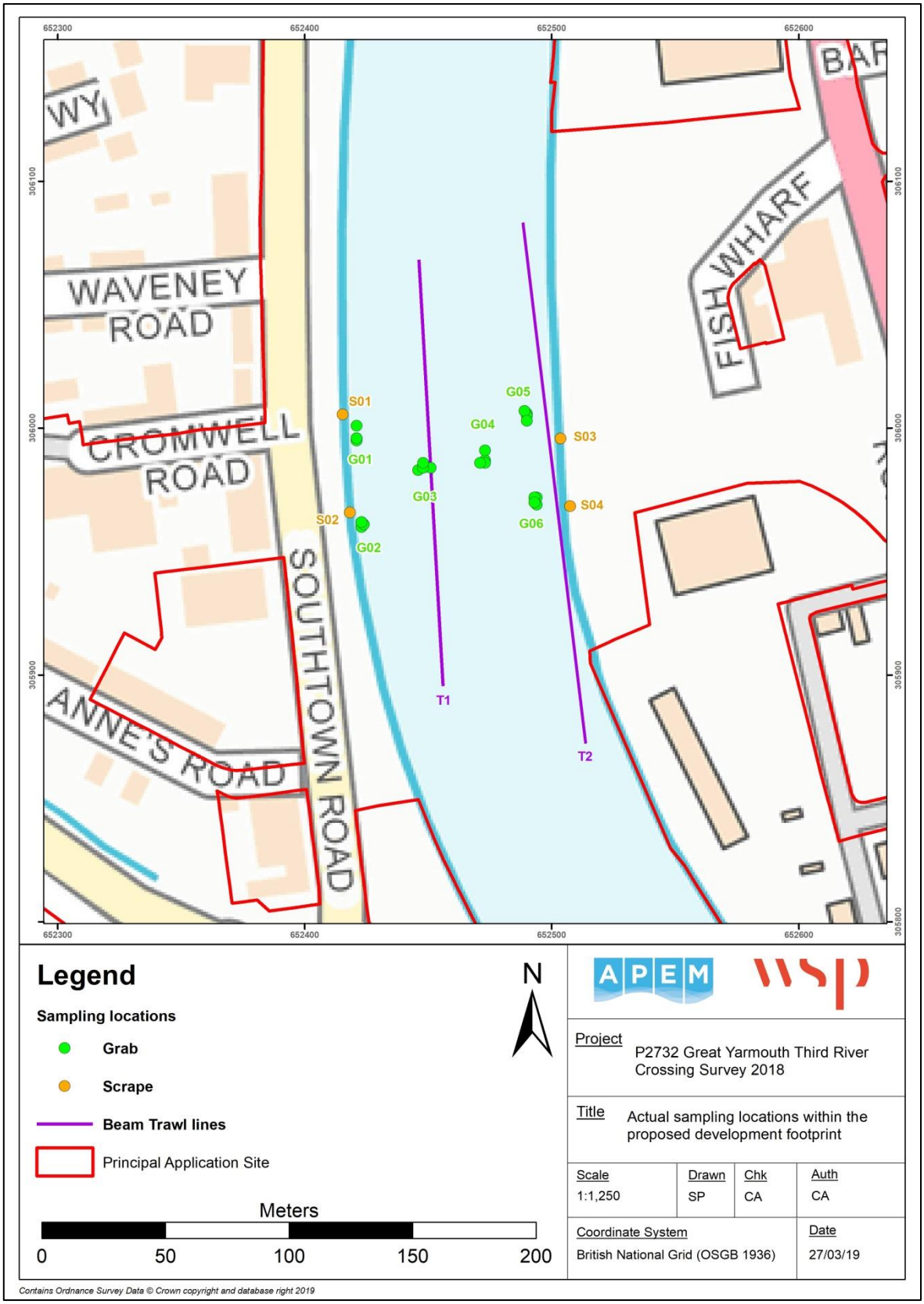

Figure 6. Wall and grab sampling stations within the impact area with positions of all replicates.

4.4 Total Organic Carbon

Percentage total organic carbon (TOC) data, expressed as percentage loss on ignition (LOI), are shown in Table 3 for each station. The values were generally very low at all stations, with five of the stations having values below 1%. The highest recorded value was 7.21% at station G02.

Table 3. Percentage TOC at each subtidal grab station

Station	Loss on ignition (%)
G01	2.10
G02	7.21
G03	0.87
G04	0.35
G05	0.31
G06	0.40
RG01	0.33
RG02	1.04

4.5 Particle Size Analysis

Full PSA data for the subtidal sediments are presented in Appendix 3 whilst summary data are given in Table 4. Proportions of mud, sand and gravel at each station are mapped in Figure 7.

The PSA data show that there was a degree of variability in sediment types across the survey area. Stations G01 and G02 had the highest proportions of finer silt and clay fractions, but differed in proportions of coarser sediments, with much higher gravel content at station G02. The more mid-channel stations G03, RG01 and RG02 had the highest proportions of coarse sediments. Stations G04, G05 and G06 were all dominated by sand fractions. Most of the samples ranged from poorly sorted to extremely poorly sorted, with the exception of G05, which had a moderate degree of sorting. Kurtosis results showed stations G02, G03, RG01 and RG02 were platykurtic, indicating a flattened distribution of size fractions, whereas the other stations were leptokurtic or very leptokurtic, indicating that most particles were distributed around the mean size.

Table 4. Summary particle size data from each subtidal grab station

Station	Mean particle diameter (µm)	Gravel (%)	Sand (%)	Mud (%)	Statistics calculated using Folk and Ward (1957) formulae			Classification	
					Sorting	Skewness	Kurtosis	Blott & Pye (2012)	Folk (1954)
G01	69.8	15.4	32.9	51.7	Extremely Poorly Sorted	Coarse Skewed	Leptokurtic	Slightly gravelly sandy mud	Gravelly Mud
G02	240.5	42.2	10.9	47.0	Extremely Poorly Sorted	Coarse Skewed	Very Platykurtic	Slightly sandy gravelly mud	Muddy Gravel
G03	3300.5	54.3	40.5	5.3	Very Poorly Sorted	Fine Skewed	Platykurtic	Slightly muddy sandy gravel	Muddy Sandy Gravel
G04	707.5	15.6	79.8	4.6	Poorly Sorted	Very Coarse Skewed	Very Leptokurtic	Very slightly muddy slightly gravelly sand	Gravelly Sand
G05	419.0	5.6	92.4	2.0	Moderately Sorted	Coarse Skewed	Very Leptokurtic	Very slightly muddy slightly gravelly sand	Gravelly Sand
G06	696.7	16.2	80.3	3.5	Poorly Sorted	Very Coarse Skewed	Very Leptokurtic	Very slightly muddy slightly gravelly sand	Gravelly Sand
RG01	1826.5	43.4	54.9	1.7	Very Poorly Sorted	Very Coarse Skewed	Platykurtic	Very slightly muddy gravelly sand	Sandy Gravel
RG02	1461.2	56.7	19.9	23.3	Extremely Poorly Sorted	Very Fine Skewed	Platykurtic	Slightly sandy muddy gravel	Muddy Gravel

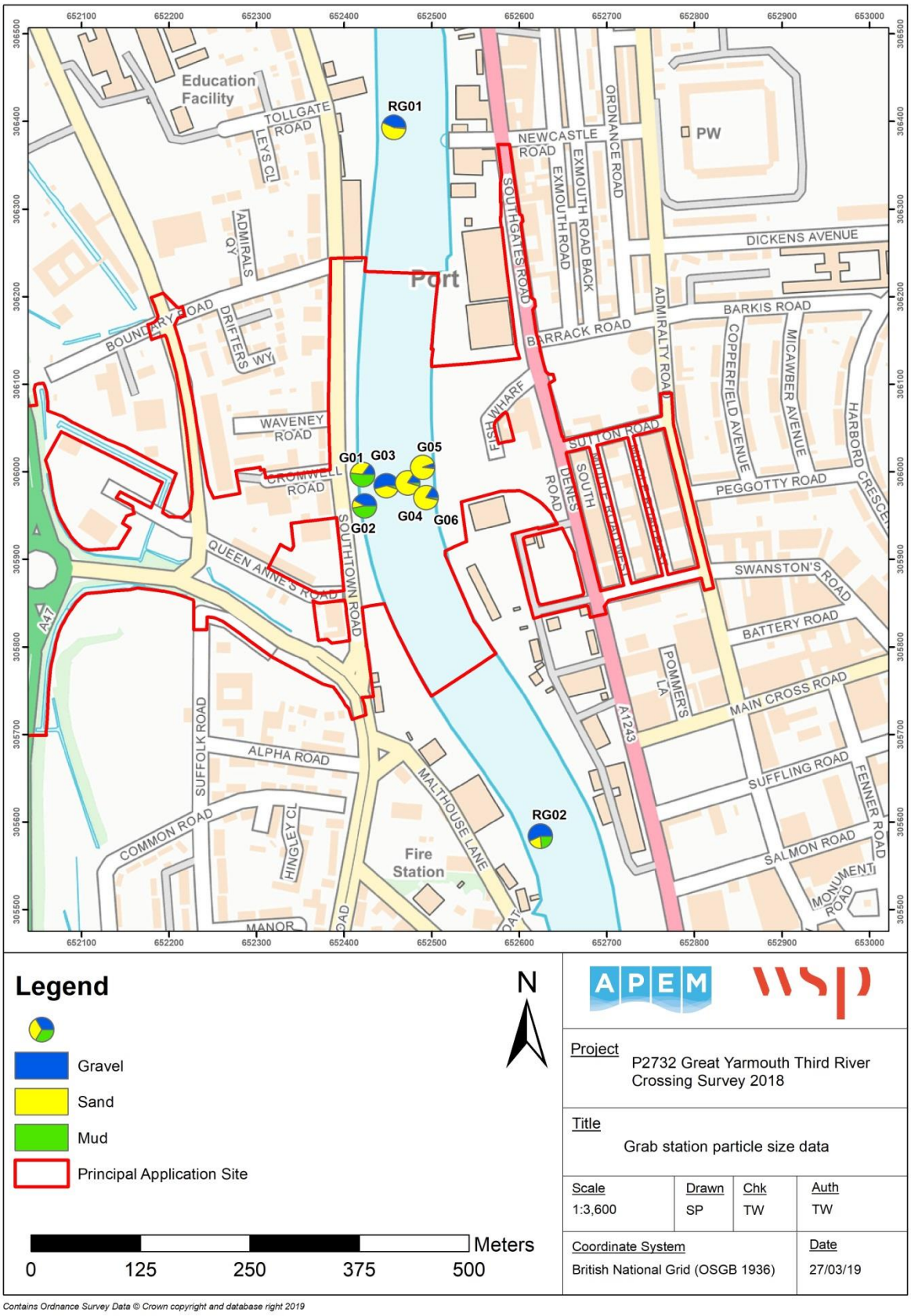

Figure 7. Map showing proportions of mud, sand and gravel at each grab location

4.6 Macrobiota

4.6.1 Benthic Grabs – Univariate Statistics

The complete benthic dataset for the subtidal grab samples is provided in Appendix 3 and photographs of the unsieved grab samples are presented in Appendix 4 . A total of 146 benthic taxa was identified from the 24 analysed subtidal benthic grab samples. Among these, nematodes and juvenile blue mussels (*Mytilus edulis*) were the most frequently recorded taxa, being present in 22 (91.7%) of the samples. Nematodes were also the most abundant taxon recorded, with a total of 580 individuals recorded across the survey, accounting for 13.9% of the total number of countable organisms from the samples. They were most abundant in sample G01A (135 individuals) and G05A (108). Numerically, annelid worms dominated the samples, accounting for 45.5% of counted individuals. Non-countable taxa (e.g. algae, bryozoans, hydroids) accounted for 40 (27.4%) of the taxa.

The univariate diversity indices are presented in

Table 5. Numbers of taxa per sample ranged from a low of 5 in sample G06B to a maximum of 75 in G01A with a mean of 28.5 across the survey. Numbers of individuals per sample ranged from 15, in samples G06C, to 997 in sample G01A, with a mean of 174.38 per 0.1m² across the survey. Margalef's species richness index (*d*) ranged from a low of 1.0, in sample G06B, to a high of 7.82 in sample G01A, with a mean value of 4.12 across the survey. Pieliou's Evenness (*J*') ranged from 0.23, in sample G05A, to 0.91 in sample RG01B, with a mean value of 0.77 across the survey. Shannon-Wiener diversity ($H'\log_e$) ranged from a low of 0.41, in sample G05A, to a high of 3.0 in sample G01A, with a mean value of 2.19. Simpson's dominance index (1- λ) ranged from a minimum of 0.16, at G05A, to a maximum of 0.93 in samples G01A-C, G02B and RG01B, with an average of 0.81 across the survey.

Table 5. Univariate statistics for the subtidal stations

Sample	Number of Taxa	Number of individuals	Density (individuals per m^2)	Margalef's species richness (*d*)	Mean Pielou's Evenness (*J'*)	Mean Shannon Wiener Diversity ($H'(\log_e)$)	Mean Simpson's Dominance (1-λ)
G01A	75	997	9,970	7.82	0.75	3.00	0.93
G01B	45	230	2,300	5.70	0.82	2.86	0.93
G01C	53	401	4,010	7.17	0.78	2.97	0.93
G02A	41	241	2,410	5.29	0.75	2.54	0.85
G02B	52	386	3,860	6.38	0.82	3.00	0.93
G02C	40	234	2,340	5.32	0.82	2.80	0.91
G03A	35	151	1,510	5.18	0.83	2.74	0.92
G03B	36	293	2,930	5.11	0.64	2.17	0.76
G03C	32	124	1,240	5.19	0.84	2.74	0.92
G04A	9	27	270	1.82	0.81	1.59	0.76
G04B	14	67	670	2.14	0.73	1.69	0.78
G04C	13	55	550	2.25	0.79	1.81	0.80
G05A	9	118	1,180	1.05	0.23	0.41	0.16
G05B	22	35	350	3.38	0.86	2.20	0.86
G05C	14	58	580	2.71	0.80	1.99	0.81
G06A	11	16	160	1.44	0.84	1.35	0.73
G06B	5	20	200	1.00	0.66	0.91	0.50
G06C	12	15	150	2.95	0.86	1.90	0.85
RG01A	13	22	220	2.59	0.86	1.89	0.85
RG01B	25	73	730	4.43	0.91	2.72	0.93
RG01C	17	29	290	4.16	0.85	2.31	0.88
RG02A	25	159	1,590	4.14	0.70	2.16	0.82
RG02B	33	189	1,890	4.77	0.71	2.31	0.84
RG01C	53	245	2,450	6.91	0.69	2.52	0.84
Min	**5**	**15**	**150**	**1.00**	**0.23**	**0.41**	**0.16**
Max	**75**	**997**	**9970**	**7.82**	**0.91**	**3.00**	**0.93**

4.6.2 Benthic Grabs – Cluster analysis

The results of SIMPROF cluster analysis on the macrobenthic data for each station are presented in Figure 8. Black lines denote significant structure within the group to that point and red lines connect samples that cannot be significantly differentiated at the 95% confidence interval. The SIMPROF test identified eight groups that can be considered statistically distinct from one-another at the 95% confidence level, four of which consisted of only single samples.

Group A comprised only sample RG02c, separating from Group B at just below 53% similarity. This sample was dominated by small lugworms (Arenicolidae) and the amphipod *Melita palmata*. The remaining two replicates from station RG02 (RG02a and RG02b) formed Group B, with many Arenicolidae, as well as mussel spat and sand mason worms (*Lanice conchilega*).

Group C comprised only sample G01a, separating from Group B at just below 53% similarity. This sample had the highest numbers of taxa and individuals of the survey and was dominated by epibiota, particularly small sea anemones (Actiniaria), barnacles (*Balanus crenatus*) and mussel (*Mytilus edulis*) spat.

Group D comprised all three replicate samples from station G03, separating from groups E-G at just below 50% similarity. This group was characterised by barnacles (*B. crenatus* and *Austrominius modestus*) as well as infaunal worms (e.g. *Pygospio elegans*) and bivalves (*Limecola balthica*).

Groups E and F both comprised single samples, G02a and G02c respectively, which separated from one-another just below 59% similarity. Group E was dominated by the cirratulid worm *Tharyx* 'species A'. Group F also included many *Tharyx* but was dominated by oligochaete worms (*Tubificoides* spp.) and had more abundant Actiniaria.

Group G included three samples: G01b, G01c and G02b and separated from Group F at just under 60% similarity. The faunal assemblages in this group were dominated by oligochaetes, *Tharyx* and *L. balthica*.

The remaining twelve samples formed a single group: H, which separated from the other groups at 22% similarity. This group was characterised by moderate numbers of Nemertea, mussel spat and infaunal worms and bivalves. Group H also had generally lower diversity than the other groups, with a mean of 14 taxa per sample, compared to means of 34-75 taxa per sample in other groups.

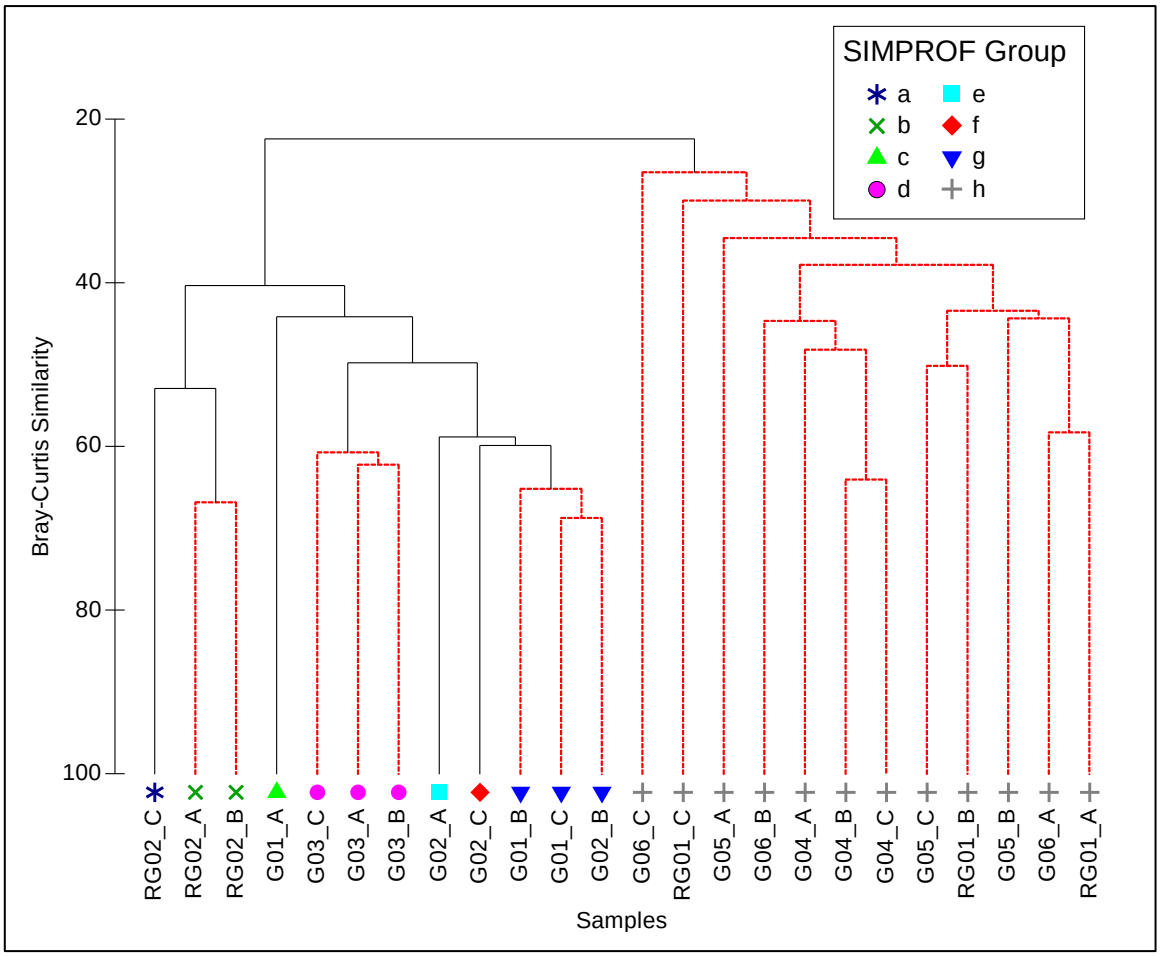

Figure 8. SIMPROF Cluster dendrogram of Bray-Curtis similarity between square-root transformed macrobenthic data for each grab sample.

4.6.3 Non-metric multi-dimensional scaling (NMMDS)

The MDS plot for the macrobenthic data is presented in Figure 9. The stress value of 0.11 is low, suggesting a good two dimensional picture of the higher dimensional relationships between samples with no real prospect of a misleading interpretation (Clarke & Warwick, 2001). The plot complements the pattern seen in the cluster dendrogram, with the samples from SIMPROF group H clearly separated from groups A-G. The samples in SIMPROF groups A-G show closer grouping of replicates from the same station, whereas those of group H show wider separation, suggesting more heterogeneity between replicates at the same station in group H.

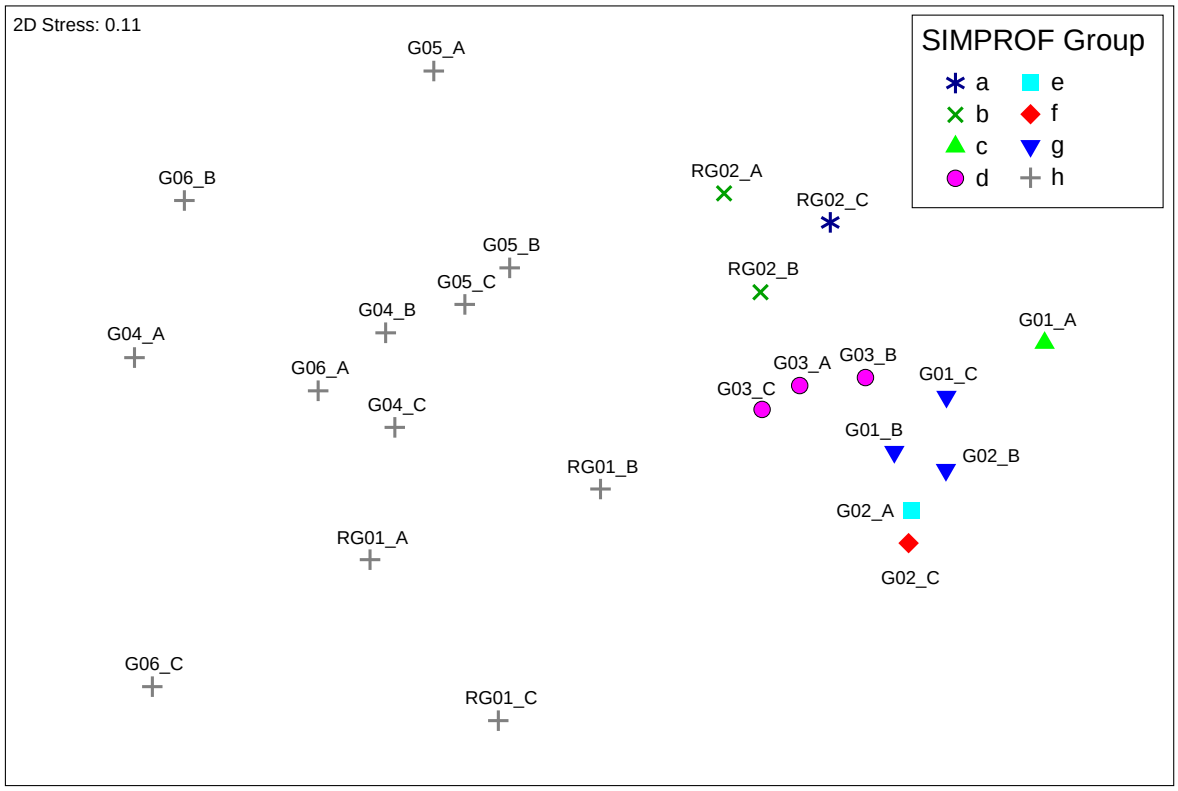

Figure 9. MDS plot of Bray-Curtis similarity between square-root transformed macrobenthic data for each grab sample

4.6.4 Correlation between PSA data and biological variables

The outputs of the BEST analysis are presented in Table 6. The results show that the highest correlation (0.873) is achieved with a single variable: % coarse sand. The highest correlation for a combination of variables is lightly lower (0.860) and includes % coarse sand along with kurtosis (phi), % silt/clay and % very coarse sand. The global test result gives a significance level of 0.4%, indicating that the correlation is significant and the null hypothesis of 'no agreement between PSA and biological multivariate patterns' can be rejected. The high correlation value indicates that the coarse sand content of the sediment is an important determining factor in the observed biological distributions.

Table 6. Results of the BEST analysis

No. Variables	Spearman Correlation (σ)	Physical Variables
1	0.873	% Coarse sand (500-1000 µm)
4	0.860	Kurtosis (phi), % Silt/clay (<63 µm), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
4	0.855	Kurtosis (phi), % Very fine sand (63-125 µm), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
4	0.847	Sorting (phi), Kurtosis (phi), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
5	0.839	Sorting (phi), Kurtosis (phi), % Very fine sand (63-125 µm), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
5	0.837	Kurtosis (phi), % Silt/clay (<63 µm), % Medium sand (250-500 µm), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
5	0.835	Kurtosis (phi), % Very fine sand (63-125 µm), % Medium sand (250-500 µm), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
3	0.834	Kurtosis (phi), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
5	0.833	Sorting (phi), Skewness (phi), Kurtosis (phi), % Coarse sand (500-1000 µm), % Very coarse sand (1-2 mm)
3	0.832	Kurtosis (phi), % Silt/clay (<63 µm), % Coarse sand (500-1000 µm)

Global Test
Sample statistic (ρ): 0.873
Significance level of sample statistic: 0.4%
Number of permutations: 999 (Random sample)
Number of permuted statistics greater than or equal to ρ: 3

4.6.5 Biotope composition

Half of the macrobenthic samples belonged to a single cluster group; other cluster groups were represented by only small numbers of samples. However, the main group represents the least rich samples and does not fit well into any described biotope. Oligochaete worms of the genus *Tubificoides* and the cirratulid polychaete *Tharyx* 'species A' were the most consistent component of most groups, which can be considered variants of the biotope SS.SMu.SMuVS.AphTubi (*Aphelochaeta marioni* and *Tubificoides* spp. in variable salinity infralittoral mud; EUNIS A5.322). The biotope description (Connor *et al.*, 2004) notes that other cirratulids may replace *A. marioni* and that the description may include inconsistent cirratulid identifications. Group G was the most typical example of this biotope. Group H was more impoverished but not enough so for it to be assigned to SS.SMu.SMuVS.MoMu (Infralittoral fluid mobile mud; EUNIS A5.324); it is best left as the biotope complex SS.SMu.SMuVS (Sublittoral mud in variable salinity (estuaries); EUNIS A5.32). The same assignment must be applied to groups A and B, which do not fit well with the biotope level classification. The remaining groups had high numbers of epifaunal taxa and are best assigned to the complex SS.SMx.SMxVS (Sublittoral mixed sediment in variable salinity (estuaries); EUNIS A5.42); they do not fit well with either of the described component biotopes, although group E could

be considered close to SS.SMx.SMxVS.CreMed (*Crepidula fornicata* and *Mediomastus fragilis* in variable salinity infralittoral mixed sediment; EUNIS A5.422).

Table 7. Biotope assignment, AMBI and IQI Scores for each subtidal grab sample

Sample	AMBI	Disturbance Classification	IQI Score	IQI Ecological Status	SIMPROF Group	Biotope	EUNIS
G01a	3.36	Moderately disturbed	0.72	Good	c	SS.SMx.SMxVS	A5.42
G01b	3.73	Moderately disturbed	0.62	Moderate	g	SS.SMu.SMuVS.AphTubi	A5.322
G01c	3.94	Moderately disturbed	0.61	Moderate	g	SS.SMu.SMuVS.AphTubi	A5.322
G02a	3.85	Moderately disturbed	0.61	Moderate	e	SS.SMx.SMxVS.CreMed	A5.422
G02b	3.78	Moderately disturbed	0.65	Good	g	SS.SMu.SMuVS.AphTubi	A5.322
G02c	4.12	Moderately disturbed	0.61	Moderate	f	SS.SMx.SMxVS	A5.42
G03a	3.16	Slightly disturbed	0.57	Moderate	d	SS.SMx.SMxVS	A5.42
G03b	3.48	Moderately disturbed	0.55	Moderate	d	SS.SMx.SMxVS	A5.42
G03c	3.49	Moderately disturbed	0.54	Moderate	d	SS.SMx.SMxVS	A5.42
G04a	3.06	Slightly disturbed	0.53	Moderate	h	SS.SMu.SMuVS	A5.32
G04b	3.34	Moderately disturbed	0.56	Moderate	h	SS.SMu.SMuVS	A5.32
G04c	2.83	Slightly disturbed	0.59	Moderate	h	SS.SMu.SMuVS	A5.32
G05a	3.09	Slightly disturbed	0.50	Moderate	h	SS.SMu.SMuVS	A5.32
G05b	3.31	Moderately disturbed	0.64	Good	h	SS.SMu.SMuVS	A5.32
G05c	3.45	Moderately disturbed	0.55	Moderate	h	SS.SMu.SMuVS	A5.32
G06a	3.00	Slightly disturbed	0.59	Moderate	h	SS.SMu.SMuVS	A5.32
G06b	2.93	Slightly disturbed	0.48	Moderate	h	SS.SMu.SMuVS	A5.32
G06c	3.12	Slightly disturbed	0.54	Moderate	h	SS.SMu.SMuVS	A5.32
RG01a	2.80	Slightly disturbed	0.54	Moderate	h	SS.SMu.SMuVS	A5.32
RG01b	3.09	Slightly disturbed	0.58	Moderate	h	SS.SMu.SMuVS	A5.32
RG01c	2.94	Slightly disturbed	0.54	Moderate	h	SS.SMu.SMuVS	A5.32
RG02a	3.11	Slightly disturbed	0.53	Moderate	b	SS.SMu.SMuVS	A5.32
RG02b	3.23	Slightly disturbed	0.55	Moderate	b	SS.SMu.SMuVS	A5.32
RG02c	2.97	Slightly disturbed	0.62	Moderate	a	SS.SMu.SMuVS	A5.32

The distributions of the identified biotopes are mapped in Figure 10, below. As biotope distribution was clearly patchy, even at a station level (as indicated by assignment of different replicate samples from a station to separate cluster groups), biotopes have been mapped as points rather than trying to assign arbitrary ranges to their distributions. For stations G01 and G02, the majority biotope or complex has been mapped (in G02, one replicate was assigned a biotope in the complex to which another replicate had been assigned).

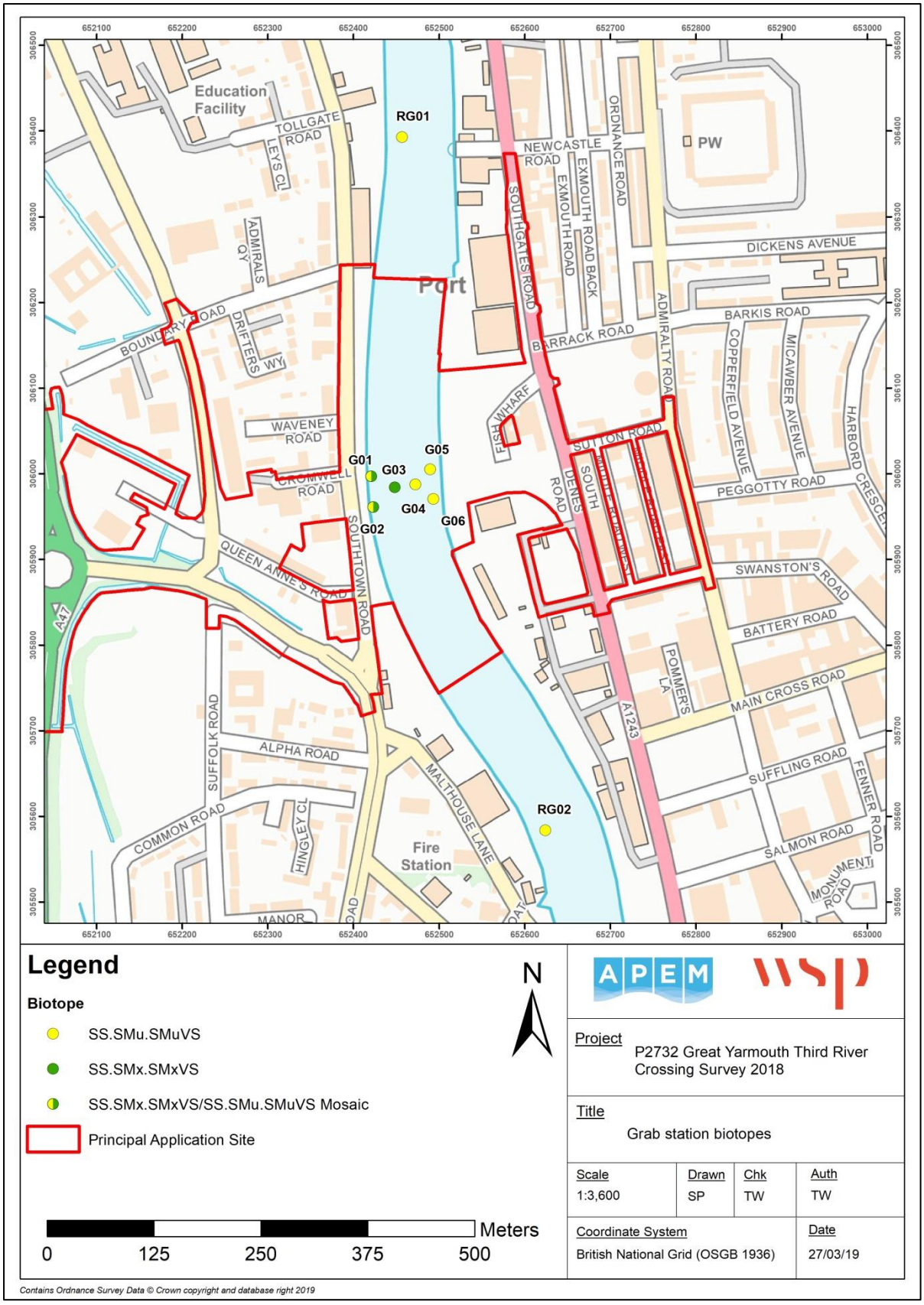

Figure 10. Biotopes present at each grab station.

4.6.6 AMBI and Infaunal Quality Index (IQI) Scores

AMBI scores for all samples (Table 7) fell within the range of 2.8 to 4.12, resulting in classifications of either moderately or slightly disturbed. Three samples had an IQI Ecological Status of 'good' (G01A, G02B and G05B), with all other samples classified as 'moderate'. These scores are likely to be highly influenced by the presence of Ecological Group III taxa that are present in the underlying structure of estuarine communities (Borja & Muxika, 2005), making it difficult to attain lower scores in estuarine conditions.

4.6.7 Wall samples

All wall stations had a covering of algae and fouling fauna. The communities were generally similar at each station, regardless of wall construction (metal or wood). Since fouling communities overgrow one another, the percentage coverage from the quadrats frequently showed more than 100% coverage, accounting for the 3-dimensional structure. The upper tidal zones of the walls showed a distinct band of green algae (mostly *Blidingia minima*). This represents a biotope with some similarity to LR.FLR.Lic.Bli (*Blidingia* spp. on vertical littoral fringe soft rock; EUNIS B3.114), although the substratum does not match. Lower down, a zone of *Fucus* was present (both *F. vesiculosus* and *F. spiralis* were noted in quadrat samples). Barnacles (*Austrominius modestus*) were abundant at most stations. Several other algal species were present, including the chlorophytes *Prasiola stipitata* and *Gayralia oxysperma*. Stations 3 and 4 had lower densities of fucoids, with correspondingly higher numbers of barnacles. Station R1 had no barnacle records. Although there was some variation between stations, the mid shore on the walls has all been assigned to the biotope LR.MLR.BF.FvesB (*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock; EUNIS A1.213). Photographs of all wall sampling stations are provided in Appendix 5 and the complete data for both wall scrape and quadrat samples are provided in Appendix 3 .

A SIMPROF cluster analysis was conducted on the wall scrape data for each replicate and is presented in

Figure **11**. The results show that none of the samples can be statistically differentiated at the 95% confidence interval, indicating similar species assemblages in all samples.

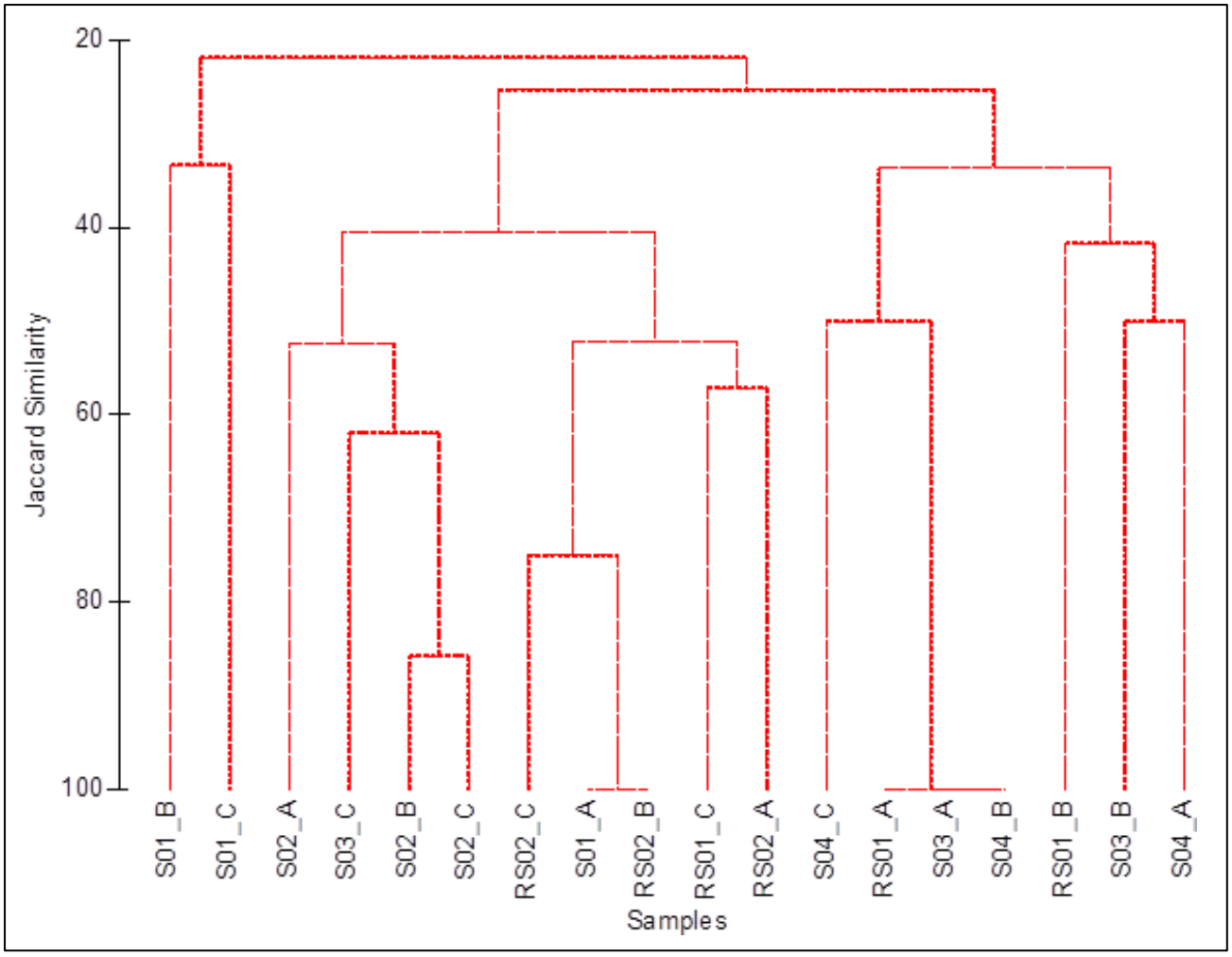

Figure 11. SIMPROF Cluster dendrogram of Jaccard similarity between wall scrape presence/absence data for each replicate.

4.6.8 Trawls

Seven invertebrate taxa and seven fish species were recorded from the beam trawl samples. The majority of taxa recorded in the trawl samples were not recorded in any of the other sample types. Data from the trawl samples are presented in Appendix 3 and photos of each trawl sample are presented in Appendix 6

The number of taxa ranged from six in RT1 and T02, to eight in RT2 and T01. The highest number of individuals (1,199) was in T02. The most abundant taxon recorded from each of the beam trawls was brown shrimp (*Crangon crangon*), with a total of 2,505 individuals recorded overall. Other invertebrates were much less common but included occasional mysids (opossum shrimps – *Neomysis integer* and *Schistomysis kervillei*) and shore crabs (*Carcinus maenas*).

Sand goby (*Pomatoschistus minutus*) was the most abundant fish species and was found in moderate numbers (8-81) in all samples. Lozano's goby (*Pomatoschistus lozanoi*) and common gobies (*P. microps*) were recorded in low numbers (totals of 2 and 1, respectively), as were the flatfish Dover sole (*Solea solea*), flounder (*Platichthys flesus*) and plaice

(*Pleuronectes platessa*) (totals of 2, 2 and 1, respectively). One three-spined stickleback (*Gasterosteus aculeatus*) was also found.

4.6.9 Notable taxa

The only benthic species of conservation interest to be recorded was the ross worm *Sabellaria spinulosa* but it is only significant if reef-forming (the reef habitat is an Annex I habitat under the EC Habitats Directive) and the numbers found in the samples were too low to constitute evidence of a biogenic reef. Commercially important species recorded in the trawl samples included brown shrimp (*Crangon crangon*) and flatfish: Dover sole (*Solea solea*), flounder (*Platichthys flesus*), plaice (*Pleuronectes platessa*); of these, Dover sole is listed as a Feature of Conservation Interest (FOCI: Reeve, 2007).

No other species considered rare (e.g. those listed by Bratton, 1991; Sanderson, 1996; Betts, 2001; Chadd & Extence, 2004) or protected under the Wildlife and Countryside Act 1981 (as amended) or the Habitats Directive were recorded. The syllid polychaete *Prosphaerosyllis chauseyensis* (Olivier *et al*., 2012) has not yet been formally published from UK waters but has been found in several surveys and is likely to have been previously overlooked.

Several non-native or cryptogenic species were recorded. The most significant may be the Manila clam (*Ruditapes philippinarum*), currently known from the south coast of England and the east coast as far north as the Orwell estuary (Ashelby, 2005); the Great Yarmouth records represent a range extension and the most northerly naturalised population in the UK, although there are farmed populations in Morecambe Bay (Humphreys *et al.*, 2015). The Australasian barnacle *Austrominius modestus* was present at most wall sampling stations and several grab samples, often in high abundance. American Slipper limpets (*Crepidula fornicata*) were found in several grab samples, especially at station G02. One specimen of the non-native ostracod crustacean *Eusarsiella zostericola* was recorded at station G01. The polychaete *Streblospio* (common at stations G01 and G02) is likely to have been the non-native *S. benedicti*, which is recently recognised to have spread widely in Britain and Europe (V. Radashevsky, Russian Aca-demy of Sciences, pers. comm.). The cryptogenic ragworms *Alitta succinea* and *A. virens* were found at stations G01-03.

5. Discussion

The River Yare is tidal for many kilometres from near Norwich to Great Yarmouth. Just upstream of Great Yarmouth, the estuary passes through a semi-enclosed broad (Breydon Water), with an extensive intertidal area, for about five km. It then passes through the town as a narrow (150m wide) marine inlet that connects to the southern bight of the North Sea at Gorleston-on-Sea. The Scheme is planned to be half way along the narrow inlet, about 2km North and upstream of the connection to the open sea. The environmental conditions at this point are tidal and euryhaline. The area is discussed within the context of Breydon Water in the JNCC Coastal Directory (Barne *et al*., 1995).

The marine environment within the footprint of the Scheme has been characterized through trawls and benthic grab samples on the sediment and by quadrats and wall scrape samples along the walls. Subtidally, the seabed comprised clay and sand, with minor mud and gravel components in some samples. Walls extended from the shallow subtidal, through the intertidal to terrestrial environments; they mostly comprised steel sheet piling, with wood over concrete in one area.

The subtidal sediment was mixed, with sand, clay and varying proportions of stone and shell, allowing the development of both infaunal and epibiota communities. Infaunal populations were characterised by varying proportions of common cirratulid, spionid and oligochaete worms in moderate to high numbers, together with typical estuarine bivalves and amphipod crustaceans. About half of the samples were of relatively low diversity and may have been affected by dredging for navigation purposes; these samples were less influenced by gravel components and belonged to the SS.SMu.SMuVS biotope complex. Other samples represented communities within this complex that were more diverse, but still difficult to assign at biotope level, as well as relatively typical examples of the widespread estuarine, shallow mud biotope (SS.SMu.SMuVS.AphTubi). There was a transition between these infaunal communities and those that had more epibiota and belonged to the complex SS.SMx.SMxVS. Of these, one community could be named at biotope level: SS.SMx.SMxVS.CreMed. In most mixed substratum samples, epibiota were dominated by barnacles and sea anemones, with encrusting Bryozoa. Although some of the benthic community compositions may suggest the need for re-evaluation of the biotope classification, it is unlikely that any would be considered of particular conservation value.

The trawl data provide a view of the larger, mobile organisms that pass over the sediment. There were large numbers of brown shrimp (*Crangon crangon*), which may be considered of commercial importance. The gobies, which dominated the trawl data, are widespread and a common component of estuaries, although the distribution of *Pomatoschistus lozanoi* in the North Sea and estuarine habitats was relatively recently recognised (Eick, 2012), relative to standard literature (Maitland & Herdson, 2009). Commercially important fish (three flatfish species) were found in low numbers.

Only the mid and upper shore biotopes were examined on the walls. The upper shore green algal zone was unusual in its dominance of *Blidingia minima* and similar to a soft rock biotope, LR.FLR.Lic.Bli, but on hard artificial substrata. The mid shore represented typical moderate exposure fucoid barnacle mozaics (LR.MLR.BF.FvesB), which are widespread nationally. The dominant barnacle was the Australasian species *Austrominius modestus*, which is now abundant in estuarine habitats, nationally (Eno *et al*., 1997).

Although the wider environment is classified as a priority habitat, estuaries, the biological communities identified within the Scheme impact zone are of limited conservation value. The construction and maintenance of the Scheme will have little impact relative to the pressures already present due to habitat modification. The main conservation interest is commercially important fish, which appear to use the area in low numbers, and brown shrimp.

There were several non-native (Eno *et al*., 1997; Minchin *et al*., 2013) and cryptogenic (species that based on distribution or other evidence may be non-native but for which there is no definitive proof) animals in the area. One of these represents a notable range extension. Manila clams (*Ruditapes philippinarum*) were found in several grab samples. It is native to the temperate northwest Pacific (Huber, 2010) and was introduced to Europe and the UK for commercial fishery. It then became naturalised in Poole Harbour and spread to other estuaries on the south coast (Humphreys et al., 2015) and as far north as the Orwell estuary, Suffolk (Ashelby, 2005). The Great Yarmouth specimens are the most northerly wild population recorded from British waters.

The non-native species are most likely to have been introduced to the area through shipping in some form and it is not possible to be certain which species have spread from within British waters or when they arrived. Care must be taken to ensure that no biological material is spread

from the area to other parts of Britain or Europe. A biosecurity risk assessment should be undertaken as part of the planning for the Scheme and a management plan put in place to avoid potentially facilitating the spread of non-native species during construction. This plan should particularly cover risks of material removed from the inlet during construction being transported beyond the harbour, without an assessment of the recipient area. It may also consider aspects of the vessels and equipment used in the process and their subsequent use in other areas. This is secured through the Outline CoCP (document reference 6.16).

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APPENDICES

Appendix 1 AMBI Truncation details

Taxon	Changes or exclusion details
Prosphaerosyllis chauseyensis	scored as per *Prosphaerosyllis* sp. (EG II)
Parougia	scored as per *Parougia caeca* (EG IV)
Dipolydora species B	scored as per *Dipolydora* sp. (EG IV)
Tharyx species A	scored as per *Tharyx* sp. (EG IV)
Notomastus	scored as per *Notomastus latericeus* (EG III)
Arenicolidae	scored as per *Arenicola marina* (EG III)
Serpulidae	scored as per *Pomatoceros lamarcki* (EG II)
Folliculinidae	Excluded: Epifauna
Animalia eggs	Excluded: Eggs
Porifera	Excluded: Epifauna
Filifera	Excluded: Epifauna
Bougainvilliidae	Excluded: Epifauna
Dynamena pumila	Excluded: Epifauna
Hydrallmania falcata	Excluded: Epifauna
Sertularia	Excluded: Epifauna
Nemertesia	Excluded: Epifauna
Campanulariidae	Excluded: Epifauna
Actiniaria	Excluded: Epifauna
Fecampia erythrocephala eggs	Excluded: Eggs
Nereididae juvenile	Excluded: Non-speciated juvenile
Pycnogonida juvenile	Excluded: Non-speciated juvenile
Acari	Excluded: Non-benthic taxon
Sessilia juvenile	Excluded: Epifauna
Austrominius modestus	Excluded: Epifauna
Balanus crenatus	Excluded: Epifauna
Copepoda	Excluded: Planktonic taxon
Coleoptera larva	Excluded: Insect
Doto	Excluded: Non-Soft sediment taxon
Cuthona	Excluded: Non-Soft sediment taxon
Crisia	Excluded: Epifauna
Alcyonidium diaphanum	Excluded: Epifauna
Alcyonidioides mytili	Excluded: Epifauna
Nolella	Excluded: Epifauna
Farrella repens	Excluded: Epifauna
Vesicularia spinosa	Excluded: Epifauna
Amathia lendigera	Excluded: Epifauna
Amathia	Excluded: Epifauna

Taxon	Changes or exclusion details
Eucratea loricata	Excluded: Epifauna
Conopeum reticulum	Excluded: Epifauna
Electra monostachys	Excluded: Epifauna
Electra pilosa	Excluded: Epifauna
Aspidelectra melolontha	Excluded: Epifauna
Flustra foliacea	Excluded: Epifauna
Bugulidae	Excluded: Epifauna
Bicellariella ciliata	Excluded: Epifauna
Scrupocellaria scruposa	Excluded: Epifauna
Ascidiacea juvenile	Excluded: Epifauna
Molgula	Excluded: Epifauna
Gloeotrichia	Excluded: Non-benthic invertebrate taxon
Rhodophyta	Excluded: Non-benthic invertebrate taxon
Plocamium cartilagineum	Excluded: Non-benthic invertebrate taxon
Heterosiphonia plumosa	Excluded: Non-benthic invertebrate taxon
Bacillariophyceae	Excluded: Non-benthic invertebrate taxon
Ectocarpaceae	Excluded: Non-benthic invertebrate taxon
Chlorophyta	Excluded: Non-benthic invertebrate taxon
Gayralia oxysperma	Excluded: Non-benthic invertebrate taxon
Blidingia minima	Excluded: Non-benthic invertebrate taxon
Chaetomorpha linum	Excluded: Non-benthic invertebrate taxon
Rhizoclonium	Excluded: Non-benthic invertebrate taxon
Bryophyta	Excluded: Non-benthic invertebrate taxon
Lemna	Excluded: Non-benthic invertebrate taxon

Appendix 2 Sampling positions

Wall sampling positions

Station / Sample	Date	Time (UTC)	OSGB36		WGS84	
			Eastings	Northings	Latitude	Longitude
S01	30/01/19	12:02	652415	306006	52.593172	1.7254051
S02	30/01/19	11:44	652418	305966	52.592812	1.7254189
S03	30/01/19	12:31	652504	305996	52.593041	1.7266938
S04	30/01/19	12:52	652507	305968	52.592797	1.7267322
RS01	30/01/19	13:24	652519	306329	52.596022	1.7271686
RS02	31/01/19	12:11	652607	305576	52.589234	1.7279064

Trawl sampling start and end positions

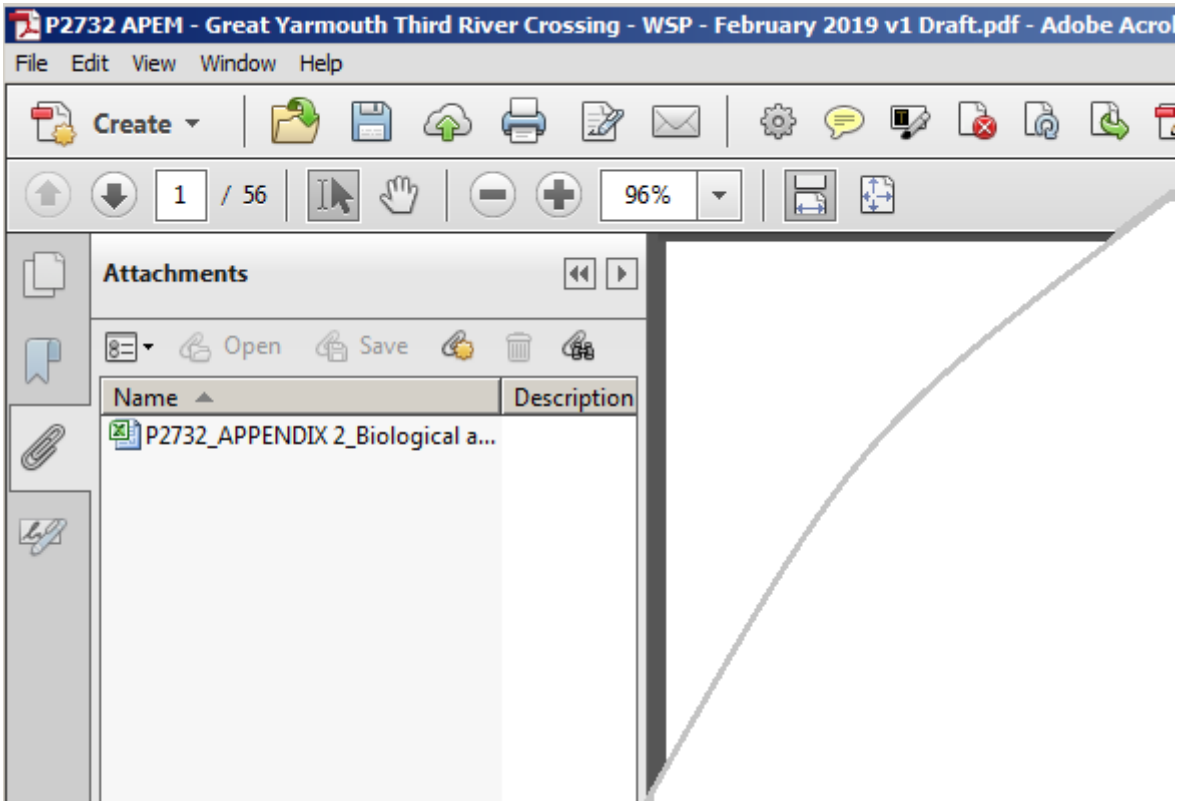
Station / Sample	Date	Time (UTC)	OSGB36		WGS84	
			Eastings	Northings	Latitude	Longitude
T01 Start	30/01/19	13:55	652456	305896	52.592167	1.7259106
T02 End	30/01/19	14:00	652446	306068	52.593723	1.7259098
T02 Start	30/01/19	14:15	652514	305872	52.591933	1.7267474
T02 End	30/01/19	14:20	652488	306083	52.593838	1.7265399
RT01 Start	31/01/19	11:21	652481	306438	52.597017	1.7266919
RT01 End	31/01/19	11:25	652485	306270	52.595517	1.7266383
RT02 Start	31/01/19	11:52	652558	305711	52.590460	1.7272721
RT02 End	31/01/19	11:57	652663	305514	52.588643	1.7286832

Grab sampling positions

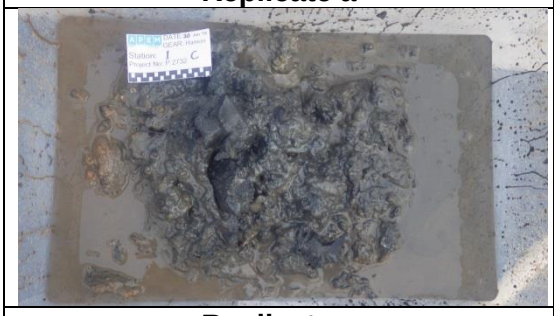
Station / Sample	Date	Time (UTC)	OSGB36		WGS84	
			Eastings	Northings	Latitude	Longitude
G01a	30/01/19	08:18	652421	306001	52.593133	1.7254905
G01b	30/01/19	08:24	652421	305996	52.593089	1.7254867
G01c	30/01/19	08:28	652421	305995	52.593080	1.7254859
G01 PSA	30/01/19	08:32	652421	305996	52.593089	1.7254867
G02a	30/01/19	08:37	652423	305960	52.592765	1.7254887
G02b	30/01/19	08:41	652424	305961	52.592773	1.7255042
G02c	30/01/19	08:44	652423	305962	52.592783	1.7254902
G02 PSA	30/01/19	08:48	652423	305962	52.592783	1.7254902
G03a	30/01/19	08:54	652451	305984	52.592967	1.7259194
G03b	30/01/19	08:58	652446	305983	52.592960	1.7258450
G03c	30/01/19	09:01	652448	305984	52.592968	1.7258753
G03 PSA	30/01/19	09:05	652448	305986	52.592986	1.7258768
G04a	30/01/19	09:11	652473	305987	52.592984	1.7262458
G04b	30/01/19	09:14	652473	305986	52.592975	1.7262450
G04c	30/01/19	09:17	652473	305991	52.593020	1.7262489
G04 PSA	30/01/19	09:20	652471	305986	52.592976	1.7262156
G05a	30/01/19	09:28	652490	306006	52.593146	1.7265107
G05b	30/01/19	09:31	652490	306005	52.593137	1.7265099
G05c	30/01/19	09:34	652489	306007	52.593156	1.7264967
G05 PSA	30/01/19	09:38	652490	306003	52.593119	1.7265084
G06a	30/01/19	09:43	652494	305969	52.592812	1.7265414
G06b	30/01/19	09:45	652494	305972	52.592839	1.7265437
G06c	30/01/19	09:49	652493	305972	52.592840	1.7265290
G06 PSA	30/01/19	09:52	652493	305970	52.592822	1.7265275
RG01a	30/01/19	10:03	652455	306393	52.596634	1.7262900
RG01b	30/01/19	10:08	652457	306394	52.596642	1.7263203
RG01c	30/01/19	10:13	652457	306393	52.596633	1.7263195
RG01 PSA	30/01/19	10:16	652458	306393	52.596633	1.7263342
RG02a	30/01/19	10:30	652625	305584	52.589298	1.7281776
RG02b	30/01/19	10:33	652623	305585	52.589308	1.7281489
RG02c	30/01/19	10:36	652624	305585	52.589307	1.7281637
RG02 PSA	30/01/19	08:18	652421	306001	52.593133	1.7254905

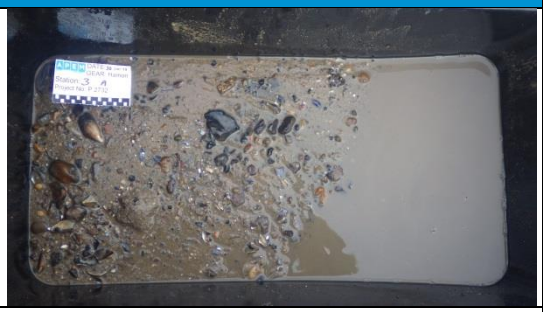
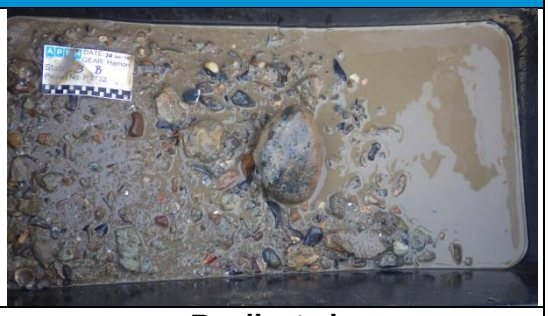
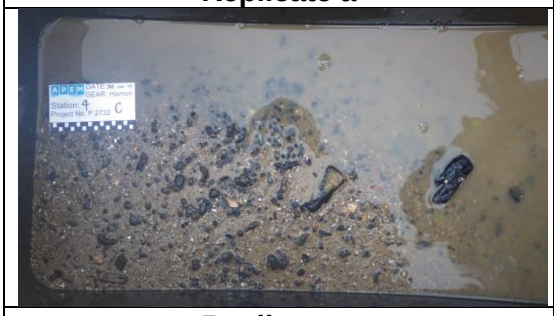
Appendix 3 Biological and sediment data

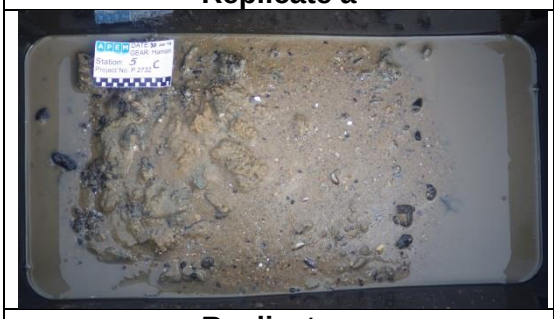
See attached file within this PDF

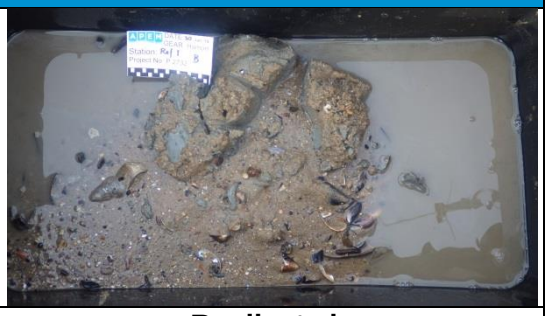
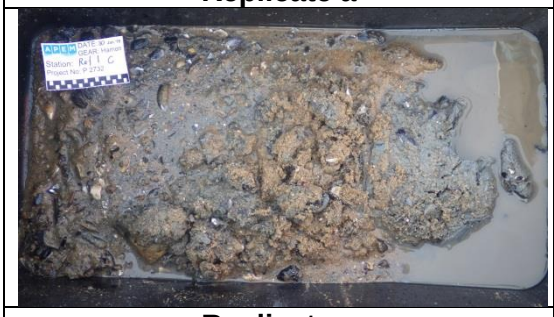
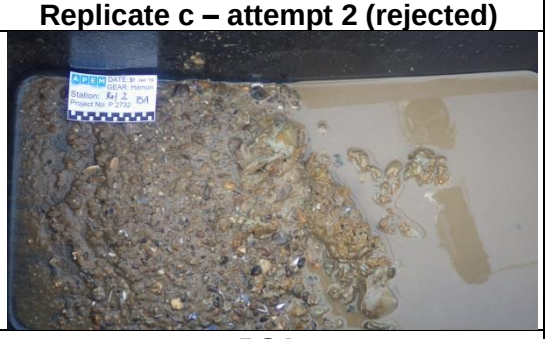


Appendix 4 Photographs of each benthic grab sample

Station		
G01		
	Replicate a	Replicate b
		
	Replicate c	PSA
G02		
	Replicate a	Replicate b
		
	Replicate c	PSA

Station		
G03		
	Replicate a	Replicate b
		
	Replicate c	PSA
G04		
	Replicate a	Replicate b
		
	Replicate c	PSA

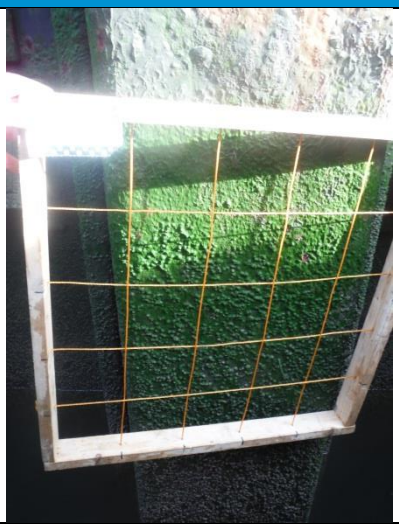
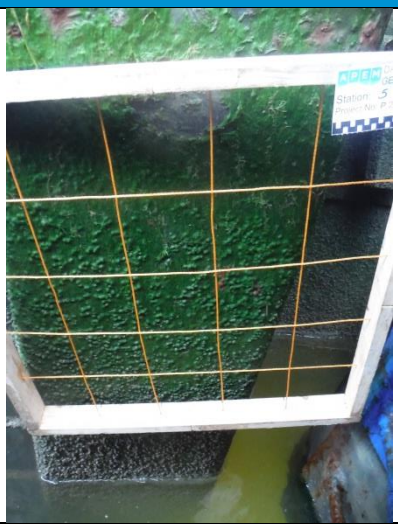
Station		
G05		
	Replicate a	Replicate b
		
	Replicate c	PSA
G06		
	Replicate a	Replicate b
		
	Replicate c	PSA

Station		
RG01		
	Replicate a	Replicate b
		
	Replicate c	PSA
RG02		
	Replicate a	Replicate b
		
	Replicate c – attempt 1 (rejected)	Replicate c – attempt 2 (rejected)
		
	Replicate c – attempt 3 (accepted)	PSA

Appendix 5 Photographs of each wall sampling station

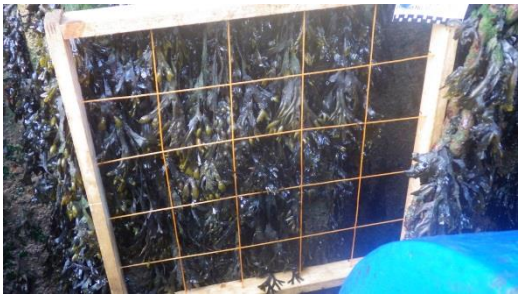
Station		
S01		
	Quadrat a	Quadrat b
		
	Quadrat c	Scrape a
		
	Scrape b	Scrape c

Station		
S02		
	Quadrat a	Quadrat b
		
	Quadrat c	Scrape a
		
	Scrape b	Scrape c

Station		
S03 (labelled as 5 in the field due to proximity to grab station G05)		
	Quadrat a	Quadrat b
		
	Quadrat c	Scrape a
		
	Scrape b	Scrape c

Station		
S04 (labelled as 6 in the field due to proximity to grab station G06)		
	Quadrat a	Quadrat b
		
	Quadrat c	Scrape a
		
	Scrape b	Scrape c

Station		
RS01		
	Quadrat a	Quadrat b
		
	Quadrat c	Scrape a
		
	Scrape b	Scrape c

Station		
RS02		
	Quadrat a	Quadrat b
		
	Quadrat c	Scrape a
		
	Scrape b	Scrape c

Appendix 6 Photographs of each trawl sample

Trawl	
T01	

T02	
Trawl	
RT01	

RT02	 APEM DATE 31 Jan '19 GEAR: Beam tr Station: REF T2 Project No: P 2732