Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 3A: Options Assessment 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

Document Reference: 6.2 – Technical Appendix 3A

Version Number: 0 – Revision for Submission

Date: 30 April 2019

Great Yarmouth Third River Crossing

Options Assessment Report

May 2016

Produced for
Norfolk County Council

Prepared by
Mouchel

Export House
Cawsey Way
Woking
Surrey
GU21 6QX
UK

Document Control Sheet

Project Title	Great Yarmouth Third River Crossing
Report Title	Options Assessment Report
Report ref no.	
Version	5
Status	Final
Report Date	31 May 2016

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
1	Draft	Rob Surl					
3	Draft	Rob Surl	19 May 2016				
4	Draft	Rob Surl	22 May 2016				
5	Final	Rob Surl	31 May 2016	DW	31 May 2016	JL	31 May 2016

Distribution

Date	Organisation	Contact	Format	Copies
19 May 2016	Mouchel	J Lyon, D Wildman, Brijesh Singh, Amanda Fogg	E	
22 May 2016	Mouchel	J Lyon, D Wildman, Brijesh Singh, Amanda Fogg	E	
31 May 2016	Norfolk County Council	Ian Parkes	E	

Limitations

This report is presented to Norfolk County Council in respect of the Great Yarmouth Third River Crossing and may not be used or relied on by any other person. It may not be used by Norfolk County Council in relation to any other matters not covered specifically by the agreed scope of this Report.

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

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

Acknowledgment

This report quotes extensively from earlier reports commissioned by Norfolk County Council from Mott MacDonald, including the Stage 1 and Stage 2 Scheme Assessment Reports and Traffic & Economic Appraisal Reports, and the supporting technical reports quoted in these.

Mapping

Maps and plans in this report are based upon the Ordnance Survey map with the sanction of the Controller of Her Majesty's Stationery Office.

AL100019340

Contents

Table of figures

Tables

1 Introduction

1.1 Overview

This report describes the first stage of the Transport Appraisal for the proposed Great Yarmouth Third Crossing, and will support subsequent stages leading eventually to the submission of a full business case. It is structured in general accordance with Department of Transport (DfT) guidance[1].

The first stage of a transport scheme appraisal involves identifying the need for an intervention, and developing options to address a clear set of locally defined objectives. These options are then sifted to enable the better performing option(s) to be taken on to further, more detailed, appraisal in Stage 2.

DfT guidance states that appraisals to be undertaken in a proportionate manner and with a 'lighter touch' approach, where appropriate. In the early stages of appraisal, it may not be cost-effective or feasible to appraise a large number of options in great detail. However, the option assessment process must ensure that proposals are developed in a robust manner, supported by fit-for-purpose and proportionate analysis. This work should form a sound basis for identifying problems and developing solutions.

This report:

- Sets out the rationale for the scheme, based on clearly identified problems and challenges
- Describes the consideration of genuine, discrete options and a range of solutions
- Clearly identifies the best performing option(s) which will be subject to further appraisal
- Summarises the public and stakeholder support for the scheme and describes the engagement processes.

1.2 Location of the proposed scheme

Great Yarmouth is located about 30 km east of Norwich on Norfolk's North Sea coast. The Great Yarmouth urban area, as defined by the Office of National

[1] Transport Analysis Guidance (WebTAG): The Transport Appraisal Process (January 2014), Paragraphs 2.1 – 2.11

Statistics, has a population of about 68,000[2]. The wider Borough of Great Yarmouth has a population of about 97,000[3] people.

Figure 1-1 Location of Great Yarmouth

Great Yarmouth is located further east than any other town in the UK, apart from Lowestoft. It is connected to Norwich and Lowestoft by rail, and by road. The A47 from Norwich, the A12 from Lowestoft, and the A143 from Gillingham terminate in the town.Great Yarmouth is, by virtue of its location, relatively isolated. It is a destination, but not a place that people pass through.

Great Yarmouth lies at the mouth of the River Yare, which separates the town from the other parts of the Borough. The River Yare is navigable to small coastal vessels between Norwich and the North Sea. The historic town centre and sea front lie on a narrow peninsula, sandwiched between the river and the sea. It is linked to Gorleston-on Sea and other parts of the Borough by two bridges over the river:

- The Haven Bridge (two lanes in each direction, single carriageway)
- The A12 Breydon Bridge (one lane in each direction, single carriageway)

[2] Population 68,317 in 2002 (ONS)

[3] Population 97,277 in the 2011 census

Both are lifting bridges, to enable boats and ships to pass through. To the west of Breydon Bridge lies Breydon Water, a large, sheltered estuary which forms the gateway to the Norfolk Broads. It is a SSSI and Local Nature Reserve.

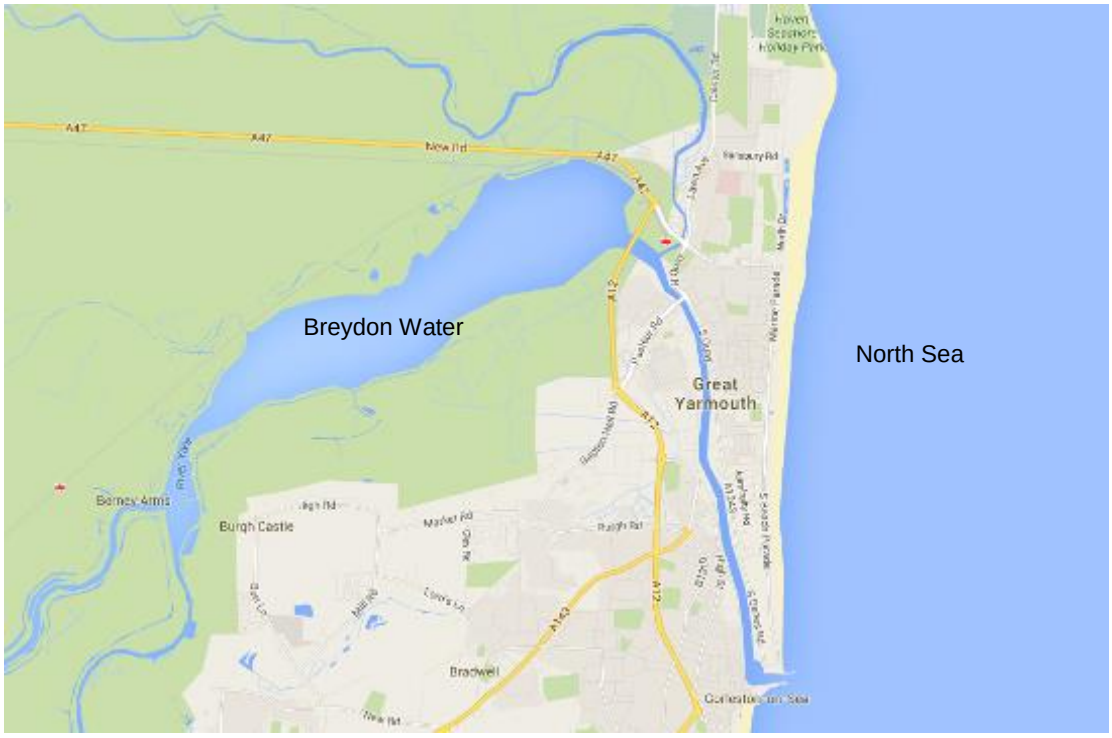


Figure 1-2 Great Yarmouth

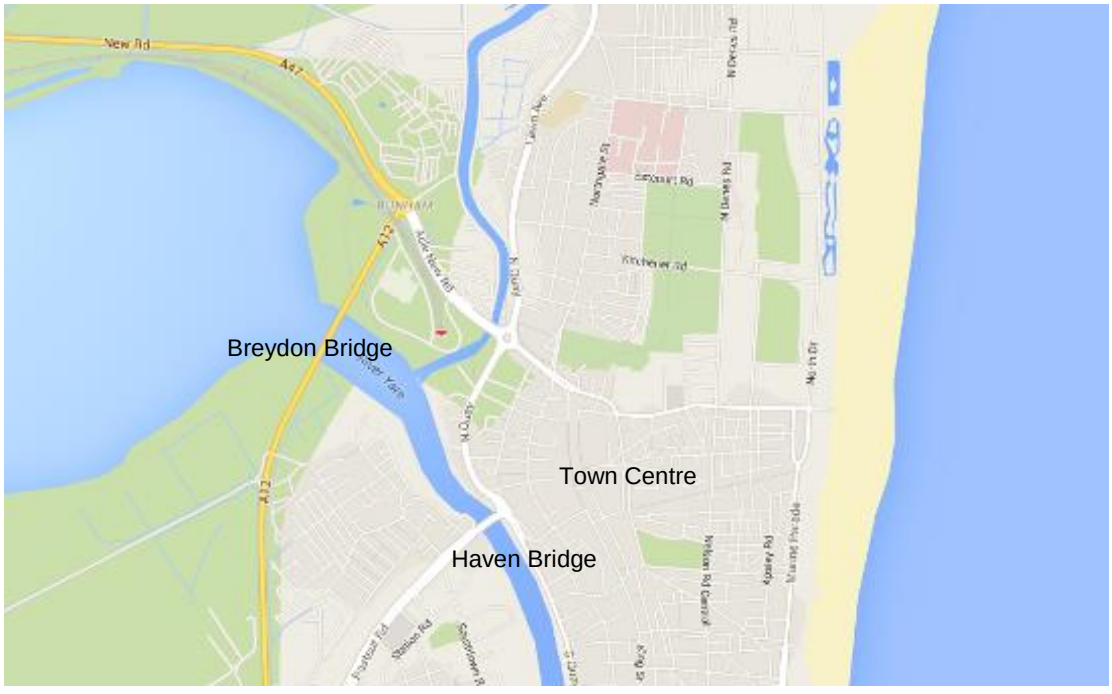


Figure 1-3 Bridges

The Breydon Bridge, constructed in 1985, enables A12 traffic to bypass the centre. The Haven Bridge provides access into the northern part of the town centre.

There are, however, no bridges further south than this. As a result, the southern part of Great Yarmouth, which is built on the peninsula, is effectively isolated from the rest of the Borough.

Despite its severe lack of accessibility, the peninsula is developed and includes several distinct character areas:

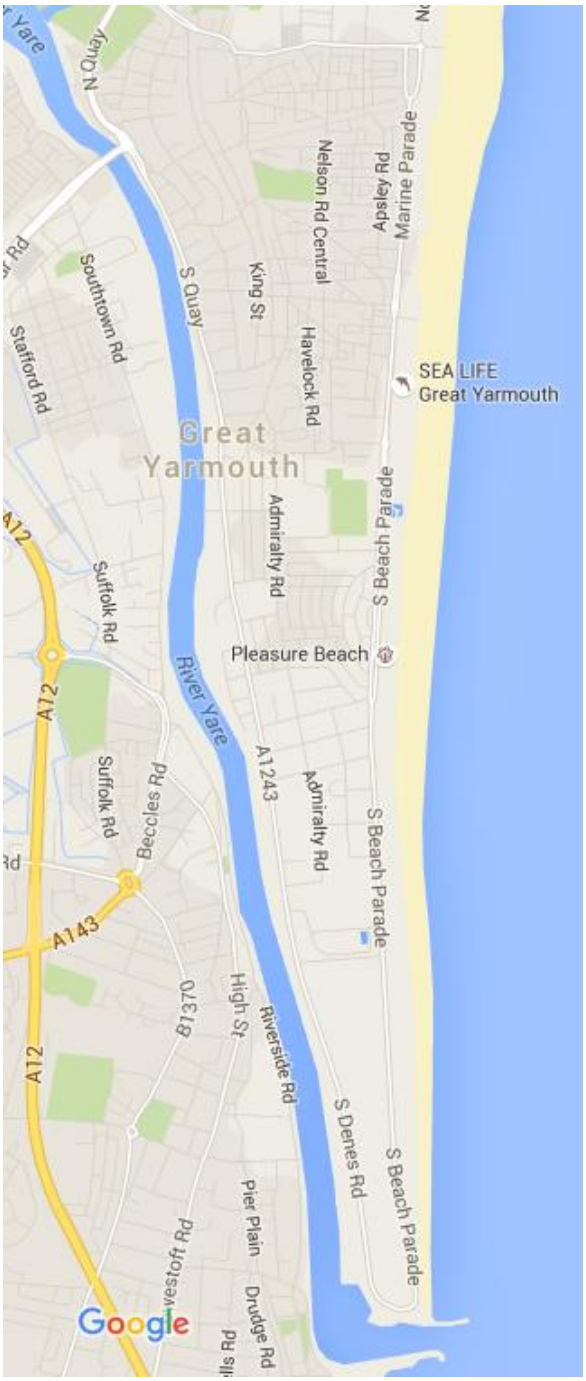


Figure 1-4 The Great Yarmouth Peninsula

The main shopping centre is located in the northern part of the peninsula. To the east of the centre is the traditional sea front, beach and pier with a wide range of visitor attractions. Major public realm improvements have recently been undertaken to Marine Parade and the northern part of South Beach Parade help regenerate the sea front. Further south is an extensive traditional residential area.

On the east bank of the river lies the historic South Quay. This leads into South Denes Road - an extensive industrial and quay area which is subject to a Local Development Order. At the southern extremity of the peninsula is the Outer Harbour, a deep water harbour constructed between 2007 and 2009. Originally intended as a 'Ro-Ro' ferry terminal and container terminal, these plans did not come to fruition. The outer harbour has been designated as an Enterprise Zone and is re-focusing on the offshore wind industry.

The only routes into and out of the peninsula are by means of the existing bridges at its northern end. The proposed scheme is to provide a third crossing of the River Yare linking the southern part of the Great Yarmouth peninsula with the A12 and A143, and the rest of the built up area. The general location of the scheme is illustrated in Figure 1-5 below.

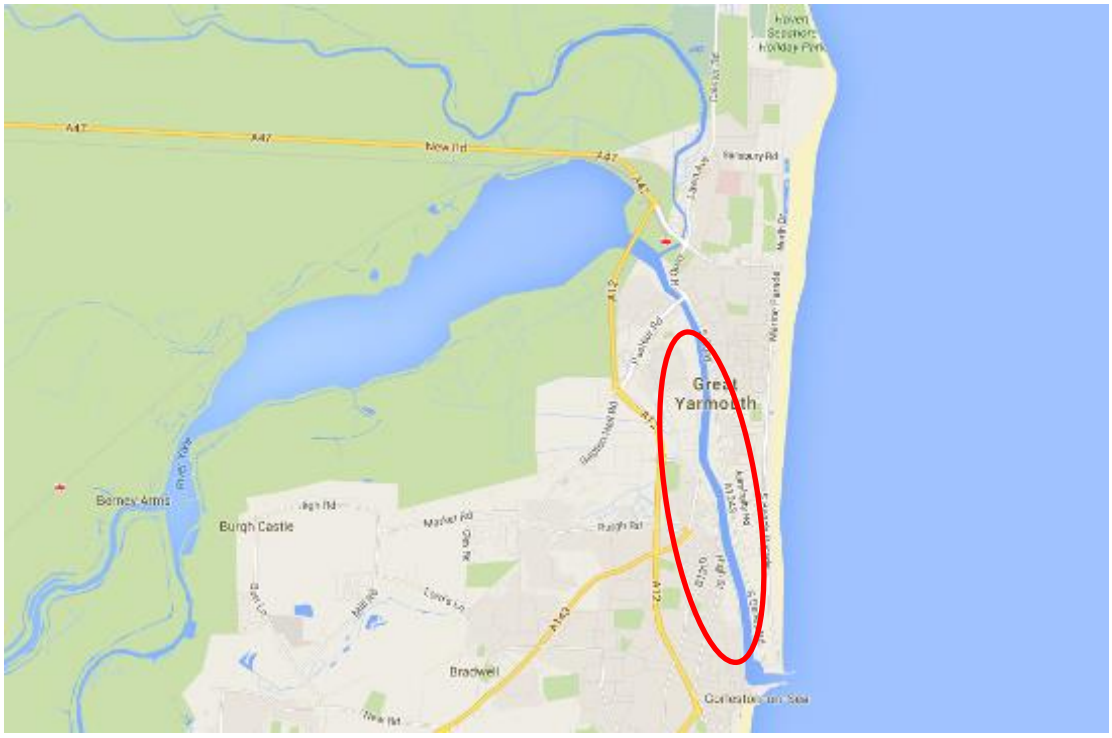


Figure 1-5 General location of the scheme

2 Context

This part of the Option Assessment Report describes the context of the scheme. It reviews the relevant policies and strategic objectives for the area and looks at existing travel conditions. It considers the opportunities for, and constraints on, growth. It considers how things are likely to change over time, and identifies the need for intervention. It sets out clear objectives for the scheme and identifies the area on which it will have an impact.

2.1 Step 1 – Understanding the current situation

As described in Section 1, Great Yarmouth is located on a narrow peninsula, physically separated by the River Yare from the rest of the built-up area. The peninsula includes the main town centre, historic and residential areas, the famous seaside resort, industrial areas, port facilities and a modern deep water harbour. All of this is accessible only from the north, using the two existing bridges.

The economic context is defined by a decline in traditional industry and tourism in the 20th century, coupled with new opportunities for growth and regeneration in the 21st century.

In the early 20th century, Great Yarmouth was a major fishing port and centre of the herring fishing industry, with over 1,000 vessels landing 120,000 tonnes of fish each year. The loss of the traditional fishing industry contributed to the economic decline of the port in the second half of the century. In the 1960s, growth in the offshore oil industry provided a short term economic stimulus, but this too has now declined. Great Yarmouth lacked facilities for vessels with a large draught, and this prompted the construction of a deep water harbour in 2009, in the hope of attracting container and ferry traffic. The worldwide economic recession from 2008 put paid to these aspirations. More recently however, as the closest deep water facility to the East Anglia Array offshore wind farm, the port is starting to benefit from growth in the new sustainable energy sector. It is now the main supply base for the offshore gas industry in the Southern Basin of the North Sea, and for offshore windfarms. There is also a small cluster of high-tech electronics and engineering companies.

Great Yarmouth is also one of the classic seaside towns of the British Isles. The coming of the railway in the first half of the 19th century led to its growth as a resort, and the 20th century saw the rise of the holiday camp. But changing tastes and the affordability of foreign holidays led to a decline in visitors to Great Yarmouth and similar resorts. In more recent years, public realm investment in the sea front area has improved the image of the town as it seeks to attract new visitors. Great Yarmouth remains one of the most popular British seaside resorts and has over 70,000 available bed spaces, caters for around 4 million day visits and nearly 5 million visitor nights each year. There is heavy dependency on the tourist industry, which has an estimated worth of over £530 million per year, and 78 per cent of the jobs in the borough are service-based. In the summer months the population effectively doubles, adding to the demands on the transport network.

2.1.1 *Current transport and other policies*

The strategic policy context is determined by:

- The New Anglia Strategic Economic Plan (2014)
- Local Development Framework documents, including:
    - The Great Yarmouth Local Plan Core Strategy (Adopted Dec 2015)
    - Great Yarmouth Waterfront Area Action Plan (Supplementary Planning Document) Consultation Draft (Nov - Dec 2010)
- Connecting Norfolk: The Norfolk Local Transport Plan for 2026 (April 2011)
- The Great Yarmouth and Gorleston Area Transportation Strategy (2009)

New Anglia Strategic Economic Plan (SEP)

The **New Anglia Strategic Economic Plan** sets out the ambition of the Local Enterprise Partnership (LEP) to deliver more jobs, improved skills, new business and housing, including:

- 95,000 growth in jobs from 2012 to 2026
- 10,000 new businesses from 2012 to 2026
- Increasing GVA by 10% to equal the national average

Figure 2-1 Greater Anglia Strategic Economic Plan area

The SEP identifies Great Yarmouth as a Growth Location, with a strong base in manufacturing and food processing. Manufacturing has seen job losses in the past decade, but there is potential to attract more investment in this sector, as well as in tourism and leisure.

The SEP sees the energy sector as the main opportunity for growth, identifying the area as a major base for the construction, operation, maintenance and servicing of offshore energy production - oil, gas, wind and tidal energy - in the North Sea. It recognises the broader supply chain of energy-related businesses, including design, engineering and manufacturing for the renewable energy industry. Great Yarmouth with Lowestoft has been designated one of six Centres for Offshore Renewable Engineering (CORE), and will receive a comprehensive package of business support. Additional investment in wind energy – including the 6,000 km2 East Anglia Array – will significantly boost activity related to offshore renewables particularly in wind farm assembly and manufacturing.

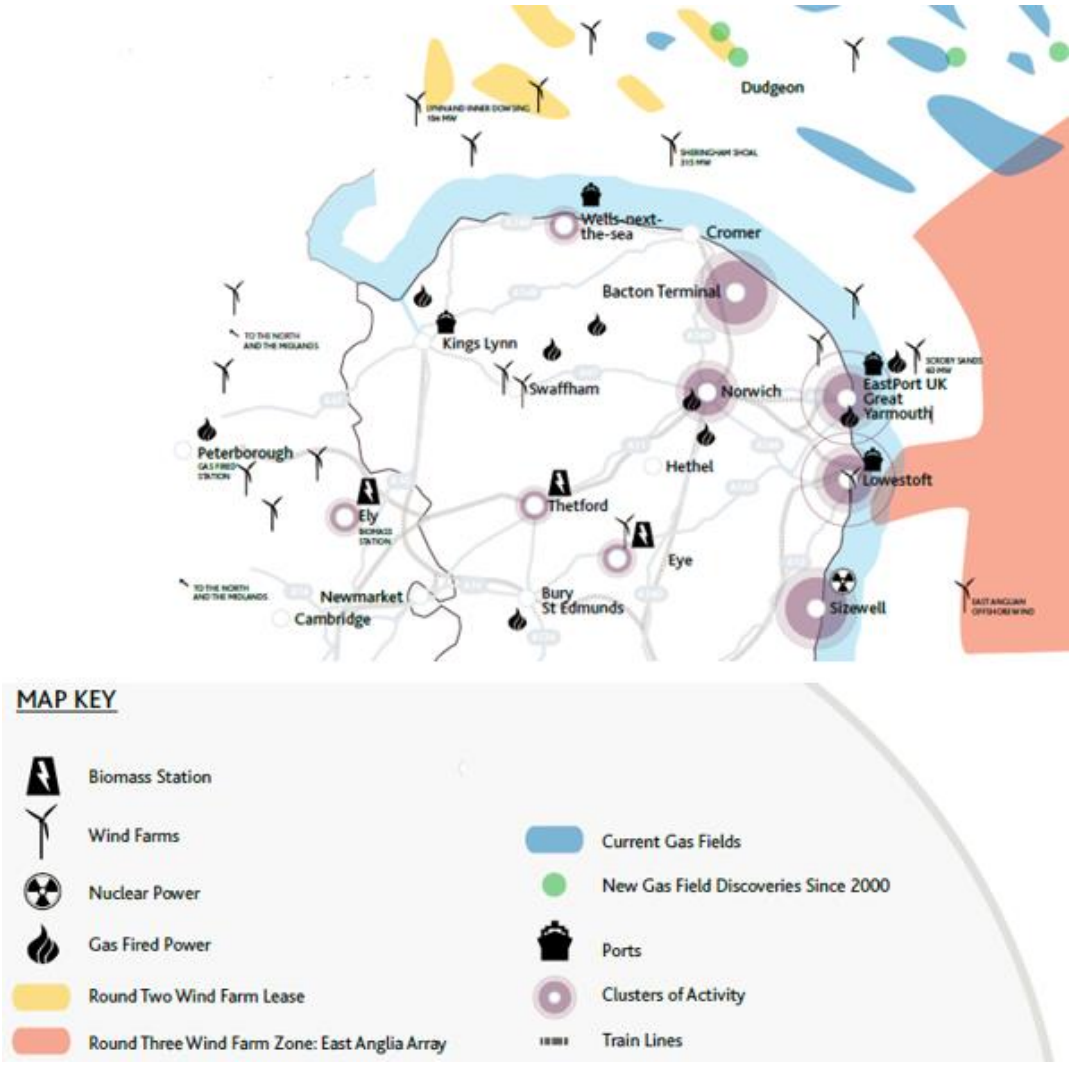


Figure 2-2 Great Yarmouth in the context of the East of England Energy Zone

The SEP acknowledges the concentration of offshore engineering businesses in Lowestoft and Great Yarmouth, together with equipment manufacturing supporting both primary production and food processing.

A key part of the SEP "offer" is the Enterprise Zone (EZ) which designates four sites for energy businesses, offshore engineering, ports and logistics. It is one of the best performing EZs in the country, in terms of jobs already created and floor space built, because local resources were used to get development started. One of the locations is at the South Denes Energy Park in Great Yarmouth which is covered by its own Local Development Order. The EZ is centred on the deep sea harbour on the Great Yarmouth peninsula.

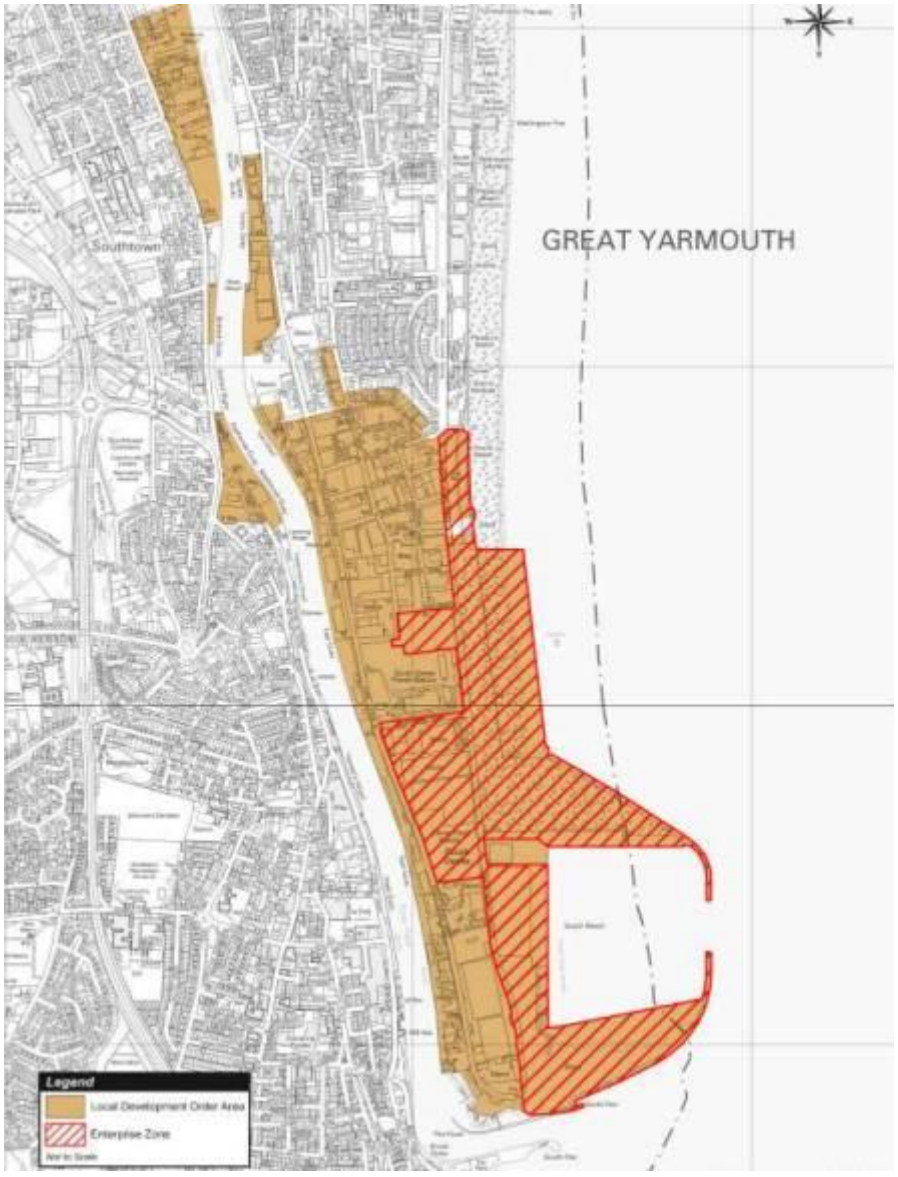


Figure 2-3 Local Development Order and Enterprise Zone, South Denes, Great Yarmouth

Incentives include business rates relief worth up to £275,000 over five years; simplified planning regulations; and Government support for the provision of super-

fast broadband. Business rates growth within the Zone will be retained by the LEP to support economic priorities for at least 25 years. It is estimated that the Enterprise Zone as a whole will create up to 9,000 direct jobs and 4,500 indirect jobs by 2025.

The SEP also includes housing growth of around 2,000 dwellings in Great Yarmouth.

The SEP also presented a strong case for Great Yarmouth and Lowestoft to be designated with Assisted Area status, and this has been recognised with inclusion in the Government's draft map. This means projects can be given more support from New Anglia's Growing Business Fund and EU pot, thus making the EZ more attractive to inward investment.

The SEP strategy addresses a very real need. Unemployment, including long term worklessness, remains high, especially among the young. This is exacerbated by poor education performance with GCSE attainment consistently failing to meet national levels. Alongside this, 40% of local graduates enter non-graduate jobs and too few enter the SME sector. The SEP will deliver a Skills Capital Investment Programme and prioritise investment that drives capacity and excellence in science and technology including investment in innovative new approaches to skills training in partnership with the private sector. The programme will promote the development of HE/FE Clusters linked to major key growth assets including the Great Yarmouth-Lowestoft Enterprise Zone and will seek to address the low participation rates in HE in areas including Great Yarmouth.

The SEP initiatives in Great Yarmouth are, necessarily, centred on parts of the town which are presently isolated with poor accessibility by land. The SEP recognises this and acknowledges that Great Yarmouth suffers from congestion arising from bottlenecks, including at North Quay and the Haven Bridge, and that the limited river crossings force traffic onto a few congested routes. It specifically supports the preparation of a scheme for **a third river crossing in Great Yarmouth**. The SEP, which pre-dates the announcement of the Local Majors Fund, envisaged that this work would lead to the inclusion of a scheme in the (then) Highways Agency's national programme.

Great Yarmouth Local Plan Core Strategy

The **Great Yarmouth Local Plan Core Strategy** is the main document in Great Yarmouth Borough Council's Local Plan (2013 – 2030) It establishes the spatial vision and objectives for how the borough will develop and grow in the future. It also sets out strategic policies and site allocations, called 'Core Policies' and 'Key Sites', which provide the strategic context for other Local Plan Documents, Supplementary Planning Documents and Neighbourhood Development Plans.

The Core Strategy sets out a vision for the borough as a more attractive and aspirational place to live, work and play, with strong links to Lowestoft, the Broads, Norwich, rural Norfolk and the wider New Anglia Local Enterprise Partnership area. It

notes that Great Yarmouth will continue to have a thriving relationship with Lowestoft, and describes a complementary and integrated approach to the regeneration of the two towns, taking advantage of the huge growth potential in the renewable energy and port sectors to create thousands of new jobs.

A **third river crossing** over the River Yare is envisioned in the Core Strategy, along with improvements to public transport and the creation of attractive walking and cycling routes from the train station to the waterfront, town centre and seafront, which will relieve congestion and provide essential links to key facilities and services, including the outer harbour.

The Core Strategy sets seven strategic objectives:

SO1 Minimising impact on the environment
SO2 Addressing social exclusion and reducing deprivation
SO3 Accommodating a growing population
SO4 Strengthening the competitiveness of the local economy
SO5 Capitalising on the successes of the local visitor economy
SO6 Protecting and enhancing the quality of the local environment
SO7 Securing the delivery of key infrastructure

Under Objective SO7, the Core Strategy aims to encourage efficient patterns of movement by recognising the strategic role that the A47, a **third river crossing**, the river port, outer harbour and rail corridor (including a rail freight interchange) will play in meeting the borough's needs.

The Core Strategy envisages provision of 1,000 new homes at the Great Yarmouth Waterfront area (at least 350 during the plan period), and:

- Encourages the redevelopment and intensification of existing employment sites, and exploring the potential to develop 22 hectares of land reclamation north of the Outer Harbour at South Denes

- Supports port-related development proposals related to the Outer Harbour and existing river port

- Encourages a greater presence of higher value technology and energy-based industries, including offshore renewable energy companies

- Supports the local visitor and retail economies

In safeguarding 118 hectares of existing employment land at South Denes, including the Outer Harbour and South Quay, the Core Strategy considers that there is considerable scope for the already thriving energy and port-related sectors to expand as a result of the Enterprise Zone (EZ) and Local Development Orders.

South Denes is a priority area for industrial and warehousing development, attracting businesses operating in, or providing essential support services to the energy, offshore engineering and ports & logistics sectors. The development of the Outer Harbour is of strategic importance to the borough's economy and is a key driver for the regeneration of Great Yarmouth. It complements the existing river port and increases its overall operating capacity. The prospects for new business for the port are starting to be realised with investment for handling grain, aggregates and wind farm maintenance. The Outer Harbour has the potential to accommodate a large range of vessels and operations, including freight ferries, general and bulk cargo, oil and gas, decommissioning and special projects, including offshore wind. The possibility of a 'roll-on, roll-off' ferry service remains a part of the port's longer-term ambitions.

The Core Strategy recognises the challenges of Great Yarmouth's unique geography, noting that the seafront, central shopping area and outer harbour are on a peninsula, separated from a high percentage of the resident population by the River Yare. The two existing river crossings; Breydon Bridge and Haven Bridge are subject to high traffic flows and become severely congested during peak hours. Great Yarmouth and Gorleston also experience a dramatic increase in traffic flows during the holiday season. This extra traffic conflicts with town centre, port and commercial traffic, creating congestion problems on the road network, particularly on the A47 and A12, South Quay, North Quay, Fullers Hill and Lawn Avenue.

For these reasons the Core Strategy specifically supports the development of a **third river crossing** to reduce congestion within the heritage area of North Quay and South Quay, reducing pressure on Haven Bridge and generally improving access across the River Yare, and to help the Outer Harbour realise its long-term potential.

Great Yarmouth Waterfront Area Action Plan (AAP)

The **Great Yarmouth Waterfront Area Action Plan** is a Supplementary Planning Document which covers a total area of some 40 ha of predominantly brownmfield land in Great Yarmouth (Figure 2-4). . It sets out a detailed vision, objectives, plans and proposals for development in this area, in line with the Core Strategy. Five Strategic Sites are identified, the development of which will contribute to the regeneration and revitalisation of the Great Yarmouth waterfront area:

- North Quay 6.98 ha
- The Conge 2.4 ha
- Runham Vauxhall 14.6 ha
- Bure Harbour Quay 7.9 ha
- Ice House Quay 7.5 ha

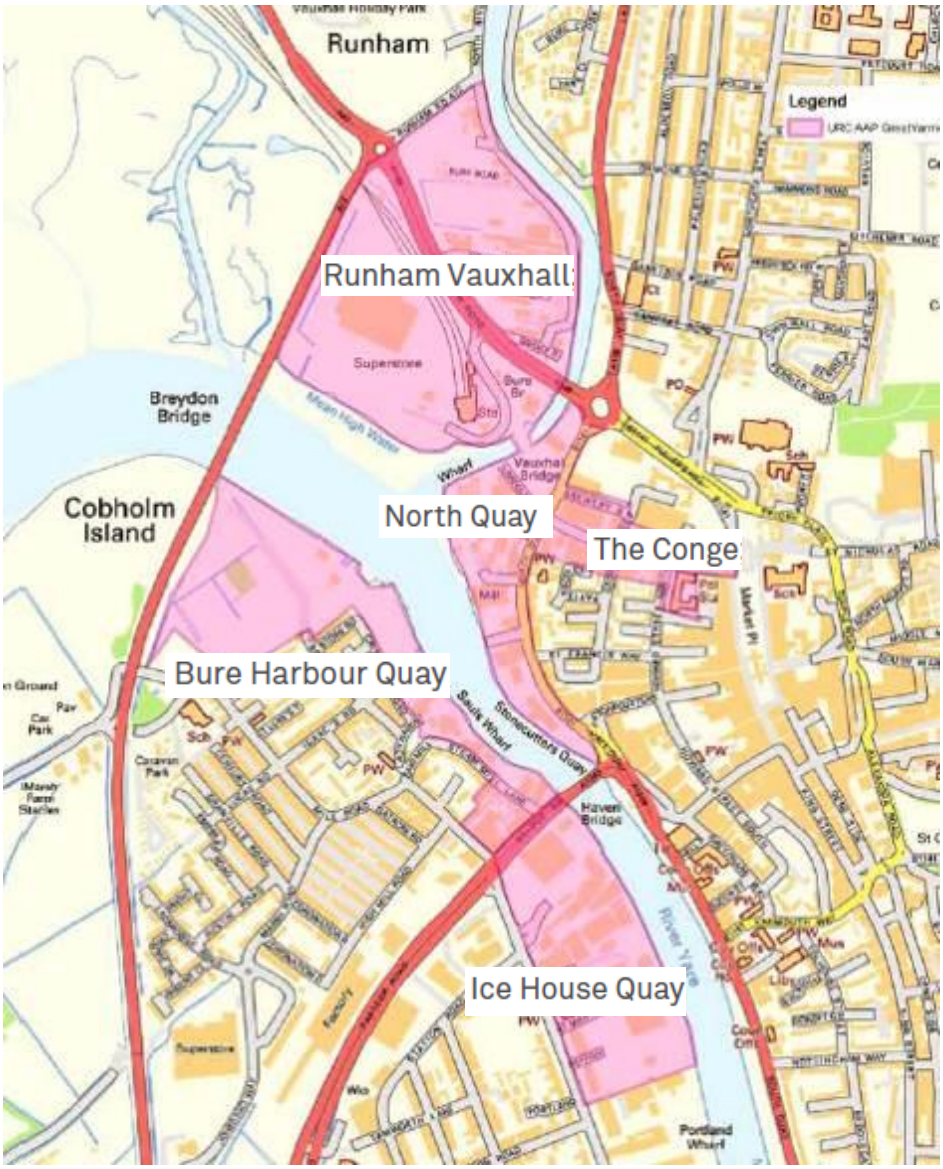


Figure 2-4 Great Yarmouth Waterfront Area Action Plan - Plan area

The North Quay strategic site occupies a triangular area defined by an extensive waterfront on two sides and the North Quay thoroughfare. The site is connected to the Station Gateway via the Vauxhall Bridge to the north of the site where there is a significant amount of vacant land. Much of the site is in fragmented land use and ownership with a mixture of residential, industrial, storage and showroom activities. North Quay provides a significant opportunity to deliver high quality waterfront development and a new focus for activity in Great Yarmouth, complementing the offer provided in the town centre and seafront areas.

The area immediately to the west of Haven Bridge is dominated by a heavily trafficked dual carriageway, Bridge Road, with a poor pedestrian and cycle environment. The inclusion of this area in the AAP seeks to ensure that an appropriate gateway is provided here on the approach to Great Yarmouth's historic river frontage and South Quay area.

The AAP notes that large vehicle flows, and in particular heavy vehicles, passing along North Quay, causes severance between the riverside sites and the town centre. It acknowledges that the development of the port beyond the AAP area will add pressure on the highway network and increase the number of larger vehicles moving through the town.

The AAP states that new developments need to minimise additional vehicle trip generation routing via Bridge Road, as the area of the network around the Haven Bridge is at risk of being declared an Air Quality Management Area (AQMA). However it notes that it is unclear what measures could be employed to mitigate air quality issues on this key route to the port, prior to the construction of a Third River Crossing.

The AAP notes that a third river crossing would provide a further vehicle connection across the River Yare to the south of Haven Bridge. Though itself outside the AAP area, it would provide access to the port from the strategic network (A12 / A47) without the need for port-related traffic to pass through the town centre.

The AAP envisages an improvement scheme at the North Quay / The Conge junction, including bus priority measures and wider footways, but states that more radical proposals for a shared layout at this junction will not be considered until a third river crossing is delivered.

The AAP identifies the third crossing as an essential long term infrastructure requirement, justifying contributions from all development sites in the AAP area.

Connecting Norfolk – The Norfolk Local Transport Plan for 2026 (LTP)

The **Norfolk Local Transport Plan for 2026** identifies six strategic aims for transport in Norfolk:

- Maintaining and managing the highway network
- Delivering sustainable growth
- Enhancing strategic connections
- Reducing emissions
- Improving road safety
- Improving accessibility

The LTP (Policy 7) identifies a number of strategic connections including to Norfolk's gateways, Norwich Airport and the ports at King's Lynn and Great Yarmouth.

The LTP notes the importance of enhancing connections to Norfolk's three international gateways: Norwich Airport and the ports at Kings Lynn and Great Yarmouth. At Great Yarmouth, the focus is on achieving a sustainable distribution of freight journeys to and from the port, including provision of a future **third crossing** of the River Yare, which will provide an enhanced link to the port from the strategic road network and help remove traffic from the town centre.

Great Yarmouth and Gorleston Area Transportation Strategy

The **Great Yarmouth and Gorleston Area Transportation Strategy** (2009) examined a wide range of strategic solutions to the areas transport problems and opportunities.

It identified a third crossing as a major scheme aimed at overcoming the problem of limited access to the peninsula of Great Yarmouth and the congestion that this causes. It would do this by offering a more direct route into the town from the south, and providing relief to the two existing road bridges. As such it would provide the missing link between the A12 trunk road and the expanding port facilities. In addition, it would provide accessibility benefits to the town by providing more direct routes between housing and employment areas, supporting regeneration.

High levels of support were reported for the provision of a third crossing, with 92% of respondents in a 2009 consultation exercise supporting the need for a new crossing.

Current transport and other policies – conclusions

Common themes in all of the above policies are:

- The need for economic regeneration in Great Yarmouth
- The potential for growth associated with the offshore energy industry, especially in the Enterprise Zone and outer harbour,
- The lack of adequate links between potential development areas on the peninsula and the strategic road network, especially to the A12 (south)
- The problem of heavy traffic on the existing bridges, and congestion in adjacent areas of the town such as North Quay, which carries traffic between the port and the A47
- The need for a third crossing of the River Yare to provide traffic relief, and better access to strategic routes, supporting regeneration and growth on the peninsula.

2.1.2 *Current demands and levels of service*

Traffic levels on the existing bridges are high, as detailed below:

2-way traffic flows 2003	12 hrs ALL (7 am – 7 pm) Observed	12 hrs HGV (7 am – 7 pm) Observed	24hr ALL AADT Modelled
A12 Breydon Bridge (across River Yare)	29,912	1,308	38,544
A1243 Haven Bridge (across River Yare)	23,813	764	35,125

Table 2-1 Traffic on existing bridges (2003)

Extensive observed data collected in 2003 – traffic flows and journey times – was used to calibrate and validate a SATURN traffic model for a 2003 base year. This model forms the basis of the scheme modelling undertaken to date, and will be updated for the Outline Business Case.

More recent observed data[4] from June 2015 is detailed below:

2-way traffic flows Thursday 18June 2015	12 hrs ALL (7 am – 7 pm)	12 hrs HGV (7 am – 7 pm)
A12 Breydon Bridge (across River Yare)	30,677	710
A1243 Haven Bridge (across River Yare)	22,429	950

Table 2-2 Traffic flow on existing bridges, 2015

Surveys show that traffic on both bridges has been increasing steadily since 2013:

2-way traffic flows 2013 - 2015	12 hrs ALL (7 am – 7 pm) 2013	12 hrs ALL (7 am – 7 pm) 2014	12 hrs ALL (7 am – 7 pm) 2015
A12 Breydon Bridge (across River Yare)	29190	29934	30677
A1243 Haven Bridge (across River Yare)	18716	20573	22429

Table 2-3 Traffic growth on bridges 2013-2015

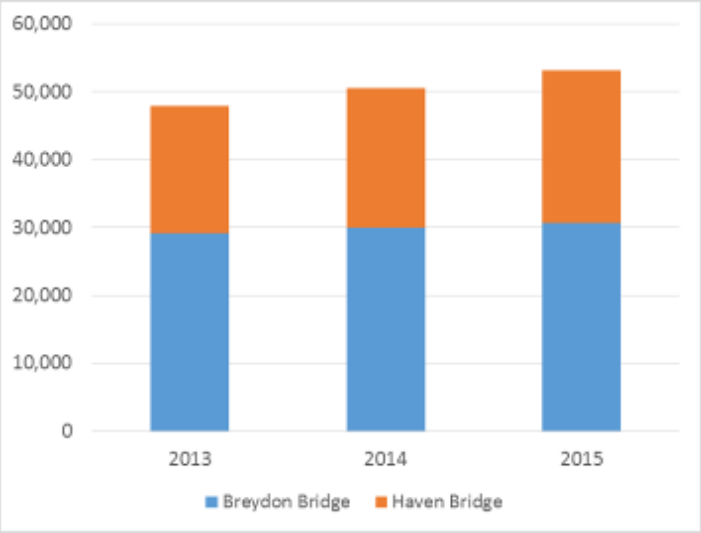


Figure 2-5 Traffic growth on bridges 2013 – 2015 (12 hour totals)

Detailed classified traffic counts and queue length surveys were undertaken by Norfolk CC at key locations in the vicinity of the Haven Bridge and town centre (Figure 2-6) on Thursday 15 October 2015.

[4] From Great Yarmouth Cordon Survey – Norfolk CC

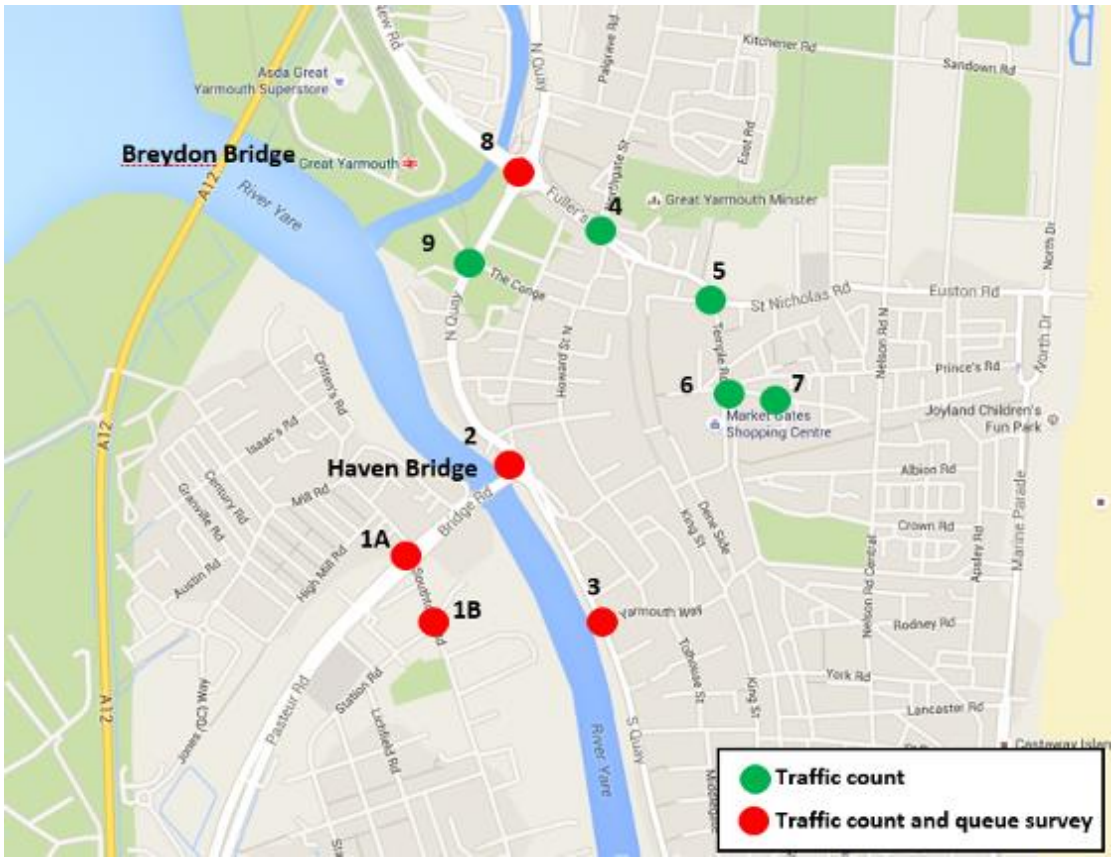


Figure 2-6 Location of traffic count and queue surveys, October 2015

Key results are summarised below:

Location	Direction	Maximum queue (veh)
1A	From Pasteur Road	>150
1A	From Bridge Road	>150
1A	From Southtown Road	100
2	From North Quay	127
2	From South Quay	>150
2	From Bridge Road	142
3	From the north	137
3	From the south	92
8	From Acle New Road	>150
8	From North Quay (north)	>150
8	From Fullers Hill	40
8	From North Quay (south)	>150

Table 2-4 Maximum observed queue lengths, 15 October 2015

2-way traffic flows Thursday 15 October 2015	12 hrs ALL (7 am – 7 pm)
A1243 Haven Bridge (across River Yare)	22,513

South Quay, south of Haven Bridge	19,697
North Quay, north of Haven Bridge	11,709
Acle New Road (across River Bure)	22,226
Fullers Hill	9,316
Temple Road	21,816

Table 2-5 Traffic flows, October 2015

These surveys illustrate the high levels of traffic on key roads in the centre of Great Yarmouth, especially around the existing bridges, and the high levels of queuing which result from the limited capacity of the local road network.

One consequence of this for road users is that journey times in peak periods are significantly longer than in the off peak. This may be illustrated by using open access data from Google Maps to compare journey times on various routes at different times of the day.

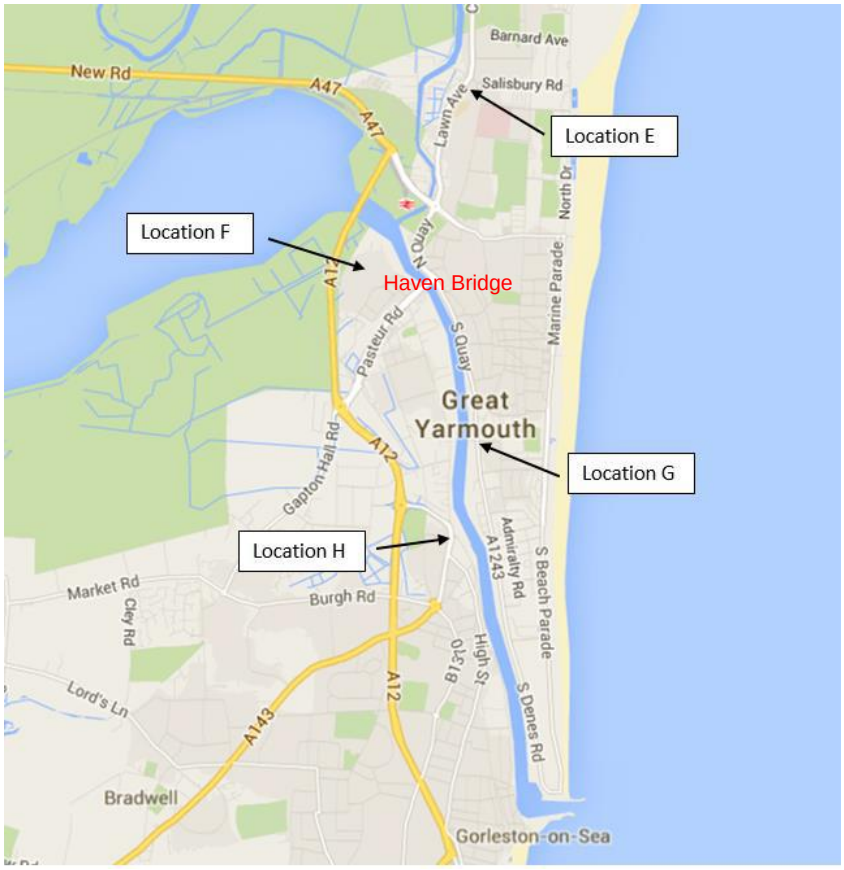


Figure 2-7 Journey times via Haven Bridge – end points for measurement

Journeys using Haven Bridge were tracked between four locations, as illustrated in Figure 2-7.

E - Caister Rd junction with Lawn Avenue (Northeast)
F – Cobholm Primary School (Northwest)
G – Newcastle Rd junction with Southgates Rd (Southeast)

H – Alpha Rd Junction with Beccles Rd (Southwest)

	To:	To E			To F			To G			To H		
From:		**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**
E	Minutes				12	12	12	8	7	8	14	12	16
	% over OP				0%		0%	14%		14%	17%		33%
F	Minutes	7	7	8				6	6	6	5	5	6
	% over OP	0%		14%				0%		0%	0%		20%
G	Minutes	6	6	8	6	6	7				7	8	9
	% over OP	0%		25%	0%		17%				-13%		+13%
H	Minutes	9	9	10	6	5	10	10	9	14			
	% over OP	0%		11%	20%		100%	11%		56%			

Table 2-6 Peak and off peak journey times via Haven Bridge, Nov 2015

	To:	To E			To F			To G			To H		
From:		**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**
E	Minutes				14	10	12	10	7	8	14	12	14
	% over OP				40%		20%	43%		14%	17%		17%
F	Minutes	7	7	8				6	6	7	5	5	5
	% over OP	0%		14%				0%		17%	0%		0%
G	Minutes	6	6	7	6	6	7				8	8	9
	% over OP	0%		17%	0%		17%				0%		13%
H	Minutes	9	9	10	6	5	9	10	9	14			
	% of OP	0%		11%	20%		80%	11%		56%			

Table 2-7 Peak and off peak journey times via Haven Bridge, March 2016

Similarly, journeys using Breydon Bridge were tracked between four locations, as illustrated in Figure 2-8.

A - Branch Rd junction on the A47 (West)
B – Caister Rd junction with Lawn Avenue (North)
C – Nelson Rd N junction with Euston Rd (East)
D – Gapton Hall Retail Park (South)

Figure 2-8 Journey times via Breydon Bridge - end points for measurement

	To:	To A			To B			To C			To D		
From:		AM	OP	PM	AM	OP	PM	AM	OP	PM	AM	OP	PM
A	Minutes				18	10	14	20	12	14	20	12	16
	% over OP				80%		40%	67%		17%	67%		33%
B	Minutes	12	12	14				4	4	4	9	8	12
	% over OP	0%		17%				0%		0%	13%		50%
C	Minutes	10	12	16	3	3	3				7	7	12
	% over OP	-17		33%	0%		0%				0%		71%
D	Minutes	12	10	14	7	7	9	7	7	9			

	% over OP	20%		40%	0%		29%	0%		29%			

Table 2-8 Peak and off peak journey times via Breydon Bridge, Nov 2015

	To:	To E			To F			To G			To H		
From:		**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**
A	Minutes				20	10	14	20	12	16	20	12	14
	% over OP				100%		40%	67%		33%	67%		17%
B	Minutes	14	12	14				4	4	4	10	8	10
	% over OP	17%		17%				0%		0%	25%		25%
C	Minutes	10	12	14	3	3	3				8	7	9
	% over OP	-17		17%	0%		0%				15%		29%
D	Minutes	12	10	12	7	7	9	7	7	10			
	% of OP	20%		20%	0%		29%	0%		43%			

Table 2-9 Peak and off peak journey times via Breydon Bridge, March 2016

Current demands and levels of service - conclusions

The above analyses of traffic data, queuing and journey time information illustrates and supports the body of anecdotal evidence which has consistently highlighted the problems of congestion in Great Yarmouth, especially that which is associated with the constrained access to the peninsula. These problems are further exacerbated by the large seasonal variation arising from Yarmouth's role as a major resort attracting both staying and day visitors at holiday times.

The quantitative impact of the traffic conditions illustrated and described above has been assessed objectively using the Great Yarmouth SATURN model which has a base year of 2003.

2.1.3 Opportunities and constraints

Opportunities

There is an opportunity to improve accessibility to the Great Yarmouth peninsula and port whilst relieving congestion, by providing a third crossing, to the south of the existing Haven Bridge. This:

- Provide a more direct route between Great Yarmouth and the A12 (south), including Lowestoft
- Provide a direct access to the A12 and A47 for traffic to/from the north, including Norwich without passing through the congested town centre
- Facilitate employment growth in the peninsula and Outer Harbour
- Provide a more direct route into the southern part of the peninsula for pedestrians, cyclists and buses

Constraints

The main physical constraints are:

- Development on either side of the River Yare means there are only a limited number of locations where a third crossing could be constructed
- The need to tie into the existing highway network. The simplest location is for a tie in to the A12 at Halfrey's Roundabout.
- The need to maintain access for shipping. A clear navigable width of at least 50m will be required for a bridge solution. Also, a bridge would either need an air draught of at least 40m above the Mean High Water Spring Tide level, or be able to open to allow the largest vessels to pass through. An air draught of 7.5m when closed would enable most power driven small craft to pass under a bridge reducing the number of times it would need to be opened.
- The need to minimise adverse impact on existing port activities.
- With a lifting bridge, there is a balance to be struck between a southerly location (which provides more direct access to the port) and a bridge further up-river (which would need to open less often).

Detailed information on the physical constraints, including topography, geology and hydrology is set in the Stage 1 and Stage 2 Scheme Assessment Reports[5] [6] and associated documents.

[5] Great Yarmouth Third River Crossing, Stage 1 Scheme Assessment Report (Mott Macdonald for Norfolk CC, 2007)

[6] Great Yarmouth Third River Crossing, Stage 2 Scheme Assessment Report (Mott Macdonald for Norfolk CC, 2009)

2.2 Step 2 – Understanding the future situation

Step 1 above has described the current situation. Step 2 considers what is expected to change in the future in terms of:

- Future land-uses and policies
- Future changes to the transport system
- Future travel demands and levels of service

Future land-uses and policies

An overview of the policies and proposals which will shape Great Yarmouth in future has been set out in Paragraph 2.1.1 above.

The current[7] version of the Great Yarmouth SATURN model has a base year of 2003. Forecasts for 2008 were developed taking account of major developments since 2003 including:

- B&Q superstore, Thamesfield Way – 11,842 m²
- Tesco superstore, Jones Way – 8,834 m²
- Gapton Hall Retail Park
- New housing development, Marsh Road – 149 houses

Traffic generation from these sites has been derived from the TRICS 2008(b) database with the exception of Gapton Hall Retail Park, where origin and destinations were observed on 11th September 2008. Overall traffic growth was constrained to TEMPRO.

Future developments in the Great Yarmouth area were added into the appropriate model zone. Development traffic was estimated using trip rates derived from the TRICS 2008 (b) database. Developments included within the model are listed in the Stage 2 Traffic and Economics Appraisal Report, Appendix A. Growth has been constrained to TEMPRO (version 5.4) levels in the remaining zones.

Future changes to the transport system

Highways England (HE) has identified schemes to address congestion hotspots on the A47 around Norwich, Peterborough and Great Yarmouth. These will include dualling of single carriageway sections and various junction improvements. The improvements will take place at six locations on the A47 between its junctions with

[7] As noted in the Stage 2 Traffic and Economic Assessment Report, any further work on the appraisal will require a comprehensive review of the model including re-validation and possible use of variable demand modelling.

the A1 near Peterborough and Great Yarmouth and on the northern section of the A12 between its junction with the A47 at Great Yarmouth and Lowestoft.

The improvements in Great Yarmouth, scheduled to start in 2020, are to the following junctions and roundabouts on the A12 and A47: Vauxhall, Gapton, Harfreys, Bridge Road and James Paget Hospital

A route map outlining the six schemes across the whole route is shown in Figure 2-9 below.

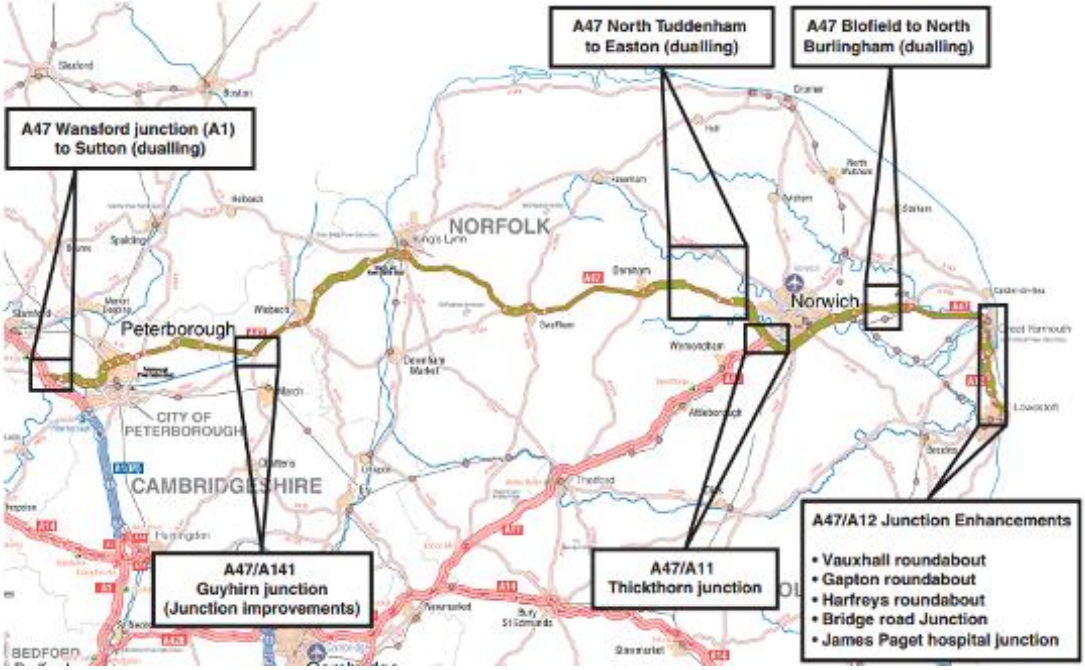


Figure 2-9 HE A47 Corridor Improvement Programme

These improvements to the Strategic Road Network will complement the provision of a third river crossing in Great Yarmouth, as users of the new crossing will also have the benefit of less congested routes to the west and south of the town, improving connectivity. However the A47/A12 improvements will not in themselves address the problems of congestion within Great Yarmouth or the lack of direct access to the peninsula and Outer Harbour. The County Council and the LEP will work closely with the HE to ensure that the two schemes take account of each other, especially in relation to the A12 Hafrey's roundabout.

Future travel demands and levels of service

Forecast flows and journey times for the Do Minimum scenarios have been derived from the future year SATURN models. Annual Average Daily Traffic (AADT) flows have been calculated using the method described in the Stage 2 Traffic and Economic Appraisal Report.

Figure 2-10 shows the modelled base flows for 2003 and 2008 on a selection of roads in Great Yarmouth, and Figure 2-11 shows the forecast ‘do minimum’ flows for 2015 and 2030.

As already noted, any further work on the appraisal will require a comprehensive review of the model including re-validation and possible use of variable demand modelling.

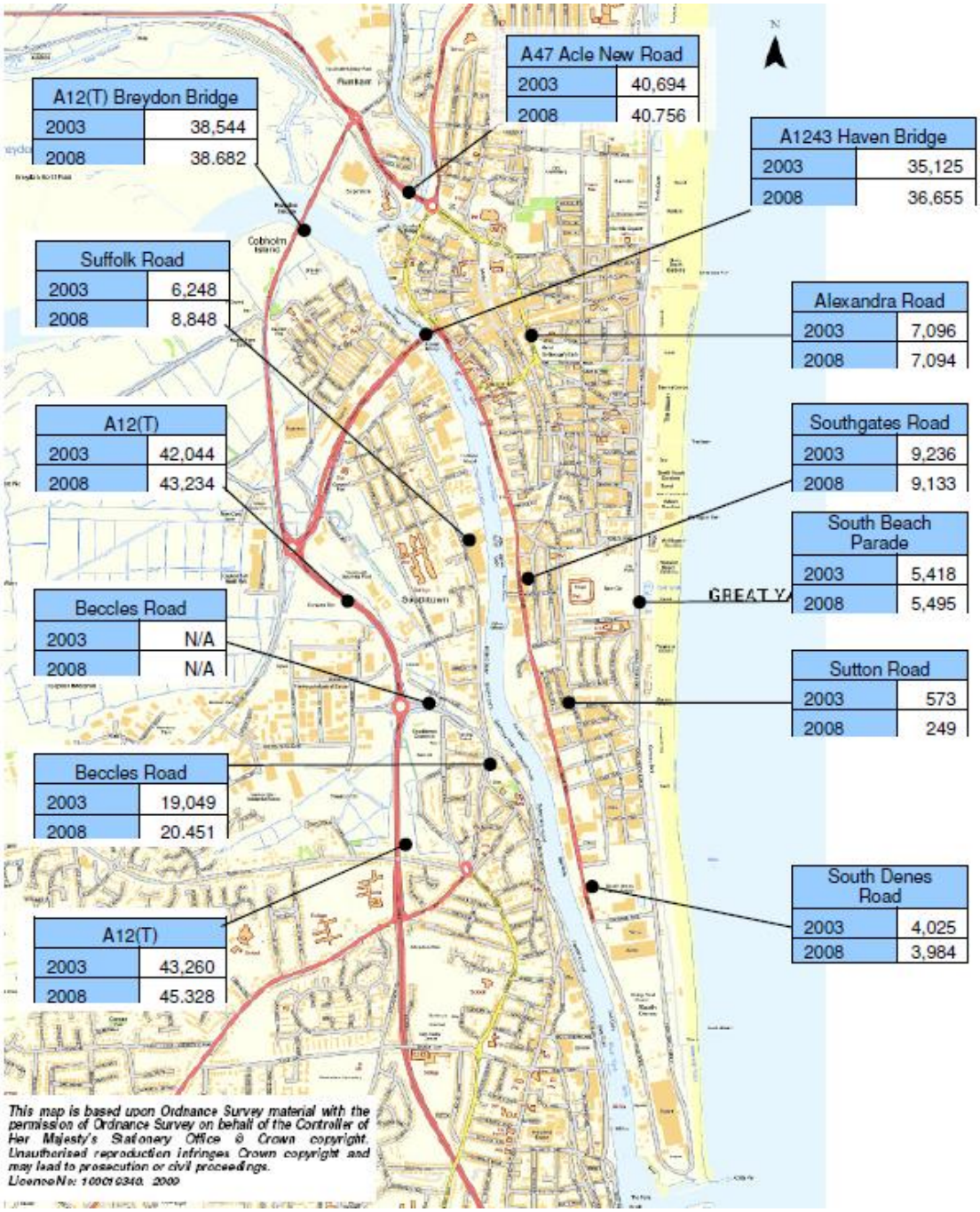


Figure 2-10 Base 2003 and 2008 AADT flows (from SATURN model)

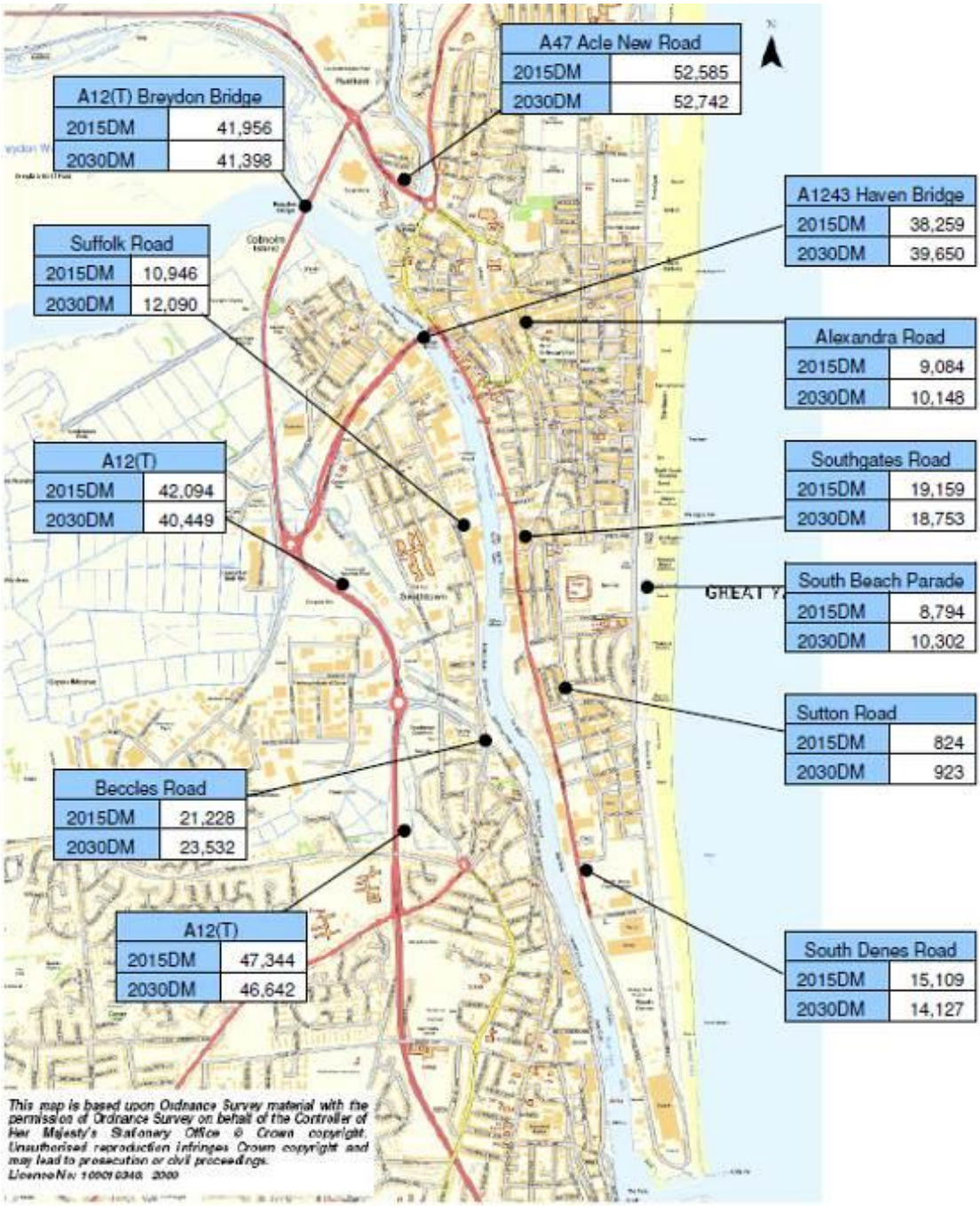


Figure 2-11 Forecast Do Minimum 2015 and 2030 AADT (from SATURN model)

The level of traffic on the existing bridges is forecast to increase, as detailed below:

Forecast AADT (all vehicles)	2003	2008	2015	2030
A12 Breydon Bridge	38,544	38,682	41,956	41,398
A1243 Haven Bridge	35,125	36,655	38,259	39,650

The forecast general increase in traffic will be associated with a general worsening of the current problems of congestion and delay, further exacerbating the problems of access to the peninsula and port.

2.3 Step 3 – Establishing the need for the scheme

This section of the report sets out the reasons why the scheme is needed. It builds on the information set out in Paragraph 2.1.2 above, and considers the problems which the scheme will address, including:

- Current transport problems, and their underlying reasons
- Future transport problems and opportunities for improvement

The main problems and related opportunities are listed in paragraphs 2.3.1, 2.3.2 and 2.3.3 below, and described in more detail in paragraphs 2.3.4 - 2.3.14.

2.3.1 Current transport problems, and their underlying reasons

- Congestion
- Inadequate access to employment areas and the harbour,
- Difficulty accessing to the town centre, sea front and leisure facilities
- Decline in town centre retailing
- Inefficient and indirect bus services into the southern part of the peninsula
- Lack of direct walking and cycle routes into the southern part of the peninsula
- Perception that Great Yarmouth is remote, discouraging inward investment
- Community severance.
- Impact of traffic on historic areas
- Emissions of CO2 and other greenhouse gases
- Impacts of traffic on air quality
- Accidents
- Lack of resilience in the local road network

All of the above problems are, to varying degrees, a consequence of the inadequacies of the transport networks accessing the Great Yarmouth peninsula.

2.3.2 Future transport problems

- Increased congestion and related problems
- Failure to achieve the full potential for growth in the Local Development Order (LDO) area and Enterprise Zone, including the port and outer harbour

2.3.3 *Opportunities for improvement*

- To improve connectivity between the port of Great Yarmouth and the strategic road network, especially the A12 towards Lowestoft and the south.
- To improve cohesion between businesses in the LDO area and Enterprise Zone, and similar businesses at Beacon Park and in Lowestoft.
- To help Great Yarmouth to contribute to, and benefit from, growth in the offshore energy industry.
- To complement recent investment in the town centre and sea front area and support continued regeneration.
- To develop more efficient bus services
- To create improved networks for pedestrians and cyclists

2.3.4 *Congestion*

Evidence of congestion and delay is set out in Paragraph 2.1.2 above. Congestion is a longstanding local concern, as evidenced by the results of a survey undertaken in connection with the Great Yarmouth and Gorleston Area Transport Strategy in 2009:

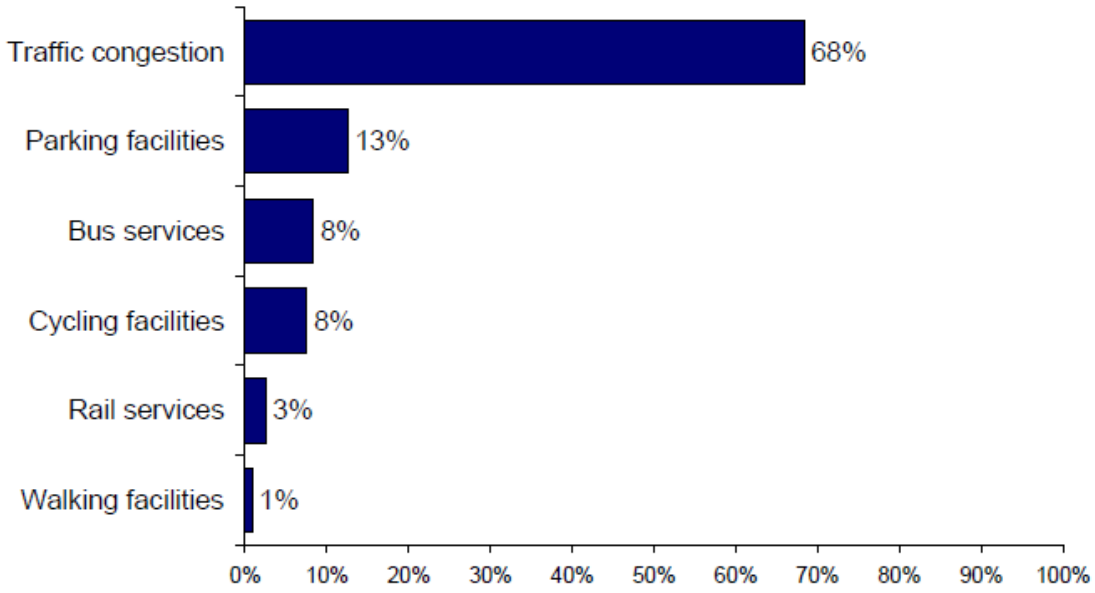


Figure 2-12 Aspects of transport which are the most important to improve. (Surveyed in 2009)

2.3.5 *Inadequate access to employment areas and the harbour*

All traffic to and from the outer harbour and the industrial areas on the Great Yarmouth peninsula have to use the existing bridges. This contributes to the congestion on and around the bridges, and makes employment areas and the port more difficult to get to. It restricts businesses' access to the labour market and

makes delivery of materials, products and imports more expensive. Access to and from the south has the additional problem that the distance by road is far greater than the distance as the crow flies, because there is no direct link between the A12 and the peninsula.

Poor accessibility makes it more difficult to encourage investment in the Local Development Order area and Enterprise Zone (Paragraph 2.1.1) especially as any new development will itself generate traffic and add to the problems. In particular the relative inaccessibility by land of the new deep water harbour could make it more difficult to attract the new business needed to regenerate the port.

A third crossing providing a direct, high standard access into the employment areas present an opportunity to attract more investment, and could be a catalyst for much needed regeneration and growth.

2.3.6 Difficulty accessing the town centre and decline in town centre retailing

Congestion around the existing bridges restricts the access into the town centre.

The town centre has experienced decline over the years. In January 2015 the Marks and Spencer store in King Street closed and moved to an out-of-town site – a significant loss to traditional centre. The Borough Council has recently invested £1m in physical improvements to help regenerate the town centre.

A third crossing would be an opportunity to complement this investment by improving access to the town centre for all modes of transport, whilst reducing the impact of traffic in key areas.

2.3.7 Difficulty accessing the sea front and leisure facilities

The sea front too can only be accessed via the congested bridges at the northern end of the peninsula. Recent investment in the public realm has led to major improvements to the northern part of the sea front; by contrast, the southern, less accessible part, is desolate and unfrequented by visitors.

A third crossing would be an opportunity to complement recent public realm improvements by improving access to all parts of the sea front, for all modes of transport, and dispelling the perception that Great Yarmouth is remote and inaccessible

2.3.8 Inefficient and indirect bus services into the southern part of the peninsula

Existing bus routes in Great Yarmouth are illustrated in Figure 2-13. Two existing bus routes penetrate part of the way into the South Denes area. In common with routes into the town centre, these services are affected by congestion at the existing bridges. Provision of a third crossing would relieve this congestion and could allow the development of more efficient services incorporating the new crossing.

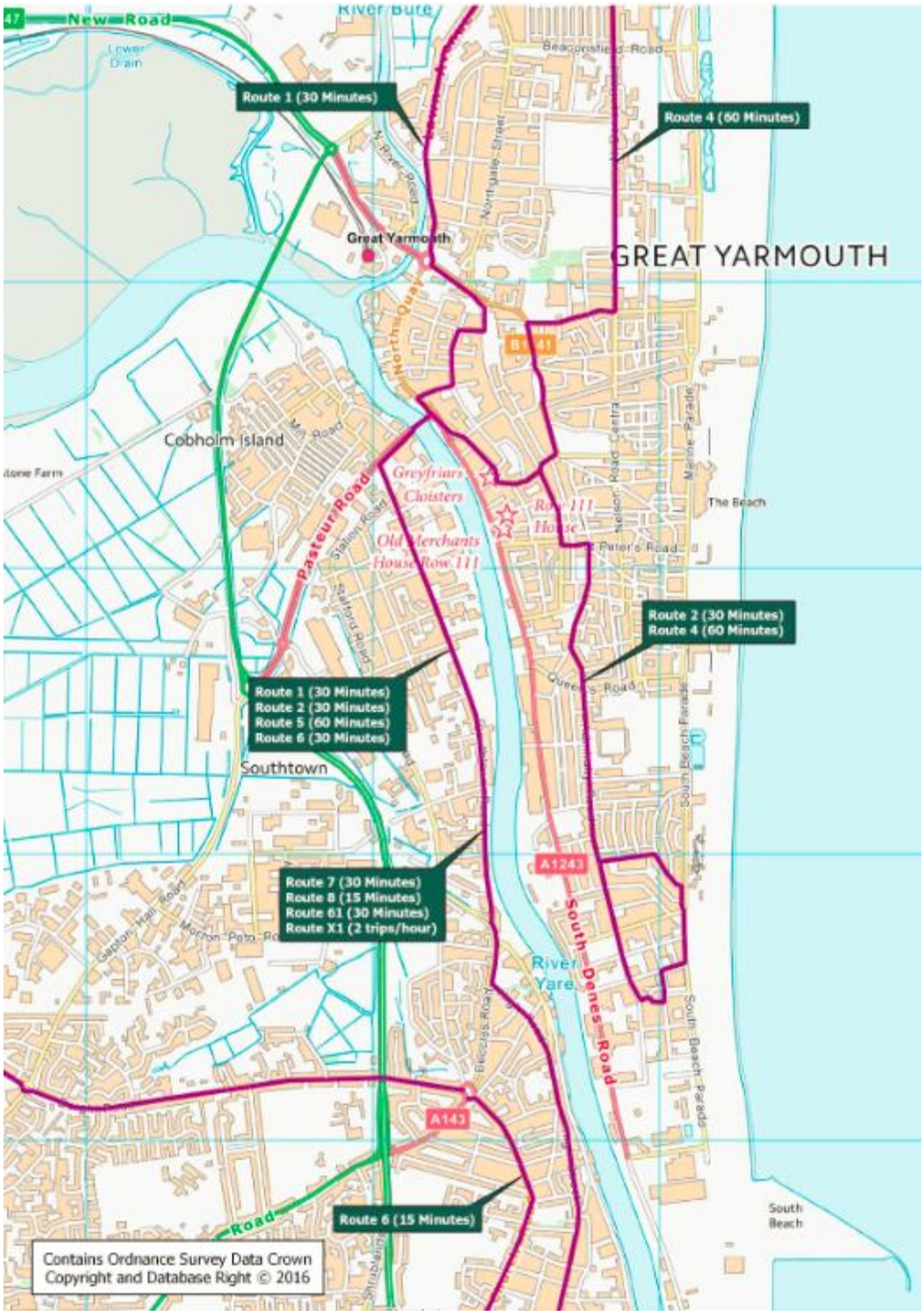


Figure 2-13 Bus routes and frequencies, Great Yarmouth

2.3.9 *Lack of direct walking and cycle routes into the southern part of the peninsula*
Similarly, pedestrians and cyclists from other parts of Great Yarmouth, or from the south or west have to use the existing bridges to access the town centre, sea front and employment areas. Existing cycle routes and facilities are illustrated in Figure 2-14. A dedicated off-road cycle route has been provided as part of the recent improvements to Marine Parade; there is an off-road route on Southtown Road on

the west side of the river and a network of advisory or traffic calmed routes on each side. A third crossing with dedicated cycle facilities would enable these to be linked to form a greatly improved cycle network. It would make it easier to encourage people to walk or cycle to work from locations that are presently too far apart.

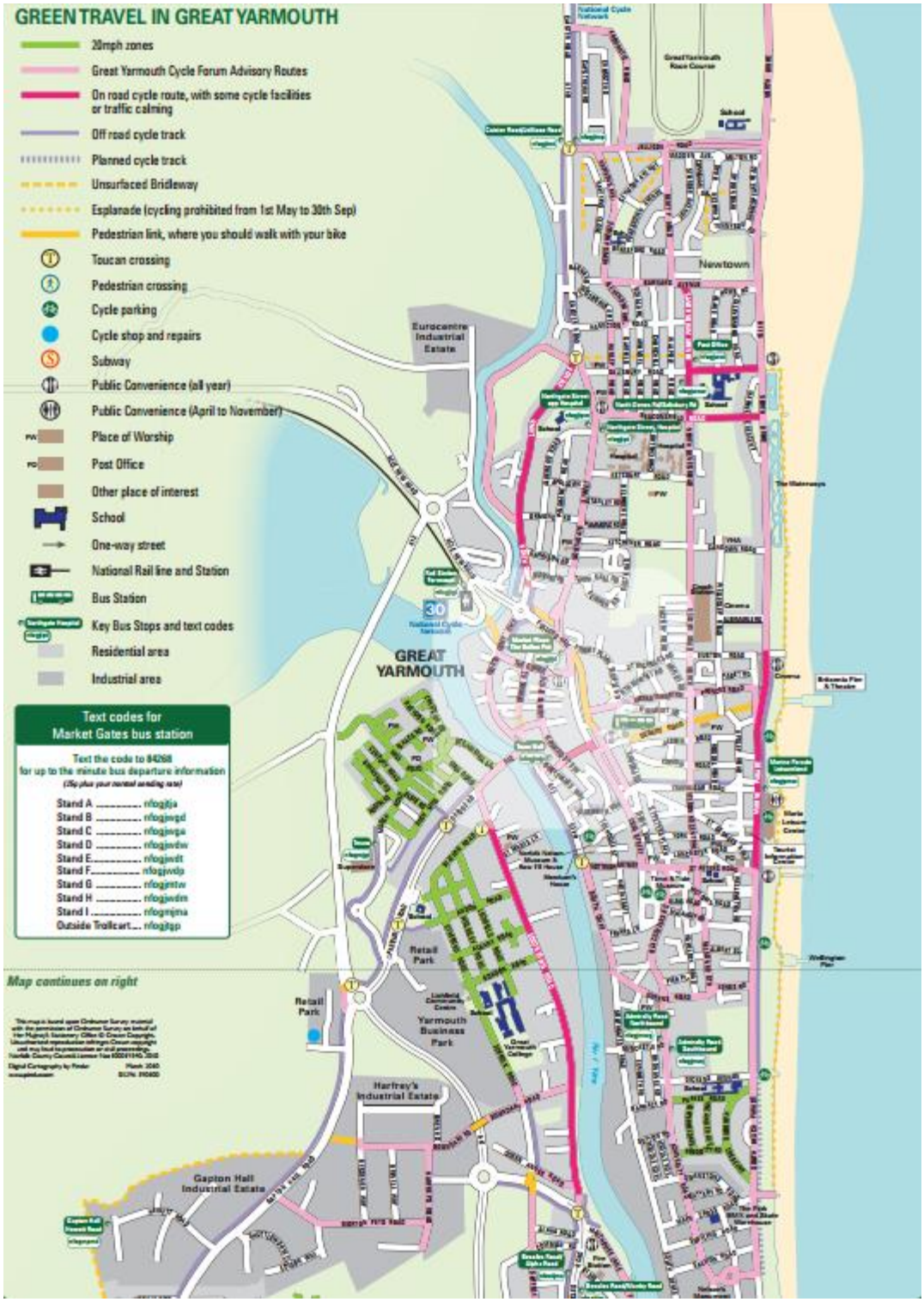


Figure 2-14 Cycle routes and facilities, Great Yarmouth

2.3.10 Community severance

The lack of a southern crossing means that the River Yare isolates Great Yarmouth from Gorleston and other parts of the Borough. The Haven Bridge is about 4 km from the river mouth and harbour, and whilst both the east and west sides of the 80m wide estuary are fully developed, the two communities are completely separated. For example, a person living on Riverside Road, Gorleston, would have to travel 6 miles to reach a place of work on South Denes Road which is physically less than a quarter of a mile away.

Provision of a third crossing would reduce community severance and improve accessibility to jobs and services throughout the Borough.

2.3.11 Impact of traffic on historic areas

As noted in Table 2-5 above, the historic North Quay carries some 11,700 vehicles over a 12 hour period. Hall Quay, directly opposite the Haven Bridge, carries ###### vehicles in 12 hours.

Figure 2-15 North Quay and Hall Quay

Figure 2-16 Hall Quay

Heavy traffic detracts from these character areas and is detrimental to efforts to improve them. A third crossing would reduce traffic in both areas.

2.3.12 Emissions of CO2 and other greenhouse gases

A third crossing would reduce the length of some trips, and would reduce congestion, leading to a net reduction in greenhouse gas emissions.

2.3.13 Accidents

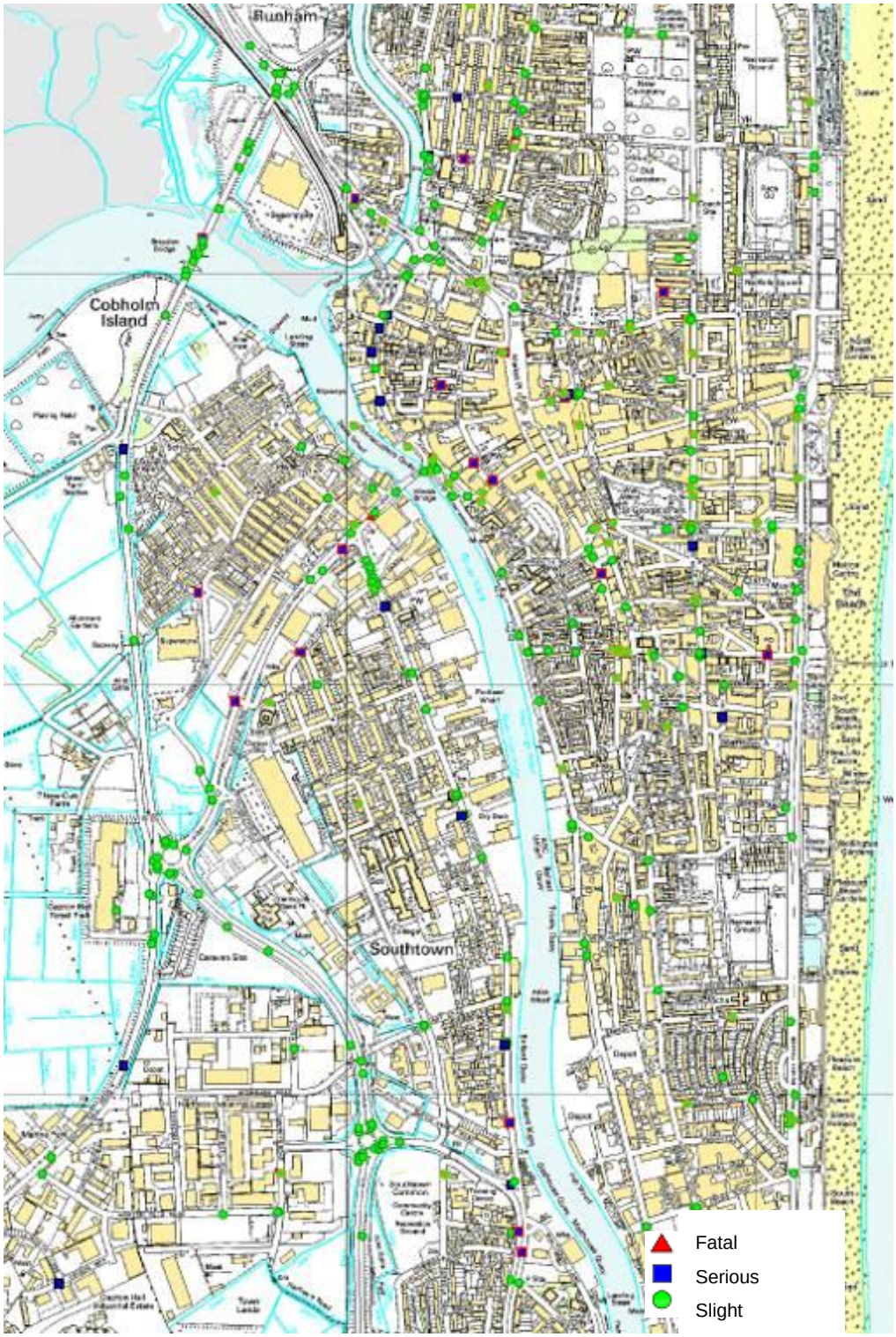


Figure 2-17 Injury accidents 2011 – 2015 (Pedestrian accidents outlined in red)

In the five years from 2011 to 2015, there were 394 recorded collisions in the Great Yarmouth area, involving 489 casualties:

Severity	Collisions	Casualties
Fatal	2	2
Serious	46	47
Slight	346	440
Total	**394**	**489**

Table 2-10 Accidents and casualties Great Yarmouth 2011-2015

Of the 489 casualties, 99 (20%) were pedestrians and 50 (10%) were cyclists. 72 casualties (15%) arose from accidents involving motorcycles. There are clusters of accidents on the approaches to the existing bridges, including North Quay

A third crossing should reduce overall vehicle kilometres, and thus exposure to accident risk, and is expected to produce a net reduction in casualties.

2.3.14 Lack of resilience in the local road network

Traffic congestion and the lack of any alternative to the existing bridges mean that the local road network is not resilient to the effect of disruptions such as road works or accidents.

A third crossing will provide a greater choice of routes into Great Yarmouth and improve the resilience of the network to disruption.

2.4 Step 4a – Scheme objectives

The objectives for the scheme are set out below, divided into:

- High level, or strategic, outcomes
- Specific, or intermediate, objectives
- Operational objectives

The **high level objectives** are:

- To support the creation of new jobs especially in the South Denes Local Development Order area and the Enterprise Zone
- To support Great Yarmouth as a Centre for Offshore Renewable Engineering, and as a port
- To support the regeneration of Great Yarmouth, including the town centre and the sea front, helping the visitor and retail economy
- To improve strategic connectivity, and reduce community severance
- To protect and improve the environment

The **specific, or intermediate, objectives** are:

- To provide traffic relief to Breydon Bridge and Haven Bridge
- To reduce congestion and delay in the town centre
- To improve journey time reliability
- To reduce traffic in historic areas, especially North Quay and Hall Quay
- To improve vehicular access to South Denes and the outer harbour, especially from the A12
- To improve access to the Great Yarmouth peninsula for buses
- To improve access to the Great Yarmouth peninsula for cyclists
- To improve access to the Great Yarmouth peninsula for pedestrians
- To reduce road accident casualties
- To reduce emissions of greenhouse gases
- To improve the resilience of the local road network

The **operational objectives** are:

- To provide an additional crossing of the River Yare for vehicles, cyclists and pedestrians
- To reduce overall journey times and vehicle kilometres in Great Yarmouth
- To minimise environmental impact, compulsory purchase and demolition of residential and commercial property.
- To achieve a balance between the needs of road and river traffic

Targets

Targets will be developed related to the above objectives at a later stage in the Assessment process. Wherever possible, these will be quantitative. These will feed in to a Monitoring and Evaluation Plan associated with the business case for the scheme.

2.5 Step 4b – Geographic area of impact to be addressed by the scheme

The geographical area of impact of the scheme is defined by:

- The geographical scope of the travel market and key origins and destinations
- The geographical extent of current and future transport problems and underlying drivers

At this stage of the assessment, scheme options have been tested using the Great Yarmouth SATURN model (2003). The model structure was developed to be compatible with the Norwich Area Transportation Strategy model (2002), but with the zoning system amended to take account of its different purposes – zoning in Great Yarmouth is more detailed whereas that around Norwich has been compressed.

It is recognised that the previous modelling work will need to be reviewed and updated if the scheme progresses to the next stage of appraisal. The proposed modelling methodology will be compliant to latest DfT guidelines and will also be supplemented by lower tier modelling (microsimulation) to enable a more detailed comparison of the different options and impact on the local and strategic road network around the tie in points. Further details are included in the ASR document accompanying this bid.

Figure 2-18 below illustrates the current model area, which represents the full geographical area of the assessment:

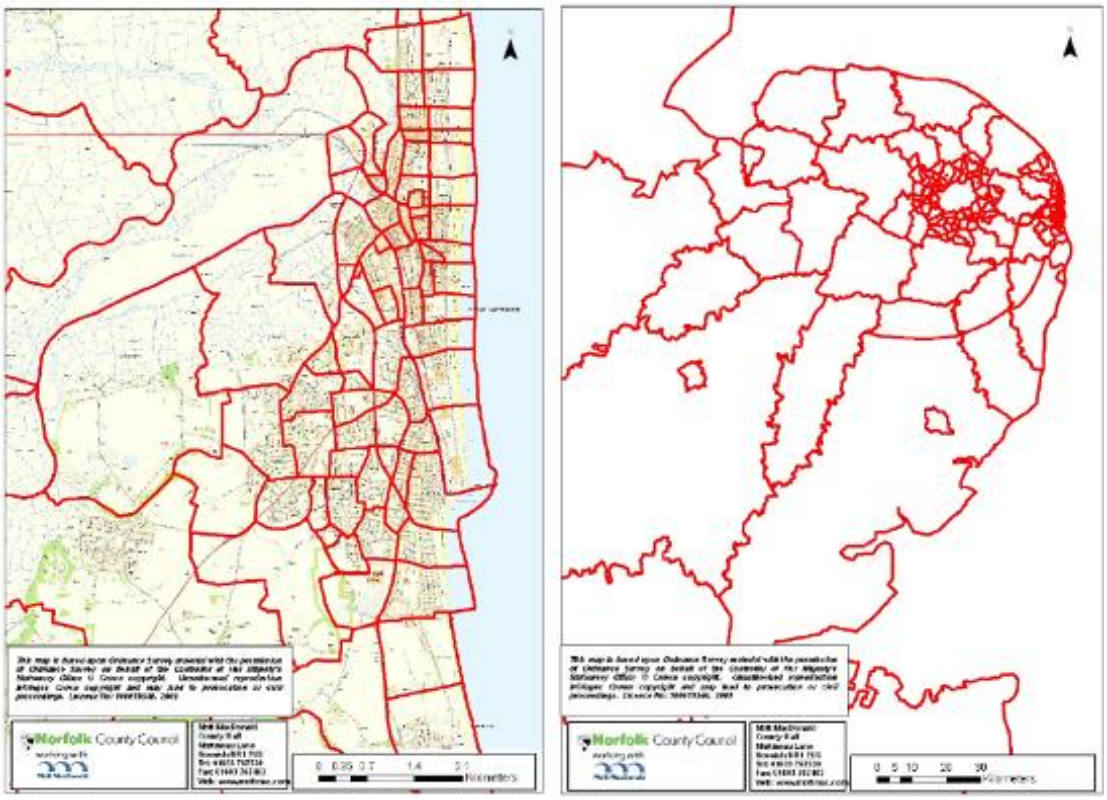


Figure 2-18 Model zoning plan

3 Option development

The assessment to date of options for a third crossing of the River Yare has been undertaken in two main stages, as detailed below.

Stage 1 (2007)

A **Stage 1 Scheme Assessment Report** (SAR)[8] was commissioned by Norfolk County Council in 2007, in order to understand the existing constraints to, and potential engineering solutions available for, the provision of a crossing of the River Yare in Great Yarmouth.

The report, prepared by consultants Mott Macdonald in March 2007, followed the methodology prescribed in the Design Manual for Roads and Bridges Volume 5, Section 1, Part 2, TD36/93 (Scheme Assessment Reporting). Stage 1 identifies the environmental, engineering, economic, and traffic advantages, disadvantages and constraints associated with broadly defined improvement strategies. The Stage 1 SAR was supported by a Stage 1 Traffic and Economic Assessment[9].

A broad area of interest was identified, and within this area nine potential options were considered, including high and low level bridge options as well as options for a tunnel.

The Stage 1 SAR recommended that three options should be taken forward for further assessment: a high level and low level bridge and an immersed tube tunnel.

Stage 2 (2009)

A **Stage 2 Scheme Assessment Report**[10] was commissioned by Norfolk County Council in 2009, in order to develop options further. This included engineering and environmental assessment and further analysis of shipping information to determine the most appropriate location for a bridge crossing. Different types of crossing were again considered, including a fixed bridge, swing bridge, lifting bridge, bascule bridge and a tunnel.

---

[8] Great Yarmouth Third River Crossing – Stage 1 Scheme Assessment Report, March 2007. Mott Macdonald for Norfolk County Council

[9] Great Yarmouth Third River Crossing – Stage 2 Traffic and Economic Assessment, October 2009. Mott Macdonald for Norfolk County Council

[10] Great Yarmouth Third River Crossing – Stage 2 Scheme Assessment Report, September 2009. Mott Macdonald for Norfolk County Council

Three options were taken forward to the outline design and simple environmental assessment process. These included 2 options for a Bascule Bridge and one tunnel option. The Stage 2 SAR was supported by a Stage 2 Traffic and Economic Assessment[11].

Adoption of a preferred route (2009)

Following public consultation from June to August 2009, Norfolk County Council adopted a preferred route in December 2009[12]. The preferred scheme was for a dual carriageway bascule bridge.

This report

This report provides a brief summary of the very comprehensive work undertaken by Norfolk County Council over a number of years to identify a preferred scheme. It does not attempt to reproduce the earlier work, as this is already set out in detail in the existing reports, which should be referred to as required.

It is now nearly seven years since the last scheme assessment work was undertaken and the preferred route adopted. It is acknowledged that some of the scheme preparation work will need to be updated, especially the traffic model. This report considers the extent to which the preferred scheme will need to be reviewed and alternatives assessed within the identified corridor, to ensure that best value for money is achieved.

3.1 Step 5 – Initial option generation

The Stage 1 Assessment identified an area of interest for the scheme, illustrated in Figure 3-1 below.

Due to the existing trunk road layout and physical constraints placed by surrounding development, the only economically viable tie-in with the trunk road network is at the Harfreys Roundabout on the A12.

Any bridge crossing would be required to open to allow the safe passage of shipping and pleasure craft that access the inner harbour. The Stage 1 Assessment concluded that an opening structure placed at the southern end of the area of interest would have to open 4000 times a year for the large vessels, with additional openings for pleasure craft. If the bridge was placed at the northern extremity of the area of interest this would reduce to 2000 times a year, with additional openings for

[11] Great Yarmouth Third River Crossing – Stage 2 Traffic and Economic Assessment Report, March 2007. Mott Macdonald for Norfolk County Council

[12] Report by Director of Environment, Transport and Development to Norfolk County Council Cabinet, 7 December 2009, Item 22

pleasure craft. The other factor considered was the potential impact of a new structure upon the navigation of the river. Any structure on a curve of the river would require a larger clear span, which would incur greater cost.

These considerations, and the need to minimise any impact on existing built development, enabled an initial area of interest to be determined. The Stage 1 report noted that highways alterations may be required outside the area to achieve effective tie in to the existing network.

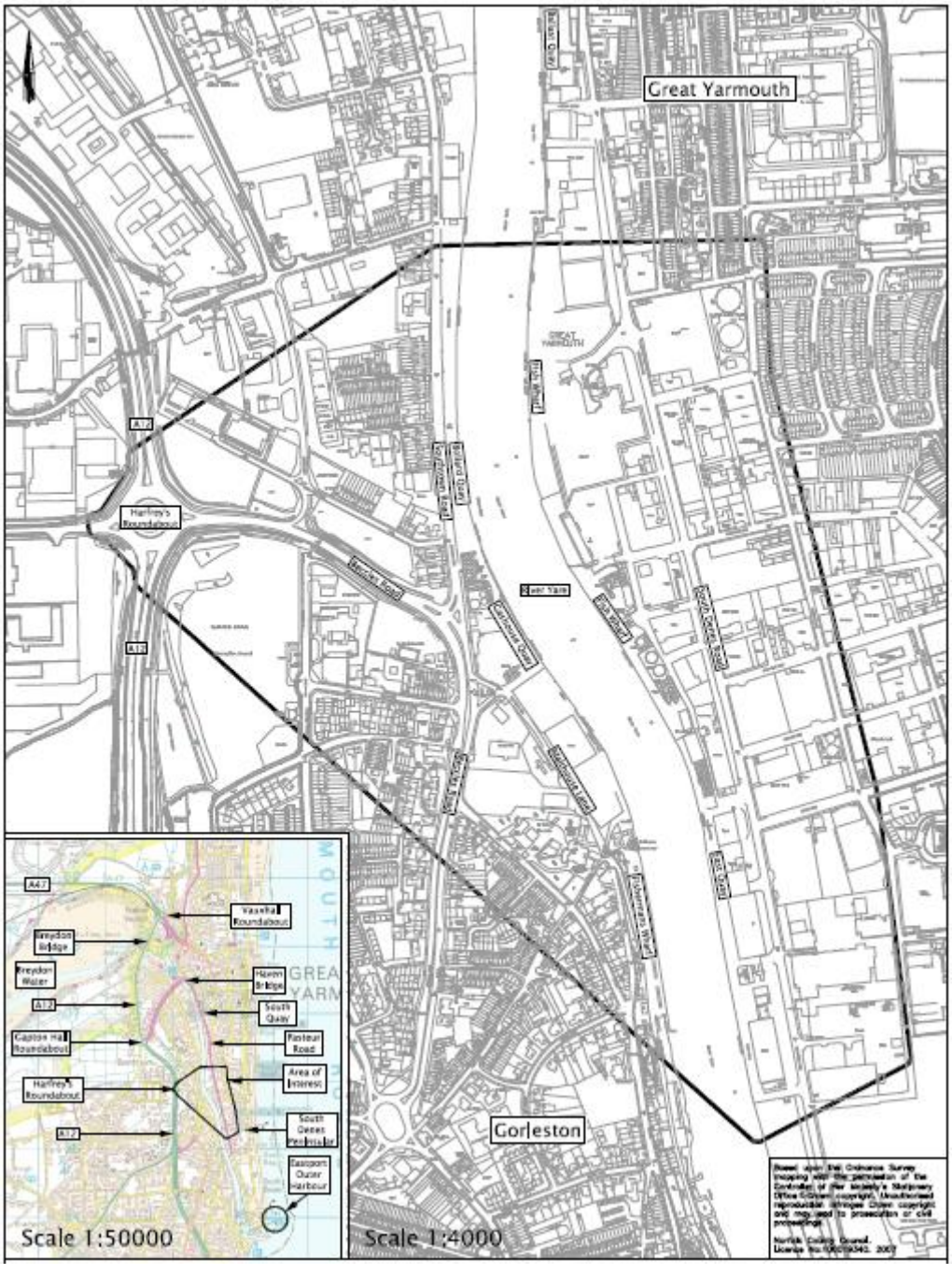


Figure 3-1 Area of interest for initial option generation

Within this area of interest, three broad alignment corridors were considered (northern, central and southern). Within each corridor, a high level and low level opening bridge feasibility alignment was produced (on similar alignments), as well as a tunnel feasibility alignment. This resulted in nine different options, with six different alignments.

The nine crossing options considered are illustrated in Figure 3-2 and listed in Table 3-1.

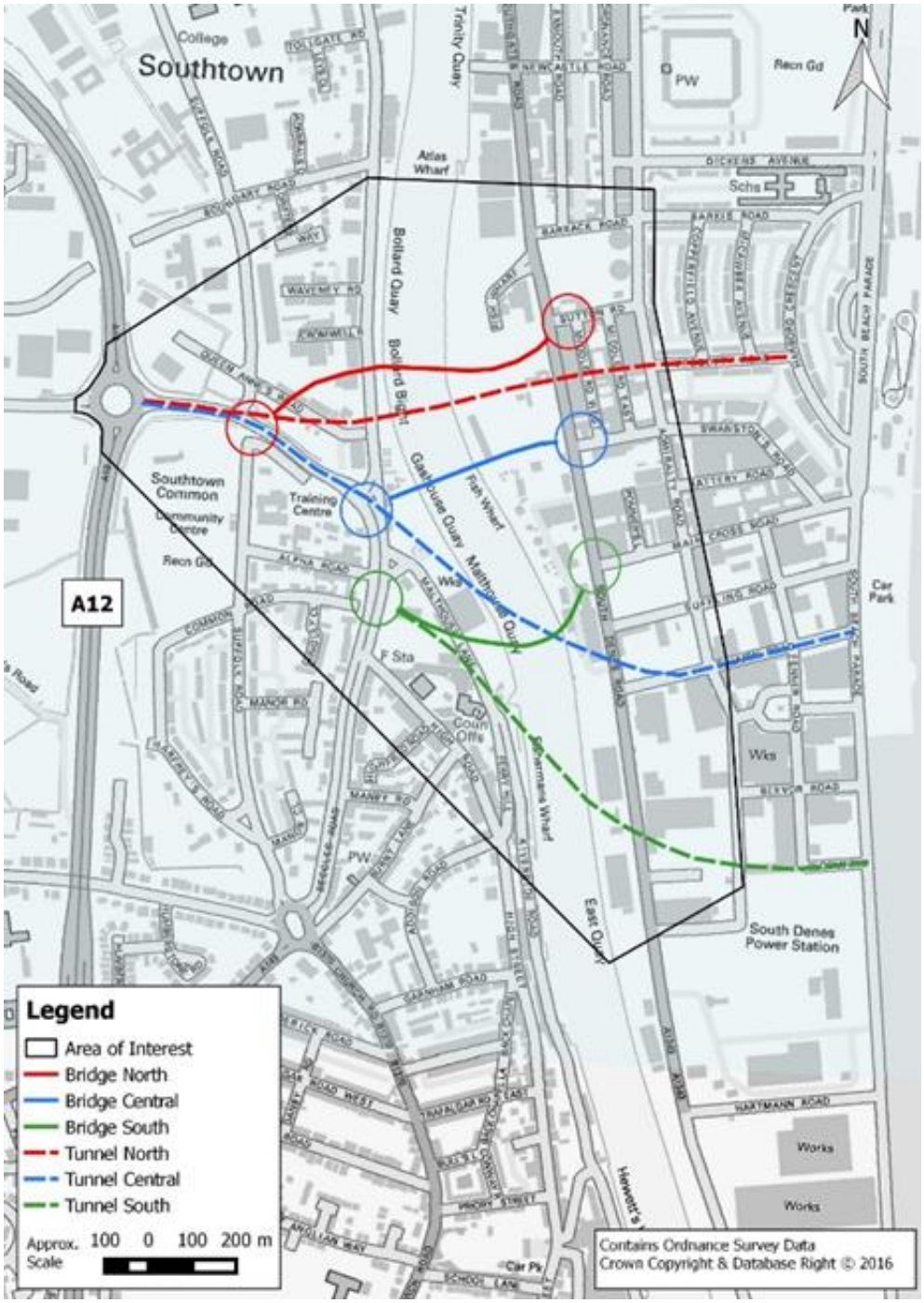


Figure 3-2 Potential locations - Stage 1 Assessment

Alignment	Type of crossing
Northern alignment	High level opening bridge
	Low level opening bridge
	Tunnel
Central alignment	High level opening bridge
	Low level opening bridge
	Tunnel
Southern alignment	High level opening bridge
	Low level opening bridge
	Tunnel

Table 3-1 Potential options - Stage 1 Assessment

Bridge options – Stage 1

For the Stage 1 assessment:

- The high level bridge was envisaged as a bascule-type bridge with an air draft of 7.50m. The preliminary engineering design of this structure envisaged a full 95.00m span of the harbour, with no structures being placed within the navigable channel. The high air draft of this structure would minimise the number of openings required to allow the passage of leisure craft, but would still require the structure to open for the majority of the existing off-shore supply vessels and all leisure craft with high masts.

- The low level bridge is envisaged as a bascule-type bridge with an air draft of 5.00m. The preliminary engineering design of this structure envisaged a full 95.00m span of the harbour, with no structures being placed within the navigable channel. The lower air draft of this structure would require more frequent opening to allow vessels to pass (reducing the overall benefit of the crossing in terms of congestion relief), but it would be less expensive than the high level bridge.

Tunnel options – Stage 1

For the Stage 1 assessment, the tunnel construction was assumed to be a combination of an immersed tube tunnel section, with cut and cover tunnels linking the ends of the immersed tube section to the tunnel portals. Alternative methods of cut and cover construction were considered – “top down” or “bottom-up” with the latter option being found more cost-effective. Details are given in the Stage 1 SAR.

The tunnel options would have no impact on the operation of the port once complete, but the approach roads and portals would require more land than a bridge at the same location.

Non-road options

All of the options generated at Stage 1 were road based, involving a physical crossing of the River Yare either by bridge or tunnel. The Stage 1 SAR considered that due to the particular geography of the Great Yarmouth area, plus the envisaged road-based developments in the area action plans, it is difficult to perceive alternative multimodal improvements that would meet the objectives of the scheme.

The sort of non-road options that might be considered as an alternative to a major highway scheme – either separately or in combination - are:

- **Traffic restraint** – physically restricting movement in sensitive areas by traffic management or traffic calming to reduce capacity and encourage traffic to choose alternative routes or alternative modes of travel, or to reduce demand overall.

- **Charging** – for use of the existing bridges, to encourage traffic to choose alternative routes or alternative modes of travel, or to reduce demand overall.

- **Improving the existing network** – e.g. increasing the capacity of the existing bridges to accommodate current and forecast demand without a new bridge.

- **Improving other modes** – e.g. improvements to public transport, cycling and walking without a new bridge

In the particular context of Great Yarmouth and its needs, it is difficult to see how these options could by themselves achieve the objectives of the scheme (as set out in Paragraph 2.4).

These objectives focus on improving the connectivity of the Great Yarmouth peninsula so as to support employment growth and the regeneration of the port, the town centre and resort. Traffic restraint or charging would generally make the peninsula less accessible and less attractive to development.

Improvements to the existing bridges – even if that were feasible - would not improve access to and from the south but could exacerbate current problems in the town centre. Furthermore, there are limitations on what can be achieved in terms of, for example, road space reallocation to sustainable modes without the removal of through traffic that a third crossing would achieve.

Improvements for other modes, whilst desirable in themselves, would not improve the connectivity of the port and new or existing industry to suppliers and markets.

For these reasons, non-road options were not considered further in the Stage 1 assessment.

3.2 Step 6 – Initial sifting (Stage 1 Assessment)

Estimated scheme costs – Stage 1

At Stage 1, cost estimates were prepared for options in the northern and southern corridors only, as this was considered sufficient to obtain an indication of the value for money of a third crossing scheme. The indicative construction costs, excluding land, are set out in Table 3-2 below:

Alignment	Type of crossing	Estimated out-turn costs (2015) excluding land cost
Northern alignment	High level bridge	£74,774,000
	Low level bridge	£70,542,000
	Tunnel	£131,181,000
Central alignment	High level bridge	n/a
	Low level bridge	n/a
	Tunnel	n/a
Southern alignment	High level bridge	£68,228,000
	Low level bridge	£66,997.000
	Tunnel	£185,555,000

Table 3-2 Estimated costs of potential options - Stage 1

The costs assumed a start on site in 2013 and opening year of 2015.

There was relatively little difference between the costs of high level and low level bridges, but the tunnel options were significantly more expensive than any of the bridge options.

Stage 1 Environmental Assessment

The Stage 1 Environmental Impact Assessment[13] (EIA) considered all nine route options. It reported that the scheme would have numerous impacts on the local environment; some of which would be beneficial, and some of which would be adverse. In some cases, an adverse impact in the study area could have a corresponding beneficial impact on other parts of Great Yarmouth.

The specific findings of the Stage 1 EIA are summarised below:

- Each of the routes would lead to a minor adverse impact on local **air quality** caused by the increase in traffic levels in the study area. A central corridor alignment would affect the least number of properties, whilst a southern corridor alignment would affect the most number of properties. Mitigation should concentrate on finding an alignment with the least impact in this

[13] Great Yarmouth Third River Crossing – Stage 1 Environmental Impact Assessment Report, (Mott Macdonald for Norfolk County Council, 2007)

respect (balanced against all the other objectives of the scheme). The scheme would benefit local air quality in Great Yarmouth town centre where traffic volumes are predicted to be reduced.

- It is unlikely that impacts on the **cultural heritage** within the study area will be anything more than minor in magnitude. Very few features would be directly affected, although several would be affected indirectly. However, these impacts should be weighed against the beneficial impacts felt elsewhere in Great Yarmouth, where the reduction in traffic will go a long way to improving the integrity and setting of the buildings, monuments, features and areas that contribute to the cultural heritage of the town. Enhancement of some areas may be possible to improve the setting of some listed buildings, although these may not be part of the envisaged scheme.

- There are many aspects of **construction** that will cause disruption to aspects of the natural environment within the study area, most notably noise and vibration, air quality, water quality and drainage and ecology and nature conservation. Some mitigation should be possible, with careful planning and forethought, although it is likely that these measures will not be able to mitigate for the impacts completely; the significance of the impacts will only be reduced.

- The **ecological** value of terrestrial habitats within the study area is of negligible value; however the River Yare, which is tidal at this location, regularly flows to and from Breydon Water, which is protected under International, European and National legislation. The current crossings envisaged should not affect the river flow regime or water quality in any way, so only a negligible effect would be inflicted on the estuarine ecosystem of Breydon Water.

- With both bridge [height] options the main impact on the **landscape and townscape** would be the presence of traffic within the view of nearby houses, and the presence of a possible bridge structure across the open river. In this respect the high level bridge option may be more intrusive, but overall it may not appear out of place within an essentially industrial townscape, particularly if the design is of a high visual quality. The tunnel would largely remove traffic impacts, but the extensive areas required for the approach ramps may have greater impacts on residential areas than either of the bridge options in terms of townscape.

- There could be adverse impacts on **land use** caused by the required demolition of residential buildings and port-related buildings/apparatus. Each of the routes would have the same magnitude of effects in this respect, with no route being significantly better or worse than the others. In such a built up area the potential to design such a major structure without needing to demolish buildings is very limited.

- It is not possible to determine the overall changes in **noise and vibration** arising from the scheme at this early stage. However, there will be a general trend whereby the more properties that are affected, the more significant the effect. An alignment in the central corridor is predicted to affect the least properties, whereas an alignment in the southern corridor is predicted to affect the most. The scheme would benefit local conditions in Great Yarmouth town centre where traffic volumes are predicted to reduce, and so noise and vibration in these areas would lessen.

- **Pedestrians and cyclists** would benefit from the construction of a bridge across the river, and journeys by foot or cycle are likely to replace some of those currently made by car. No equestrians currently use, or are likely to use, the study area due to its urban, industrial nature. A tunnel would offer no discernible change from the existing situation for non-vehicular users.

- A [new] river crossing would have moderate beneficial impacts for **vehicle users**. Reduced journey times and congestion would mean that driver stress would also reduce, although the magnitude of this is not calculable at this early stage. The view from the road, which is currently very restricted, would also improve by permitting wide open views of the river and surroundings. The construction of a tunnel would have the most beneficial effects for vehicular travellers, as a bridge would require the deck to be lifted on a regular basis to allow shipping through, which would mean vehicular travellers would have to queue. This temporary queuing would reduce the overall beneficial effect on driver stress that the bridge would have.

- The fact that the bridge/tunnel crosses a major watercourse means that impacts on **water quality and drainage** are likely, both in terms of surface water and groundwater flows. Pollution represents the greatest risk, from both vehicle spray in wet weather and accidental fuel spillages, so effective drainage systems will be required to ensure that the quality of the water is not affected. A tunnel will impact groundwater flows, and this impact is not able to be mitigated, although only a minor adverse impact is envisaged at this time.

- The underlying **geology** is largely alluvium, over London Clay Formation. No important geological features exist. The scheme will cause minimal adverse impacts on the geology and soils in the study area, partly due to its existing built-up nature, so no mitigation measures are envisaged at this time.

Stage 1 Traffic Assessment

Three of the options identified at Stage 1 were tested using the Great Yarmouth SAURN model. The Stage 1 Traffic and Economic Assessment Report describes the development and use of the model.

The initial options tested were:

Alignment	Type of crossing
Northern alignment	Opening bridge (no distinction between high and low level bridges)
Central alignment	Tunnel (Beccles Road to Salmon Road / South Beach Parade
Southern alignment	Opening bridge (no distinction between high and low level bridges)

Table 3-3 Options tested in traffic model (Stage 1)

The forecast impact of each of these options on traffic flows is illustrated in Table 3-4 and Table 3-5 below.

Two-way traffic flow	Do minimum 2003 AADT	Northern bridge 2015 AADT	Southern bridge 2015 AADT	Central tunnel 2015 AADT
A12 Breydon Bridge	35,300	31,400	33,700	31,800
A1243 Haven Bridge	32,500	20,300	21,500	26,000
Third river crossing		23,300	20,100	15,800
TOTAL	**67,800**	**75,000**	**75,300**	**73,600**

Table 3-4 Forecast traffic on bridges, 2015 Stage 1 Assessment

Two-way traffic flow	Do minimum 2003 AADT	Northern bridge 2030 AADT	Southern bridge 2030 AADT	Central tunnel 2030 AADT
A12 Breydon Bridge	35,400	32,200	33,000	32,600
A1243 Haven Bridge	35,000	20,500	24,100	26,500
Third river crossing		28,300	24,400	18,900
TOTAL	**70,400**	**81,000**	**81,500**	**78,000**

Table 3-5 Forecast traffic on bridges - 2030 (Stage 1 Assessment)

The key findings are that either of the bridge options would carry more traffic (and hence provide more traffic relief) than the tunnel option. A northern bridge alignment would provide a greater level of traffic relief to the existing bridges than a southern alignment. It should be noted that at Stage 1 no distinction was made between the number of bridge openings required to let ships through at the north or south locations. A southern bridge might have to open more often.

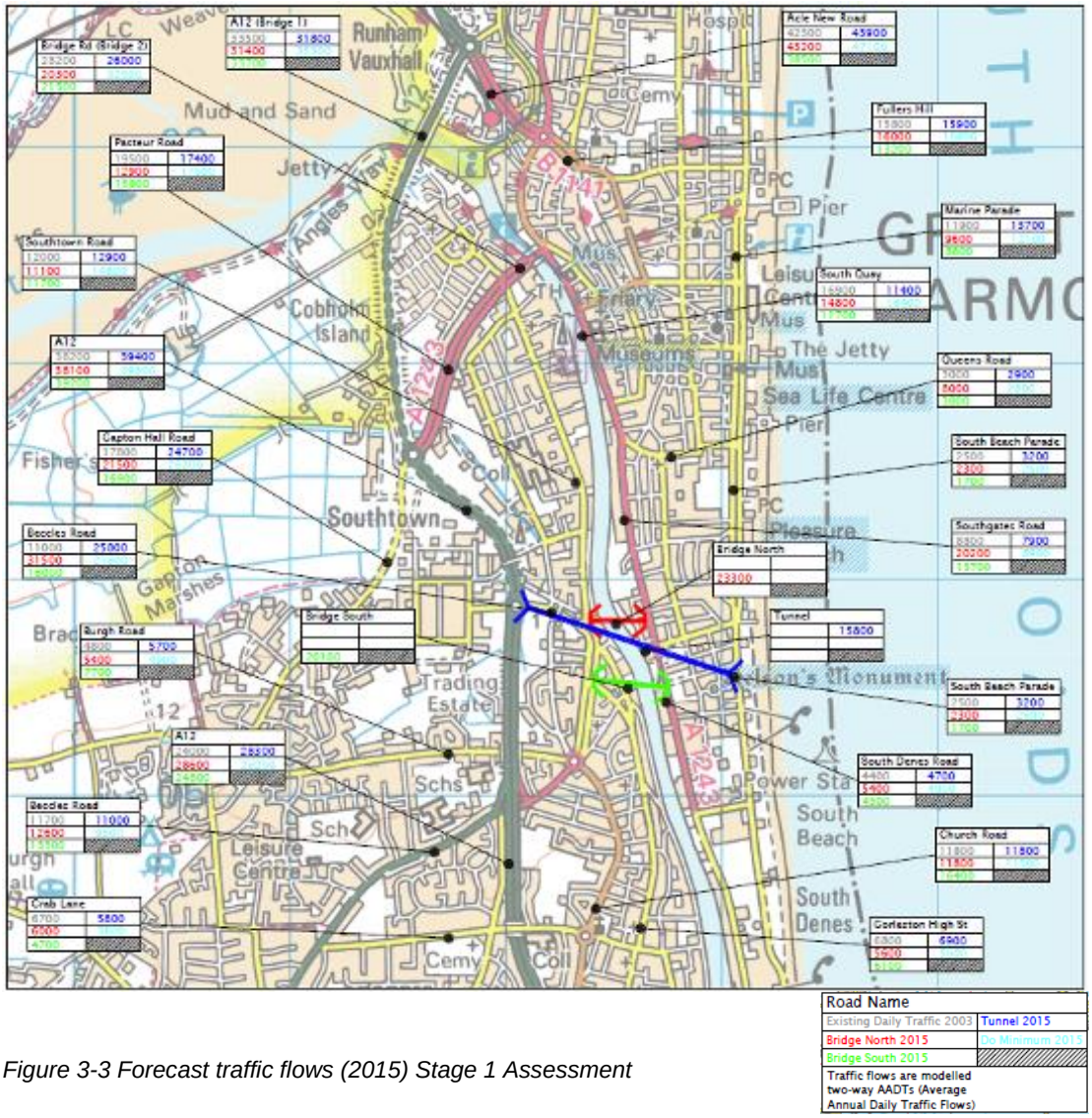


Figure 3-3 Forecast traffic flows (2015) Stage 1 Assessment

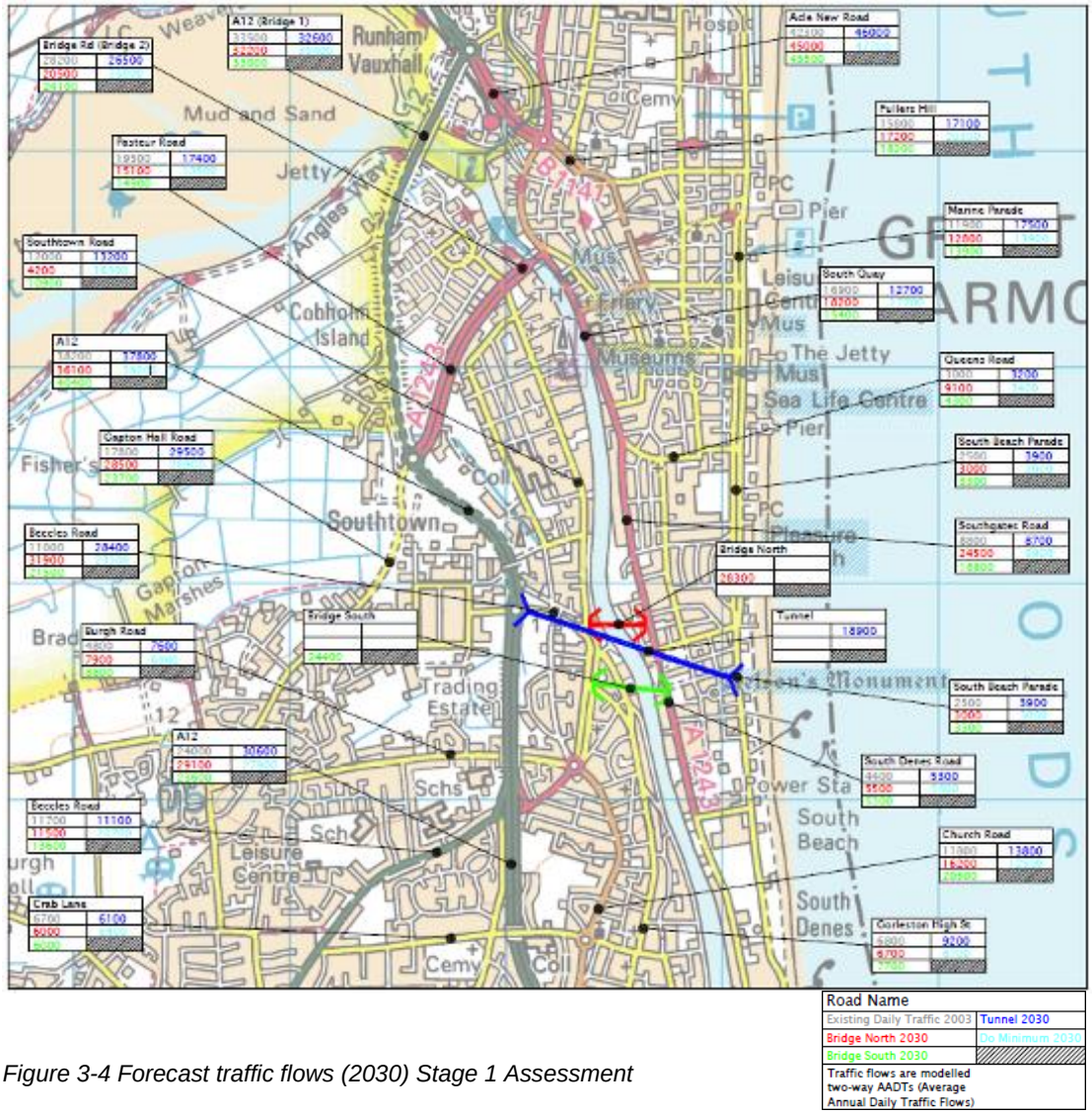


Figure 3-4 Forecast traffic flows (2030) Stage 1 Assessment

Stage 1 Accident Assessment

Accidents were forecast over a 60 year assessment period. Expected casualty reductions are set out in Table 3-6 below.

	Total	Reduction (60 yrs)		
	Base	Northern bridge	Southern bridge	Central tunnel
Accidents	44,398	-2,260	-2,644	-2,385
Casualties	61,270	-3,092	-3,619	-3,230

Table 3-6 Forecast accident and casualty reductions, 60 yrs (Stage 1 assessment)

All options would produce accident and casualty savings of more than 5%. The southern bridge would produce the largest savings.

Stage 1 Economic Assessment

An economic assessment was undertaken using TUBA, with accident benefits calculated using COBA.

All of the options tested show a positive benefit-cost ratio, as set out below:

- Bridge (northern location) **4.3**
- Bridge (southern location) **4.9**
- Tunnel (central location) **2.2**

The results are set out in more detail in Table 3-7 below.

Benefits/Disbenefits/Costs	Northern bridge £,000	Southern bridge £,000	Central tunnel £,000
Consumer User Benefits	112,727	121,295	78,468
Business User Benefits	110,153	117,174	83,266
Private Sector Provider Impacts	0	0	0
Carbon Benefits	1,501	1,696	987
Accident Benefits	85,611	96,844	88,551
Present Value of Benefits (PVB)	**309,992**	**337,009**	**251,272**
Investment Costs	61,674	57,544	109,971
Indirect Tax Revenue	10,189	11,475	6,714
Present Value of Costs (PVC)	**71,863**	**69,019**	**116,685**
Net Present Value (NPV)	**238,129**	**267,990**	**134,587**
BCR (PVB/PVC)	**4.3**	**4.9**	**2.2**

Table 3-7 Economic assessment results (Stage 1)

Conclusions from the Stage 1 appraisal (2007)

The Stage 1 assessment included a number of simplifications. Not all of the potential alignments were subject to modelling and economic assessment. The likely differences in frequency of opening between northern and southern bridges (or between high level and low level bridges) were not modelled. Only advance design work was undertaken and land costs were excluded. These simplifications were considered appropriate because the main purpose of the Stage 1 assessment was to establish the general feasibility of a third crossing in engineering terms and to test whether it could be justified in economic terms.

Although a simplified assessment, it served to show that a third crossing would be feasible, and that either a bridge or a tunnel could produce benefits in excess of its costs, although a bridge would be less expensive and therefore produce a significantly better benefit-cost ratio than a tunnel.

The conclusions and recommendations of the Stage 1 Assessment in 2007 were:

"Due to the perceived viability of the high level bridge, low level bridge and the tunnel option to provide a new crossing of the River Yare with good benefit to cost ratios, the following should be considered for inclusion for assessment at the start of the Stage 2 scheme assessment process: -

1. *High Level Opening Bridge*
2. *Low Level Opening Bridge*
3. *Immersed Tube Tunnel*

"The exact route alignment will depend on the cost (environmental, social and economic) of the alignment, and will require detailed discussions with landowners and the statutory bodies.

"Due to the difference in opening frequencies envisaged for the two bridge options between the upper and lower sections of the area of interest, it is envisaged that the most benefit would actually be derived from the placement of the bridge options in the upper part of the area of interest, rather than in the southern area as the current economic modelling predicts. It is recognised that this may not the most advantageous position for the redevelopment of the waterfront area, but the scheme objective is primarily to relieve existing congestion elsewhere on the highway network. The placement of any crossing within the area of interest will give substantial benefits to the regeneration area in terms of access. It may be appropriate to consider in more detail the difference in benefits between bridge options at different geographic locations within the area of interest once additional information is made available during the Stage 2 assessment.

"It is envisaged that a tunnel option would cross the river in a north-west to south-east direction. This could allow the highway approach from Harfreys Roundabout to fit amongst the existing residential and industrial development with the minimum of disturbance. It may also allow a more suitable connection into the highway network on the South Denes peninsular. However, consideration should be given in Stage 2 to realigning the tunnel into a southwest to northeast alignment, to better fit the desire line of traffic wishing to access the peninsular, although it is recognised that the desire lines may change with the potential opening of the outer harbour development."

3.3 Step 7a – Further development of potential options

For the Stage 2 Assessment, a wider range of possible crossing types was considered:

- A fixed bridge
- A swing bridge
- A lift bridge
- A bascule bridge
- A tunnel option

The detailed investigation of these options was described in a Structural Options working paper[14] and is briefly summarised below.

Fixed bridge options

A fixed bridge would be available to traffic and shipping at all times and would not include any opening mechanism. It would therefore need to be tall enough to allow all vessels currently using the inner harbour to pass beneath it. This would require a clearance of at least 40m. In order to gain this height from ground level, approach structures of more than 650m in length would be needed, as well as connections to existing roads.

Six potential alignments were identified for a fixed bridge option – options F1, F2, F3, F4, F5 and F6. These are illustrated diagrammatically in Figure 3-5. They were evaluated in terms of their likely impact on traffic flow, and in terms of the type and area of land that would be required for their construction. Details are set out in the Structural Options Working Paper. Option F1 was identified as the best of the six, as it would require the least amount of land, mainly industrial and highway land. A variant, F1A was identified which would allow a greater vertical clearance than the other options.

Despite this, it was not possible to devise any fixed bridge option high enough not to obstruct some existing shipping movements. Option F1A would cost £75 million (2009 out-turn costs, excluding land and service diversions), significantly more than a movable bridge. It would have a significant adverse environmental impact. For these reasons, the idea of providing a fixed bridge was rejected.

[14] Great Yarmouth Third River Crossing, Structural Options Working Paper (Mott MacDonald for Norfolk County Council January 2009

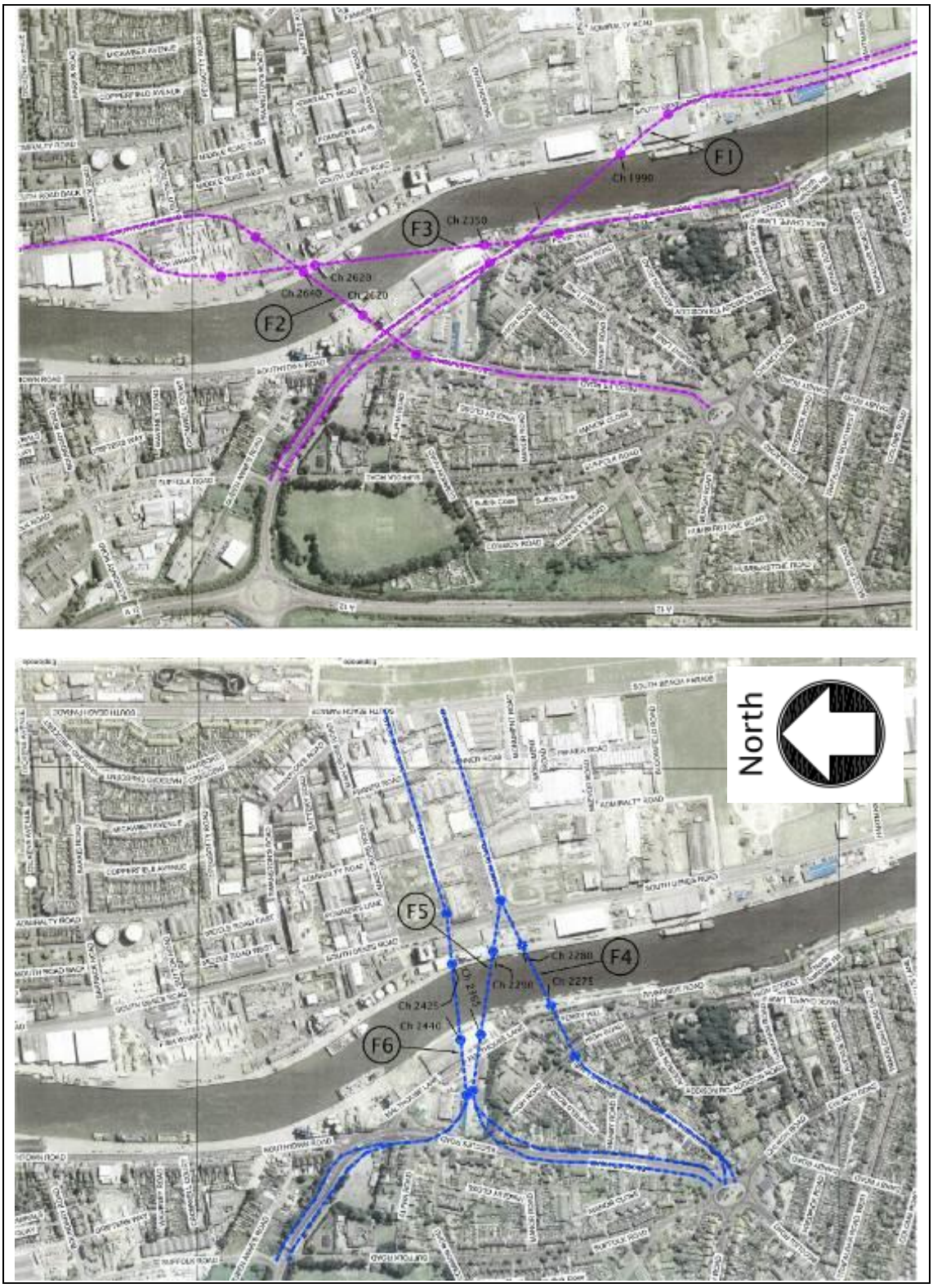


Figure 3-5 Potential fixed bridge alignments

Swing bridge option

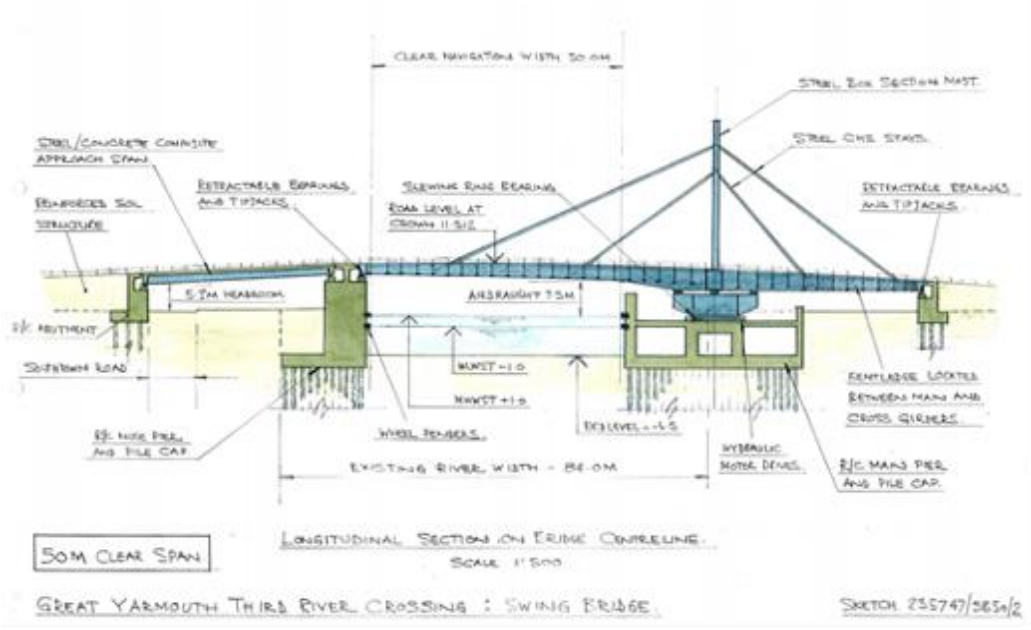


Figure 3-6 Swing bridge

A swing bridge option was considered, but rejected. The superstructure would be very vulnerable to damage from ship collision and the cost of protecting against this would be prohibitive.

Lifting bridge option

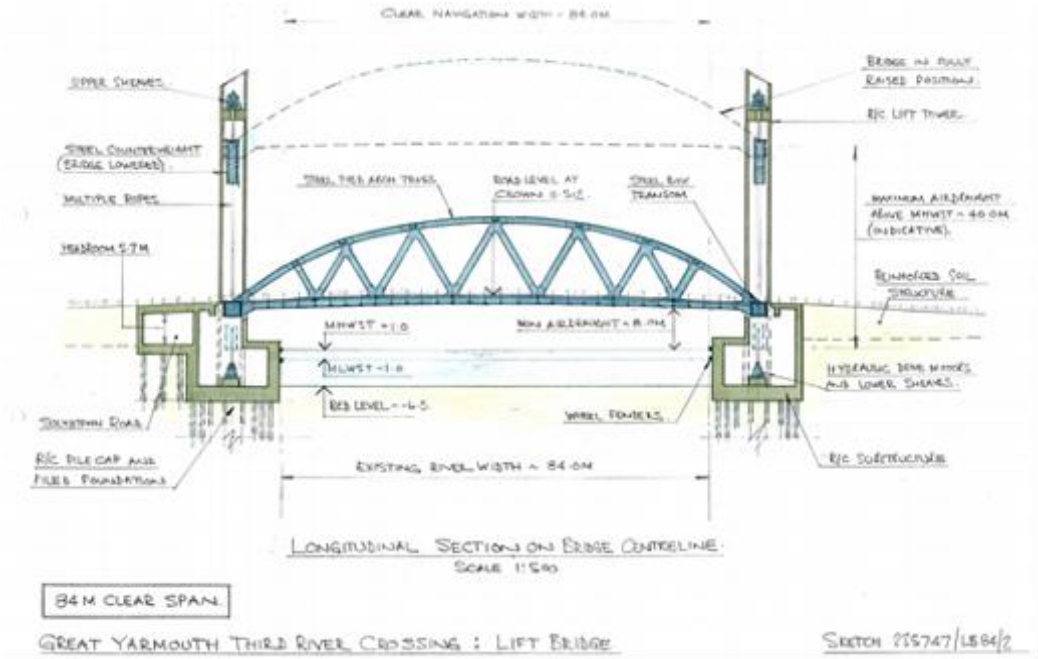


Figure 3-7 Lifting bridge

A lifting bridge option was considered but rejected. The towers would have to be at least 40m high, with a high adverse visual impact, and the maintenance cost would be higher than with a bascule bridge.

Bascule bridge option

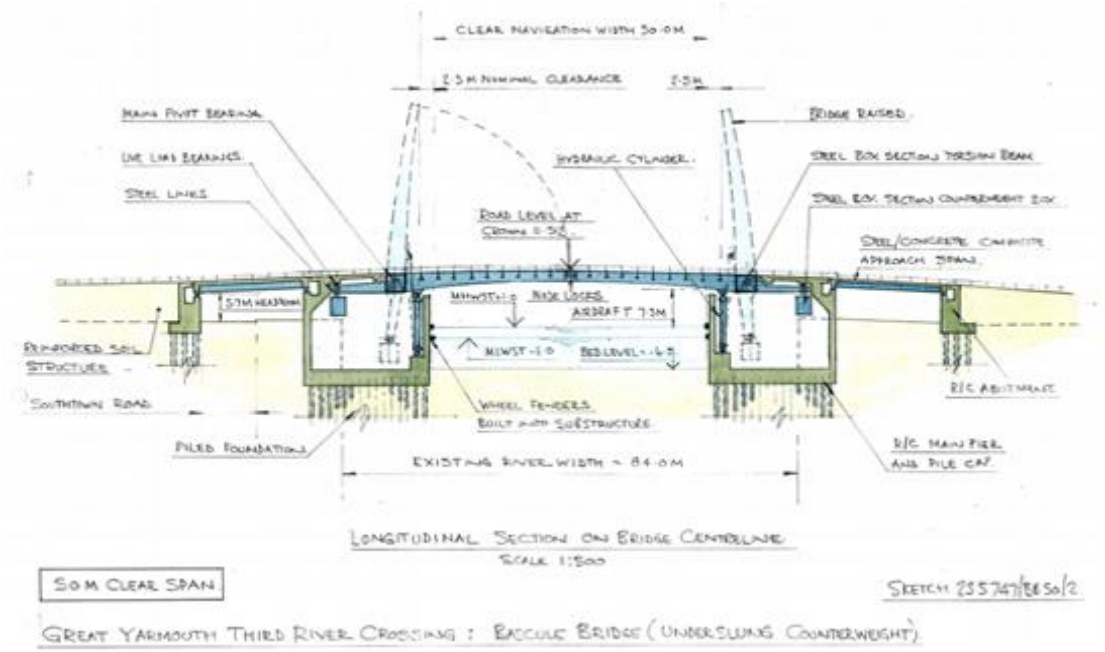


Figure 3-8 Bascule bridge option (example)

The Structural Options Working Paper concluded that a bascule bridge was the most appropriate type for this location. It would be less expensive than the other types of bridge considered, have a lower visual impact, especially when closed, and would allow passage of vessels of any height when opened.

Optimising the bridge location

Having confirmed that a bascule bridge was likely to be the best type of bridge, the Stage 2 Assessment gave further consideration to the options which had emerged from the initial sift (Stage 1 Assessment).

A navigation simulation was undertaken to determine the scope for reducing the opening spans of a bascule bridge to reduce the overall cost, and to optimise the alignment of the bridge.

Detailed data on commercial vessel movements within the inner harbour was obtained and used to estimate the number of bridge openings required per day and different possible bridge locations. This was used to determine the optimum location for a bridge. A bridge with the shortest route across the river from A12 Harfrey's Roundabout would require on average 6 openings a day. Further south, the number of openings would increase. Further north, the number of openings would be fewer, but more land would be required for longer approach roads, increasing the costs.

Tunnel option

The ground investigation confirmed that only an immersed tube tunnel, or a tunnel cast *in situ* into the river bed would be feasible due to the poor ground conditions. The overall length of the tunnel scheme would be longer than the tunnel options as the road level of the scheme would need to change from ground level to c. 16m below ground level, whereas the bridge options only require a c. 9.5m level change.

Any tunnel option would require mechanical and electrical systems for ventilation, drainage and fire protection. It would be difficult to prevent flood waters from entering the tunnel so it a temporary closure of the tunnel due to inundation must be considered a possibility. A tunnel would take approximately 3 years to construct, and would have a material impact on the current commercial operation of the inner harbour during construction.

Optimising the tunnel location

The tunnel alignments considered in the Stage 1 report were further reviewed, in the light of the initial finding that they did not adequately cater for the desire line of traffic movement. An improved alignment, running generally from the SW to the NE was identified, tested and found to be capable of attracting 35% more traffic than a NW – SE alignment.

3.4 Step 7b – Further assessment of shortlisted options (Stage 2 Assessment)

Three options – two bridge options on the shortest alignment and an improved tunnel option - were therefore shortlisted and developed for more detailed assessment. They are described in detail in the Stage 2 Scheme Assessment and Traffic & Economic Assessment reports, and their key features are summarised and illustrated below:

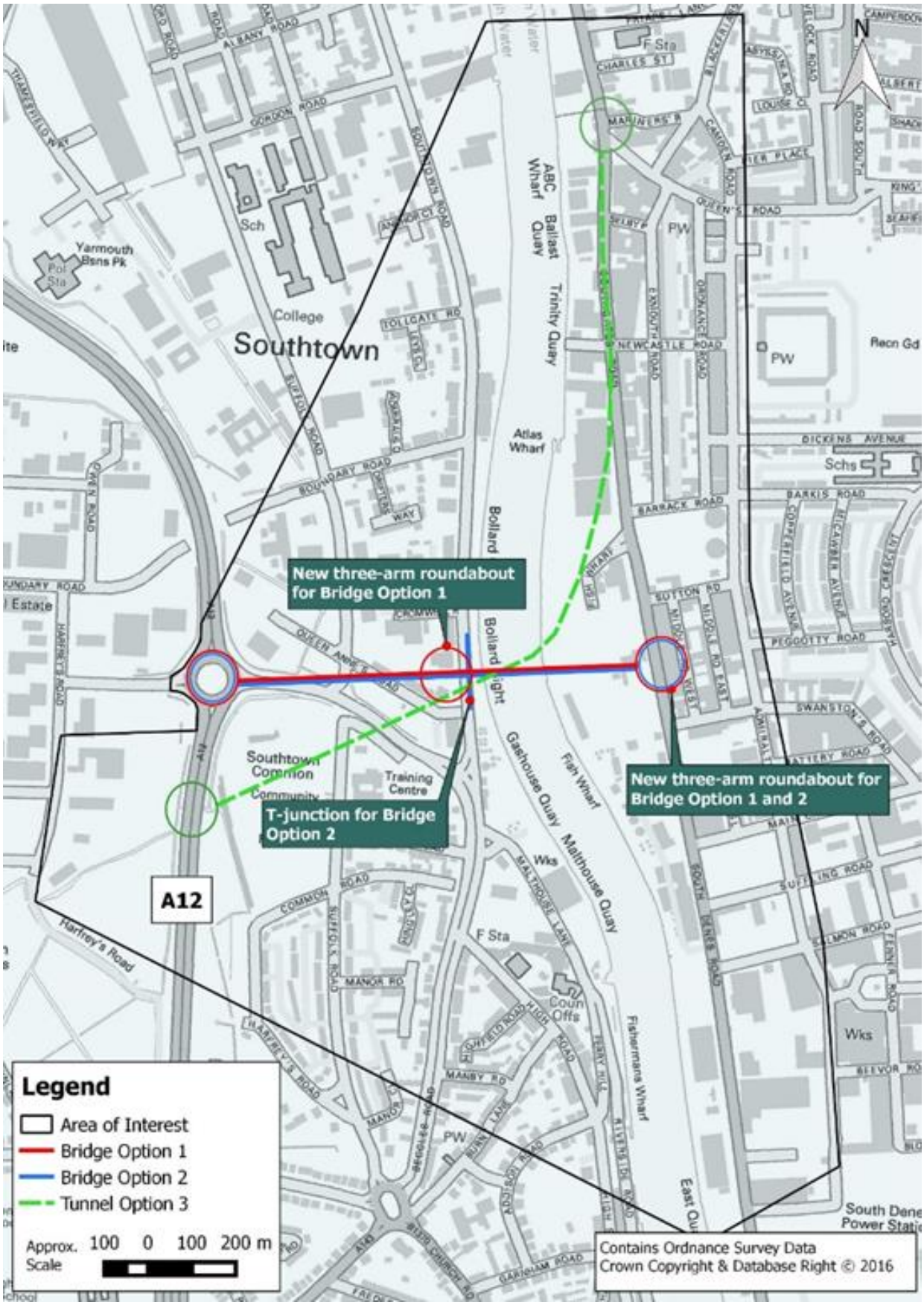


Figure 3-9 Shortlisted options

Bridge option 1 – Bascule Bridge with roundabout on Southtown Road

This option would provide a dual carriageway bascule bridge between the A12 Harfrey's Roundabout over Southtown Road and the River Yare to a new three-arm roundabout on South Dene Road between Sutton Road and Swanston's Road. This would give a headroom clearance of 5.3m on Southtown Road and 7.5m clearance to mean high tide level of 1m Above Ordnance Datum (AOD) when closed.

Other changes to the road network will also be necessary to accommodate the bridge. Beccles Road will be stopped up at its junction with Southtown Road, whilst Queen Annes Road will also be closed from its junction with Suffolk Road. A new roundabout will be provided on Southtown Road beneath the bridge and slip roads will be provided from this junction into the link to the A12 Harfrey's Roundabout.

.

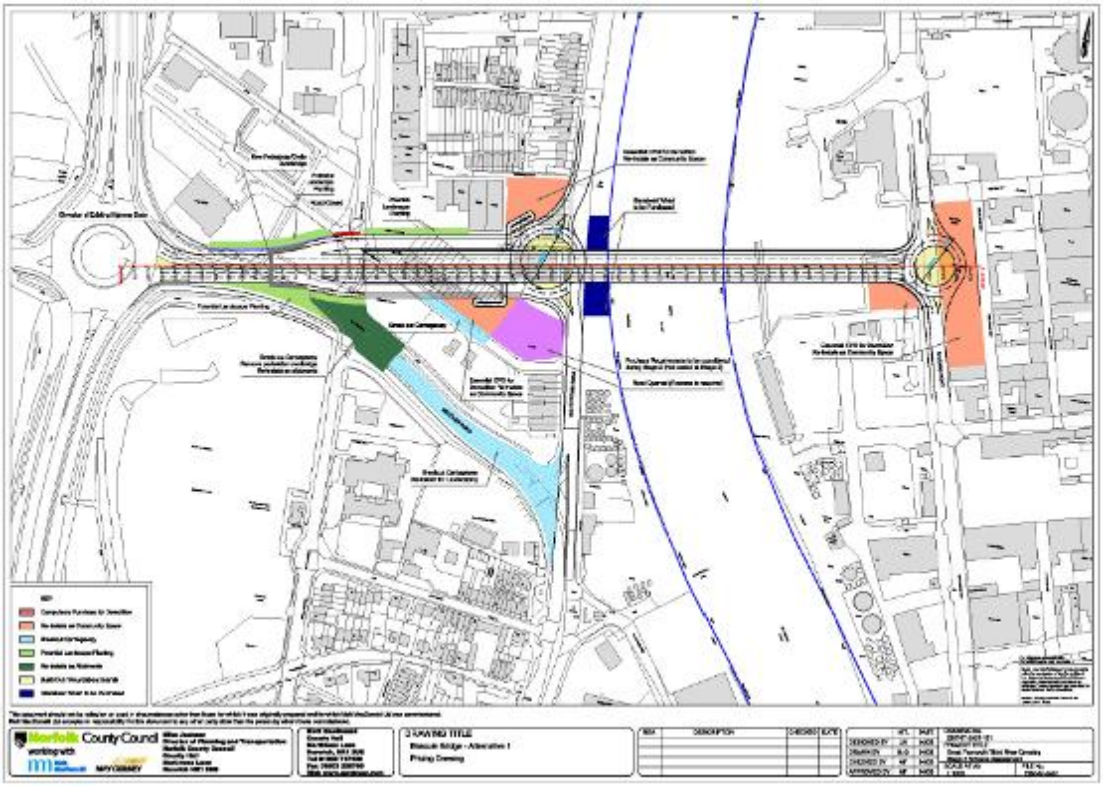


Figure 3-10 Bridge option 1 (Stage 2)

Costs for option 1 are set out below:

- Construction £ 105.426 million
- Land £ 10.900 million
- Preparation £ 2.125 million
- Supervision £ 3.225 million

The construction costs include optimism bias at a rate of 65%

Bridge option 2 – Bascule Bridge with T-junction on Southtown Road

This option would provide a dual carriageway bascule bridge between the A12 Harfrey's Roundabout over Southtown Road and the River Yare to a new three-arm roundabout on South Dene Road between Sutton Road and Swanston's Road. This would give a headroom clearance of 5.3m on Southtown Road and 7.5m clearance to mean high tide level of 1m Above Ordnance Datum (AOD) when closed.

Beccles Road would remain open from its junction with Southtown Road, but would provide a westbound one-way link towards the A12. Queen Annes Road would be closed to vehicle traffic from its junction with Suffolk Road. An eastbound off-slip will be provided from the bridge into Southtown Road

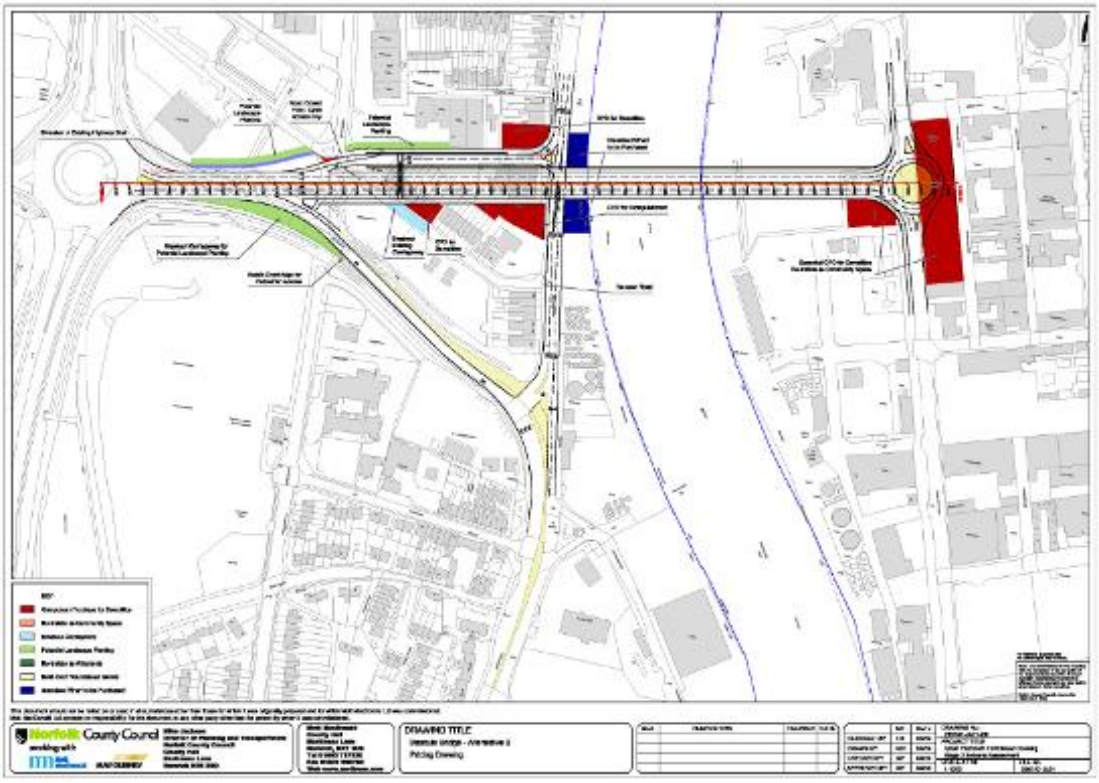


Figure 3-11 Bridge option 2 (Stage 2)

Costs for option 2 are set out below:

- Construction £ 97.169 million
- Land £ 10.200 million
- Preparation £ 1.959 million
- Supervision £ 2.973 million

The construction costs include optimism bias at a rate of 65%.

Tunnel option – Tunnel from A12 north east onto Southgates Road

This option would provide a dual carriageway tunnel between the A12(T) south of the existing A12 Harfrey's Roundabout and a new three arm roundabout at the junction of South Quay, Queens Road and Southgates Road. It would also provide improvements to Southgates Road and South Dene Road between Queens Road and Sutton Road. The existing access into the Fish Wharf would be replaced and the northbound carriageway of South Denes Road would run through the area. The tunnel portal would be located between Barrack Street and Newcastle Road.

A replacement roundabout to the south of the existing Harfrey's Roundabout would be provided with diversions to the existing Beccles Road and Harfrey's Road to link into the new junction. The existing roundabout will be removed. On and off-slips would be provided onto Southtown Road to retain access to the A12(T).

There would be no pedestrian provision through the tunnel, but cyclists could use the tunnel by travelling on-carriageway with other traffic.

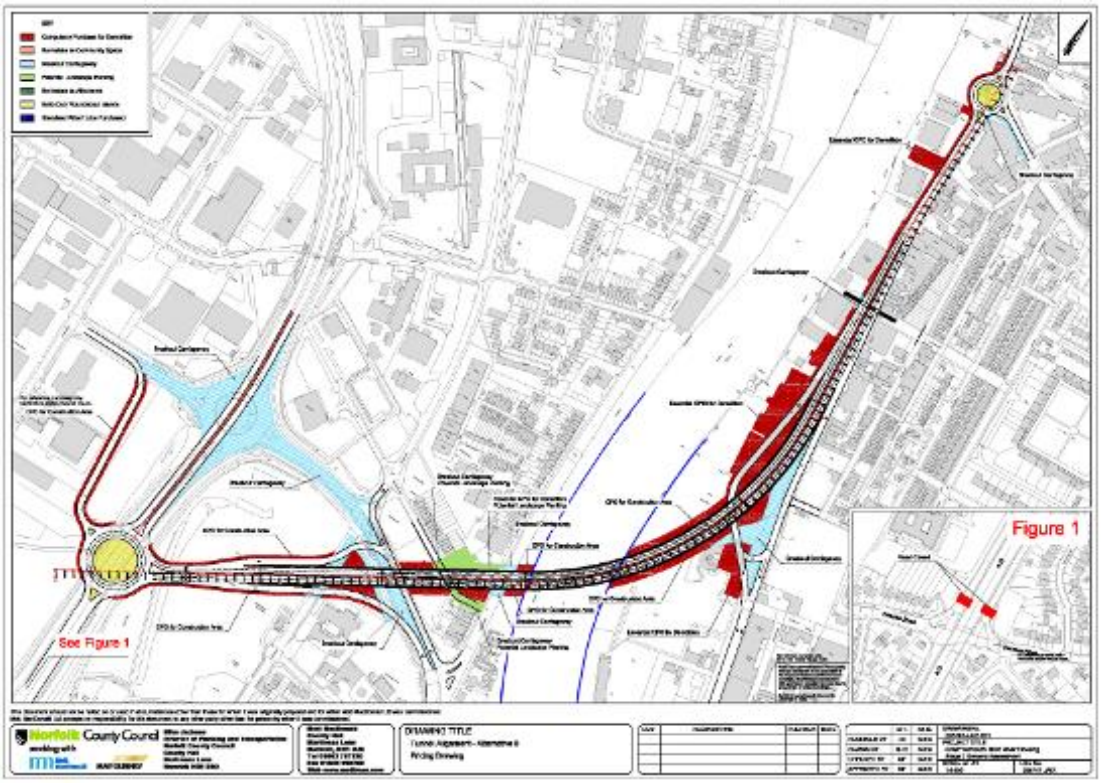


Figure 3-12 Tunnel Option (Stage 2)

Costs for the tunnel option are set out below:

- Construction £ 346.254 million
- Land £ 12.000 million
- Preparation £ 6.981 million
- Supervision £ 10.593 million

Summary of costs

The total cost of each shortlisted option at 2015 out-turn prices excluding VAT is set out in Table 3-8 below:

Option	Bridge option 1	Bridge option 2	Tunnel
Cost 2015 out-turn	£121.676 million	£112.301 million	£375.828 million

Table 3-8 Shortlisted options - costs

Environmental assessment

A Stage 2 Simple Environmental Assessment Report[15] was commissioned by Norfolk County Council in order to understand the existing environmental constraints relating to the three options for a new crossing. The findings are summarised in the SAR and the key findings are set out below:

Air Quality

For all three of the options a number of areas are predicted to experience changes in annual mean NO2 concentrations as a result of changes in traffic flows across the road network. Modelling predicted that all changes in particulate matter (PM10) concentrations would be negligible at all receptors for all three proposed options.

The overall effects on air quality as a result of the three proposed options are similar. Within Great Yarmouth as a whole, it is considered that the beneficial air quality effects caused by any of the proposed options compared to the Do-Minimum scenario outweigh the adverse effects.

Cultural Heritage

Archaeology: Overall, there will be negligible adverse effects on recorded archaeological sites, except for the possible buried shore line on the east side of the river. The most significant of the recorded archaeological remains in the vicinity is likely to be the buried shore and any associated deposits, although the proposed crossing is not expected to affect it at this location.

Historic buildings: In general, the number and significance of historic buildings within the study area is low, and the scheme will have neutral to slight adverse effect on the majority of them. However, both bridge options require demolition of 19th century buildings for which there is no effective mitigation option. Only one listed building (The Dolphin Inn) is judged to be affected to a moderate/large degree, and appropriate mitigation measures should help reduce the significance of this effect.

[15] Stage 2 Environmental Assessment Report, Mott MacDonald for NCC, 2009

Historic Landscape: The historic landscape within the study area has been extensively eroded, with little evidence of pre-20th century land use, and the scheme will therefore have only neutral to slight adverse effect. There is the slight possibility that construction works will uncover evidence of earlier land use, particularly within the Fish Wharf area and mitigation measures should be put in place to provide appropriate recording for any historic features which might be revealed.

Ecology and Nature Conservation

The impacts of ecological assets in the area, both terrestrial and marine, have been assessed following specific site surveys. Both construction and operational phases have been considered.

The construction impacts of Options 1 and 2 include loss of terrestrial habitats e.g. garden allotments, broadleaved trees and drainage ditches, direct loss of aquatic habitat, indirect disturbance to aquatic habitats caused by the disturbance of silts etc, and light and noise pollution, affecting some fauna known to exist locally. Several protected species are known to exist locally, including water voles, several species of bats, and grass snakes, all of which are likely to be affected by construction. No direct effects are considered likely on Breydon Water during construction.

The construction impacts of Option 3 would be similar to Options 1 and 2, but to a greater extent, as the areas of land take would be greater, and in more sensitive areas. A large portion of Southtown Common would be lost to this option, and the impacts on the river bed would be far greater due to the requirement to excavate a trench across the width of the river, rather than locally, as would be the case with the piers for Options 1 and 2.

The operational impacts of Options 1 and 2 include increased light pollution, with its associated impacts on bats and birds, and the possible flight pattern disruption caused by the structure itself. Indirect impacts caused by the increased traffic are likely to have some detrimental effects on ecological assets adjacent to the new traffic corridor, but could also provide improvements to ecological assets within the areas of Great Yarmouth and Gorleston which will experience a reduction in traffic and congestion.

The operational impacts associated with Option 3 are likely to be less significant compared to the other options. Impacts associated with lighting would still occur, as would the indirect effects associated with elevated traffic levels and any control building.

Landscape

The landscape effects resulting from the proposed works have been assessed, in terms of both impacts on the surrounding landscape and on visual intrusion on the local community.

The main impact of Options 1 and 2 would be the presence of traffic and the bulk of the structure within the view of nearby houses, and the presence of the bridge structure across the open river. Option 3 would largely remove traffic impacts across the river, but the extensive areas required for the approach ramps would have greater impacts on residential areas than either of the bridge options.

For all three options construction impacts are likely to be significant but once completed, a bridge structure could be considered as a visually striking iconic gateway feature, with potentially beneficial landscape and visual effects.

Community and Private Assets

The impacts on private and commercial assets and land used by the community, existing pattern of land use and the areas of land lost, and the resultant impact on land use have been assessed.

Option 1 requires the demolition of up to 42 private properties, both residential and commercial, and would require the purchase of suitable exchange land for community allotments.

Option 2 requires up to 25 properties to be demolished, and suitable exchange land is required to compensate for the loss of the community allotments as required by Option 1.

Option 3 requires the demolition of approximately 24 private properties, but has a much larger overall footprint; the tunnel option requires the finding of exchange land for a small area of community used allotments and an area of recreation ground. The recreation ground will be split in two by the tunnel alignment and will thereby be rendered unfit for purpose as a playing field; although not registered as common land or town or village green there would still be a requirement to replace this facility. At present there is no proposed mitigation for the reinstatement of the entire recreation ground so this could represent the option with the most significant effects in terms of loss to communities and private assets.

Option 2 represents the design with the least effects when compared with Options 1 and 3.

Noise and vibration

The impacts on the local environment caused by noise and vibration have been assessed for each option. The assessment has included both construction phase and operational phase impacts.

In general, impacts on people have been quantified, although at this stage detailed impacts associated with construction have not been carried out as a detailed construction strategy is not available. Therefore, a number of assumptions have been made, to permit simple quantitative assessment.

Mitigation has not been considered as at this stage of assessment too many parameters associated with each option are unknown.

During the construction phase, all three options could result in significant adverse noise and vibration impacts at nearby receptors. At this level of assessment there are not marked differences in their respective impacts. Options 1 and 2 would most likely produce nearly identical construction impacts given their similar scheme extents. Options 1 and 2 and would be expected to have lesser construction impacts as they would take approximately 12 months less time to construct compared to Option 3.

During operation of the scheme options, impacts can be either short term or long term.

In the short term, based on current traffic model predictions

- Option 2 could produce a third fewer significant adverse noise impacts and a few more significant beneficial impacts than Option 1.

- Option 3 could result in more than twice as many receptors experiencing a significant adverse noise impact than Option 1, and an even greater number of receptors experiencing a significant adverse noise impact than Option 2.

In the long term, based on current traffic model predictions

- Option 2 could produce a quarter fewer significant adverse noise impacts and the same number of significant beneficial impacts than Option 1.

- Option 3 could result in five times as many receptors experiencing a significant adverse noise impact than Option 1, and seven times as many receptors experiencing a significant adverse noise impact than Option 2.

- Option 3 could result in almost twice as many receptors experiencing a significant beneficial noise impact than either Option 1 or 2.

Overall, Options 1, 2 and 3 could produce similar beneficial impacts. However, Options 1 and 2 should produce fewer adverse impacts in Great Yarmouth town centre than Option 3. Therefore Options 1 and 2 meet their aims of reducing traffic noise in Great Yarmouth town centre, but Option 3 does not.

<u>Pedestrians, cyclists and equestrians</u>

During construction, pedestrians and cyclists would experience minor adverse impacts, as routes would be closed off and diversions put in place. The works are likely to be phased, both spatially and temporally, reducing the potential impacts of the construction process. The construction of Option 3 could last for approximately twice as long as Options 1 and 2, so the impacts associated with this Option would be felt over a longer period.

Once completed, Options 1 and 2 would have beneficial impacts for both pedestrians and cyclists by offering relief from the existing severance that the River Yare creates in the absence of any crossing. Shared use footway/cycle paths would be provided in both directions over the crossing. Existing routes would generally experience negligible impacts.

Option 3 would also have beneficial impacts by offering relief from the existing severance created by the river, although only for cyclists as pedestrians would not be allowed to use the tunnel due to safety reasons. It is likely the pedestrians would benefit indirectly however, as public transport routes would be provided to take advantage of the new crossing.

Vehicular Travellers

Two aspects affecting vehicular travellers have been assessed; the view from the road and driver stress.

The view from the road along the existing route between Harfreys roundabout and South Denes Road, for comparison to that of the crossing options, fluctuates between an intermittent view and no view, except on Haven Bridge where the view is a lot more open. This would remain the case during construction of each of the options, except where the features of the construction site itself reduce the view.

Options 1 and 2 would allow a beneficial impact, permitting an open view for most of their lengths due to the height of the structure. Option 3 would have an overall minor adverse impact, as the route would have no view for the majority of its length.

Driver stress along the existing route between Harfreys roundabout and South Denes Road is moderate to high. Using the simple criteria laid down in DMRB, each of the three alternatives would also have high driver stress levels, in both the opening year and design year.

In real terms, driver stress levels will be reduced, because of the much shorter distance travelled, improved traffic capacity, junctions, surfacing and pedestrian and cycle facilities. Potential disbenefits in Options 1 and 2 would arise when the bridge is open to navigation, meaning vehicular travellers have to either wait or use the original route.

Road Drainage and the Water Environment

During construction, the Option 3 would have a greater negative effect on surface and ground water quality compared to the Bridge Options, due to the larger area and longer duration of dredging works within the River Yare. Release of contaminated sediments could have a negative impact on the ecologically sensitive receptors at Breydon Water. During operation, Option 3 could also have a larger negative effect on groundwater flow (quantity) due to the size and length of the structure within the groundwater table.

During operational activities, Option 3 would have a neutral effect on surface water quality and Options 1 and 2 would have a slight adverse effect. The neutral effect of Option 3 is due to the dilution capacity of the River Yare of the additional road runoff. The slight adverse effect is due to the localised restriction of river water flow, and increased river bed scour expected from Options 1 and 2 pier foundations.

All options are within a high flood risk area. Options 1 and 2 are deemed preferable to Option 3 in terms of flood risk, as they would facilitate the passage of flood flows beneath the approach ramps. The embankments would offer no greater obstruction to flood flows than the existing structures.

It has not been possible to determine the exact effect of flood waters on any of the options at this time as the revised strategic flood risk assessment for the Great Yarmouth area has not yet been made publicly available. It is difficult to see how the tunnel option will meet the scheme objective of providing an essential infrastructure link to the peninsula in times of inundation.

Geology and Soils

No adverse impacts on geology and soils (including terrestrial soils and river sediments) are anticipated, as there are no sensitive receptors that would be affected by construction or operation of any of the options. The removal of any existing contaminated material from site is considered to be potentially beneficial for each option. Option 3 has the potential to lead to the removal of more potentially contaminated material than Options 1 and 2. Similar amounts are likely to be removed between Options 1 and 2.

The impacts of disturbing contaminated soils have the potential to affect ecology, surface water, groundwater and pedestrians, cyclists and equestrians. Option 3 is likely to lead to the greatest disturbance of potentially contaminated soils, and hence have the greatest adverse effect in this respect.

The disturbance of potentially contaminated soils could also lead to impacts on construction workers. However, assuming use of appropriate Personal Protective Equipment and implementation of a suitable Construction Environmental Management Plan, the consequence of contact with contaminated land would be low and the risk is also considered to be low.

The impacts caused by the disturbance of any contaminated river sediments have the potential to lead to effects on ecological and surface water receptors. Option 3 is likely to lead to the greatest disturbance of any contaminated sediments.

Traffic assessment

The three shortlisted options were tested using the Great Yarmouth SAURN model. The Stage 2 Traffic and Economic Assessment Report describes the development and use of the model.

The model is based on detailed surveys in 2003 and updated to 2008 to take account of major developments during that period. The assessment years are 2015 and 2030, with growth constrained to TEMPRO. It is recognised that this model will need to be fully updated if the scheme progresses to the next stage of appraisal.

The options tested were:

Option	Description	Reference
Bridge option 1	Bascule Bridge with T-junction on Southtown Road	Figure 3-10
Bridge option 2	Bascule Bridge with roundabout on Southtown Road	Figure 3-11
Tunnel	Tunnel from A12 north east onto Southgates Road	Figure 3-12

Table 3-9 Shortlisted options tested in traffic model

The forecast impact of each of these options on traffic flows is illustrated in Table 3-4 and Table 3-5 above.

2015 AADT (two way)	Do minimum	Bridge option 1	Bridge option 2	Tunnel
A12 Breydon Bridge	41,956	38,929	38,588	36,661
A1243 Haven Bridge	38,259	25,750	25,032	26,095
Third river crossing		23,870	23,807	23,442
TOTAL	**80,215**	**88,549**	**87,427**	**86,198**

Table 3-10 Forecast traffic on bridges, 2015 (Stage 2 Assessment)

2030 AADT (two way)	Do minimum	Bridge option 1	Bridge option 2	Tunnel
A12 Breydon Bridge	41,398	39,857	39,347	37,648
A1243 Haven Bridge	39,650	27,934	27,341	28,515
Third river crossing		26,879	26,957	25,825
TOTAL	**81,048**	**94,670**	**93,645**	**91,988**

Table 3-11 Forecast traffic on bridges - 2030 (Stage 2 Assessment)

All of the options produce a big reduction in traffic over Haven Bridge and a smaller reduction in traffic over Breydon Bridge. The bridge options are more effective than the tunnel option in reducing traffic on Haven Bridge (by more than 30%), but the tunnel option produces the biggest reductions on Breydon Bridge (more than 9%) at this level of detail.

All of the options produce a net increase in traffic crossing the River Yare (up to 17%). This is because the new crossing enables traffic from South Denes to the west and north to bypass the town centre using the Western Bypass and Breydon Bridge.

Do Minimum traffic flows are illustrated in Figure 3-13. Forecast do something flows for 2015 and 2030 are illustrated in Figure 3-14 and Figure 3-15.

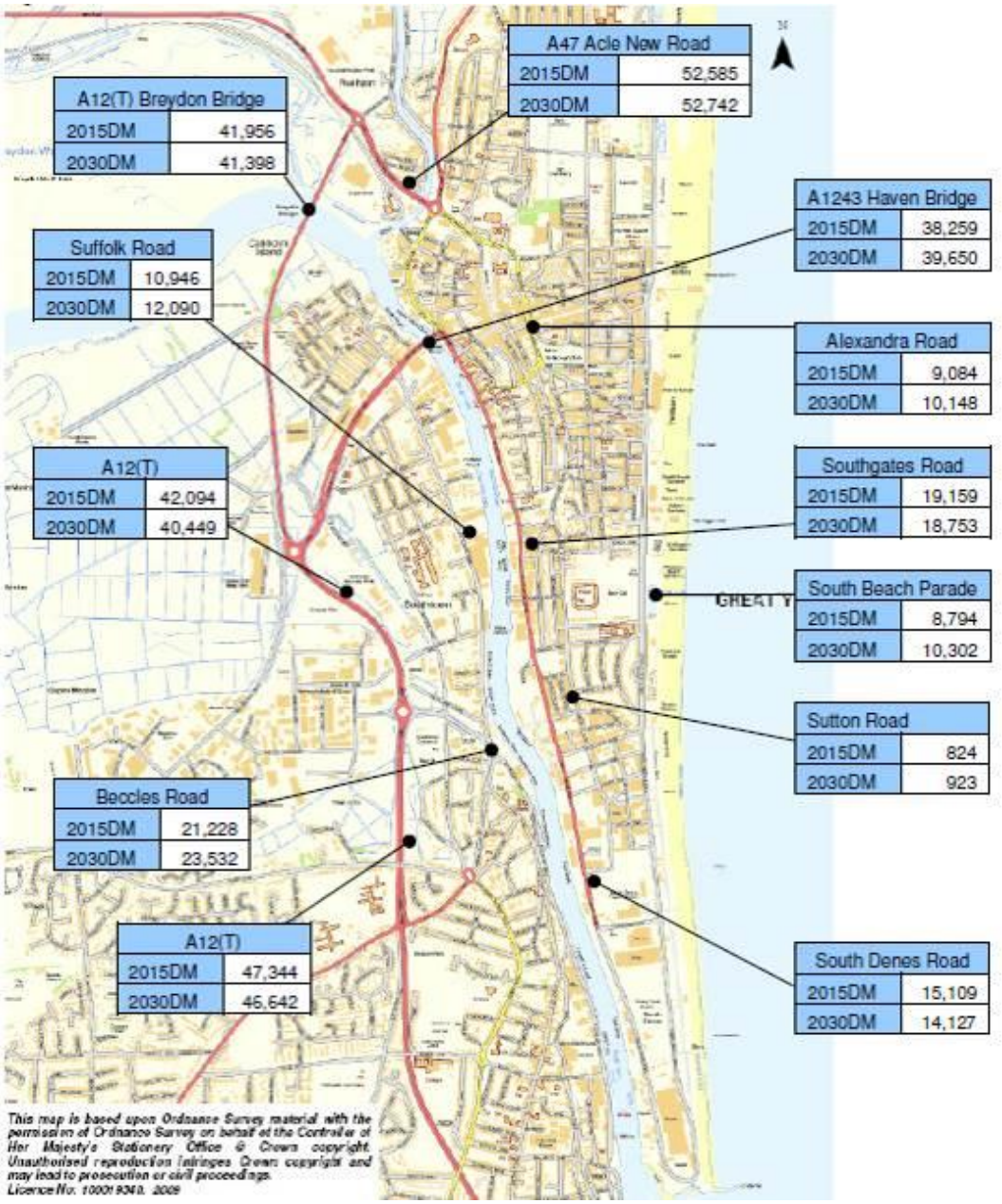


Figure 3-13 Do minimum forecast traffic, 2015 and 2030 (from Stage 2 Traffic & Economic Assessment)

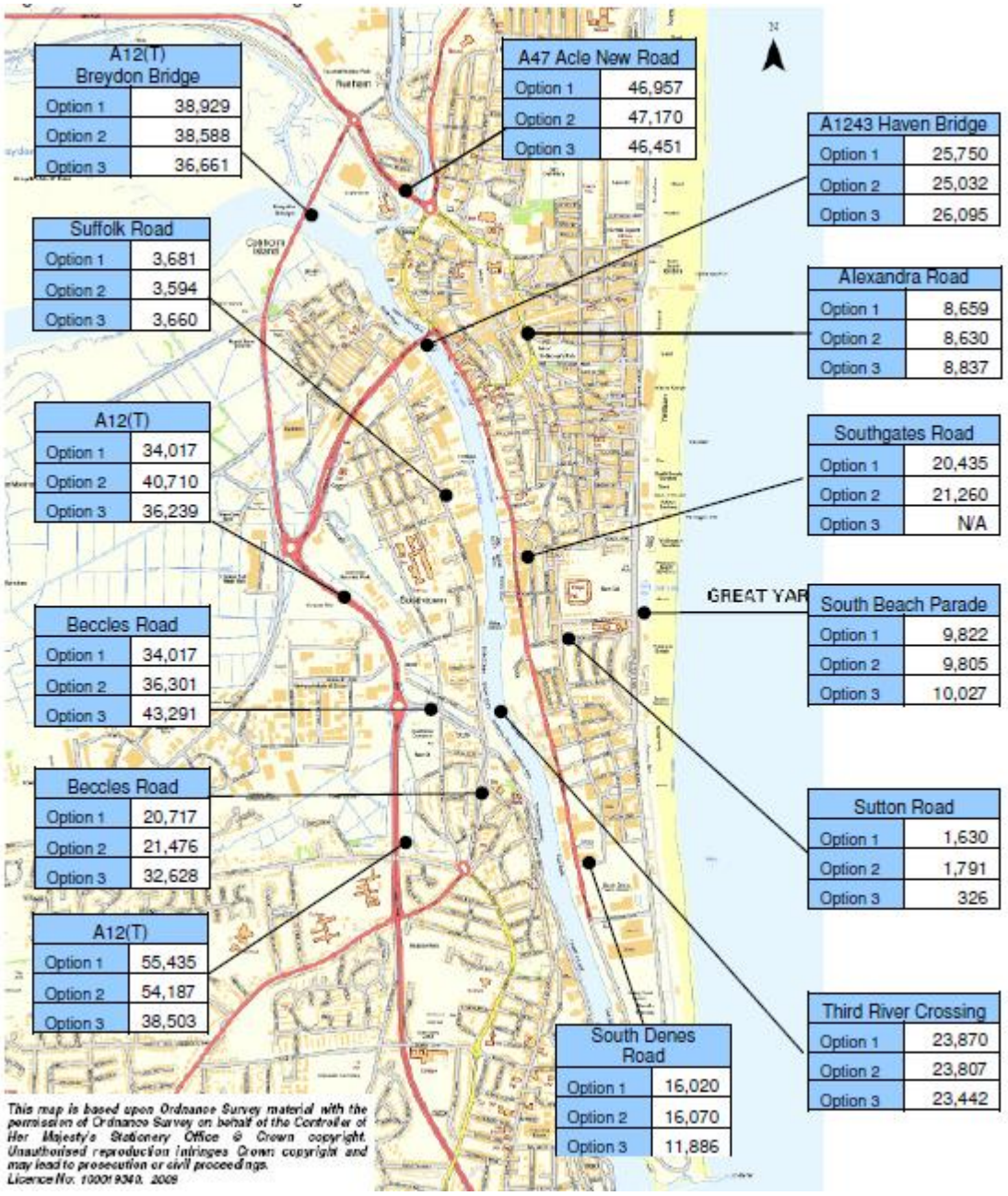


Figure 3-14 Do something forecast traffic 2015 (from Stage 2 Traffic & Economic Assessment)

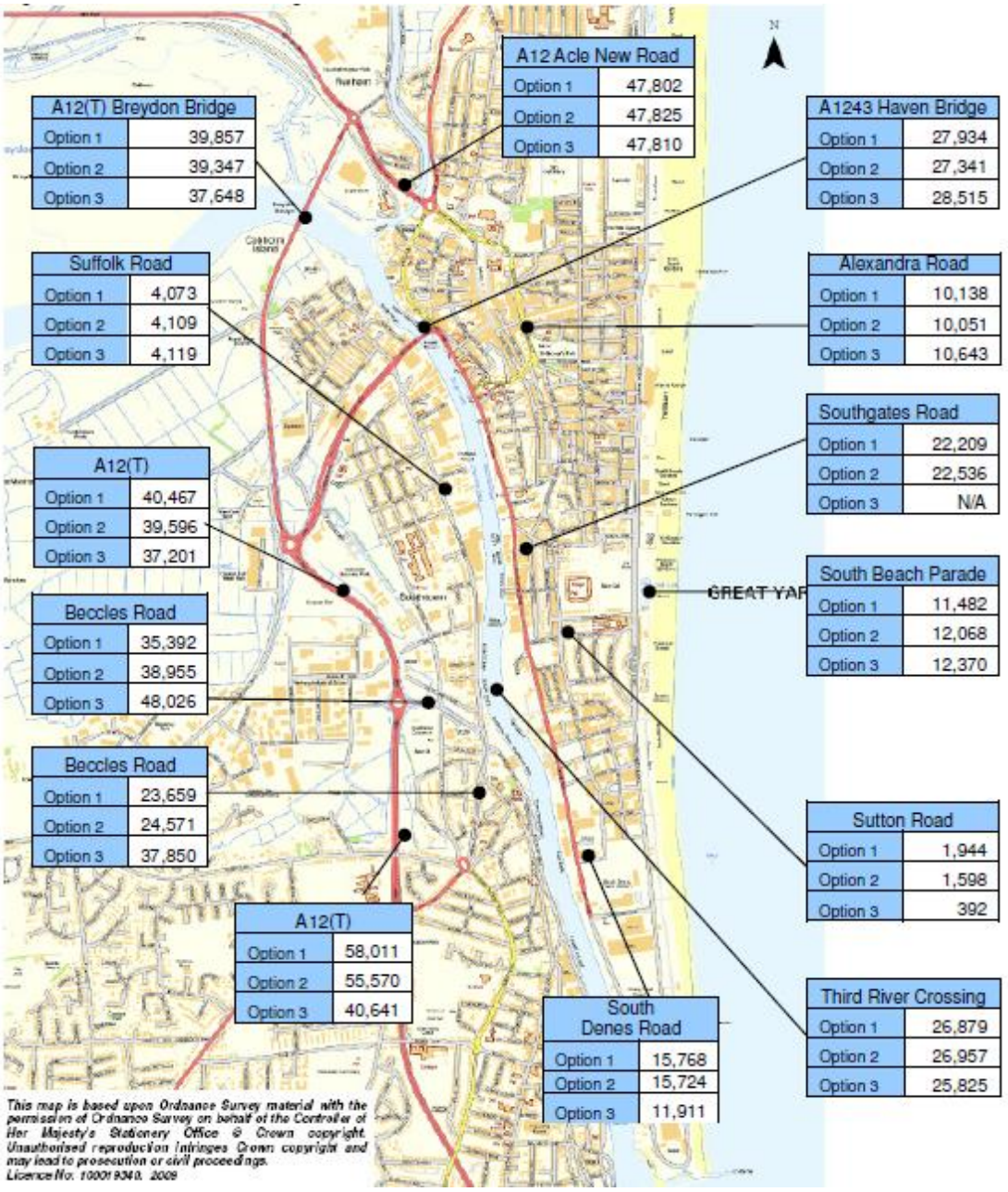


Figure 3-15 Do something forecast traffic 2030 (from Stage 2 Traffic & Economic Assessment)

Journey time savings

The Stage 2 Traffic and Economic Appraisal Report gives details forecast journey time savings on seven routes in the study area. Journey time savings for a route via Pasteur Road and the Haven Bridge in 2030 (p.m. peak) are summarised below:

Route 4 - Pasteur Rd / Haven Bridge Journey time saving (2030) p.m. peak (min)	Bridge option 1	Bridge option 2	Tunnel
Inbound	5.97	5.94	4.27
Outbound	4.15	4.32	3.69

Table 3-12 Indicative journey time savings

All of the options produce significant savings in journey times on existing routes over a wide area. In addition, a third crossing produces significant distance journey time savings for journeys transferring to the new route, especially journeys between the peninsula and the A12 (south).

All of the journey time impacts are captured in the economic assessment.

Accidents

The Stage 1 assessment showed that a third crossing would produce high accident benefits. An assessment of the accident benefits was not undertaken at Stage 2, but it is expected that accident benefits will be similar to those in previous assessments.

Stage 2 Economic Assessment

An economic assessment was undertaken using TUBA. All of the options tested show a positive benefit-cost ratio, as set out below:

- Bridge (option 1) **4.5**
- Bridge (option 2) **4.8**
- Tunnel **1.5**

The results are set out in more detail in Table 3-13 below.

Benefits/Disbenefits/Costs	Bridge option 1 £,000	Bridge option 2 £,000	Tunnel £,000
Present Value of Benefits (PVB)	**£474,450**	**£472,841**	**£441,726**
Present Value of Costs (PVC)	**£105,256**	**£98,042**	**£301,578**
Net Present Value (NPV)	**£369,194**	**£374,799**	**£140,148**
BCR (PVB/PVC)	**4.508**	**4.823**	**1.465**

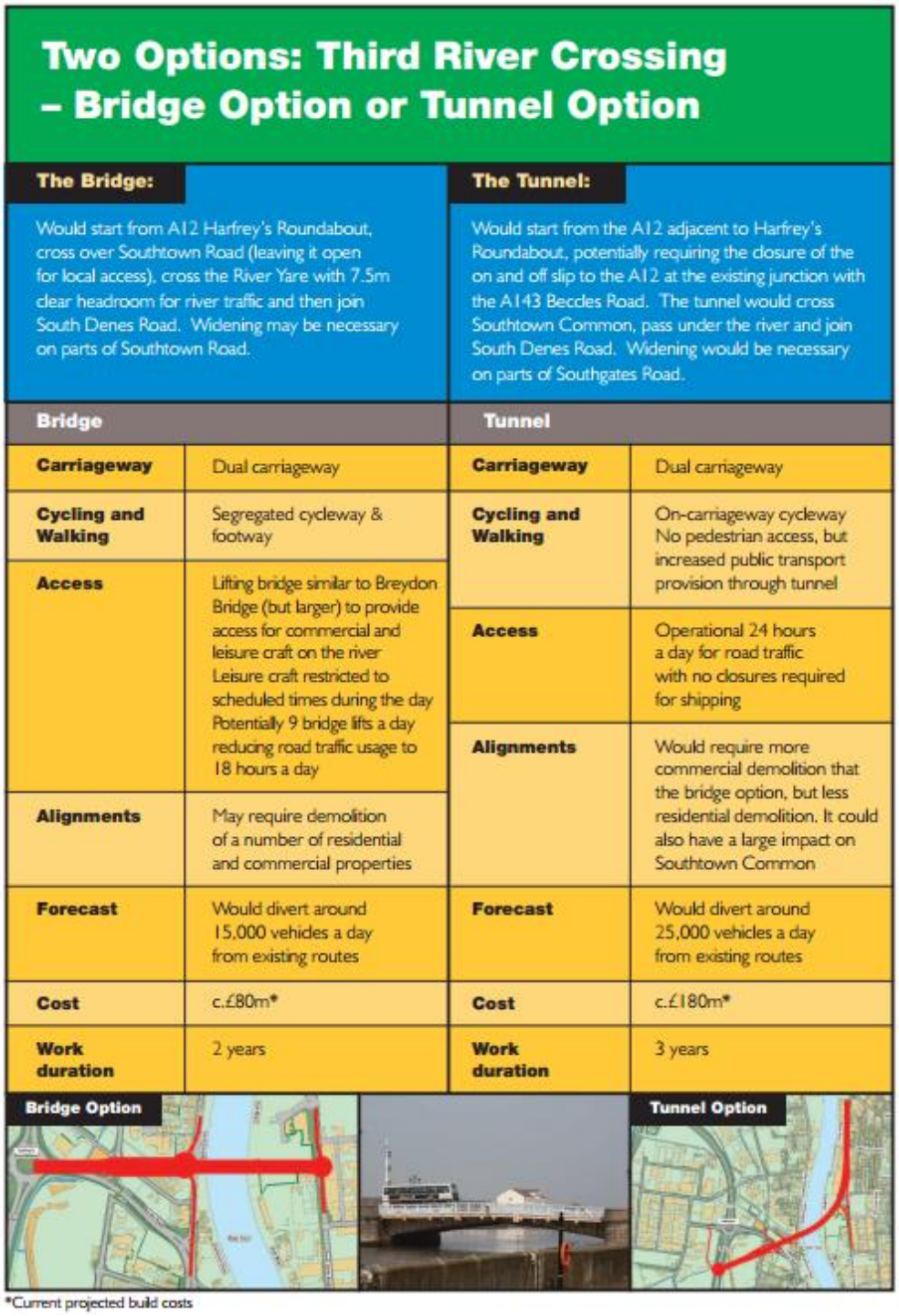
Table 3-13 Economic assessment results (Stage 2)

Although the economic benefits of the tunnel option are nearly as high as those for the bridge options, its cost is much higher. The resulting BCR is less than 2.0 and this confirms that a tunnel option is not a viable solution. There is little difference between the benefits of the two bridge options, but option 2 is a less expensive solution and produces the highest BCR. Both of the bridge options have a BCR of greater than 4.0. Based on the criteria in DfT guidance[16], they offer **very high** value for money.

[16] Value for Money Assessment: Advice Note for Local Transport Decision Makers. (DfT, December 2013)

Public consultation

Norfolk County Council consulted local people on the scheme from 19 June to 38 August 2009 as part of a wider consultation on the Great Yarmouth and Gorleston Area Transportation Strategy. The two main options were presented – a bridge and a tunnel.



Two Options: Third River Crossing – Bridge Option or Tunnel Option

The Bridge:

Would start from A12 Harfrey's Roundabout, cross over Southtown Road (leaving it open for local access), cross the River Yare with 7.5m clear headroom for river traffic and then join South Denes Road. Widening may be necessary on parts of Southtown Road.

The Tunnel:

Would start from the A12 adjacent to Harfrey's Roundabout, potentially requiring the closure of the on and off slip to the A12 at the existing junction with the A143 Beccles Road. The tunnel would cross Southtown Common, pass under the river and join South Denes Road. Widening would be necessary on parts of Southgates Road.

Bridge		Tunnel	
Carriageway	Dual carriageway	**Carriageway**	Dual carriageway
Cycling and Walking	Segregated cycleway & footway	**Cycling and Walking**	On-carriageway cycleway No pedestrian access, but increased public transport provision through tunnel
Access	Lifting bridge similar to Breydon Bridge (but larger) to provide access for commercial and leisure craft on the river Leisure craft restricted to scheduled times during the day Potentially 9 bridge lifts a day reducing road traffic usage to 18 hours a day	**Access**	Operational 24 hours a day for road traffic with no closures required for shipping
Alignments	May require demolition of a number of residential and commercial properties	**Alignments**	Would require more commercial demolition that the bridge option, but less residential demolition. It could also have a large impact on Southtown Common
Forecast	Would divert around 15,000 vehicles a day from existing routes	**Forecast**	Would divert around 25,000 vehicles a day from existing routes
Cost	c.£80m*	**Cost**	c.£180m*
Work duration	2 years	**Work duration**	3 years

Bridge Option

Tunnel Option

*Current projected build costs

Figure 3-16 Consultation information leaflet

The results of the consultation are set out in Table 3-14 below:

Consultation question	Yes, definitely	Yes, possibly	No
Do you support the need for a new river crossing in Great Yarmouth?	**92%**	**-**	**8%**
Would a new crossing, with improved pedestrian and cycle facilities, encourage you to walk or cycle for some of your journeys rather than drive?	**42%**	**25%**	**33%**

Table 3-14 Consultation results

The provision of a third crossing was supported by more people than any other transport measure identified in the consultation.

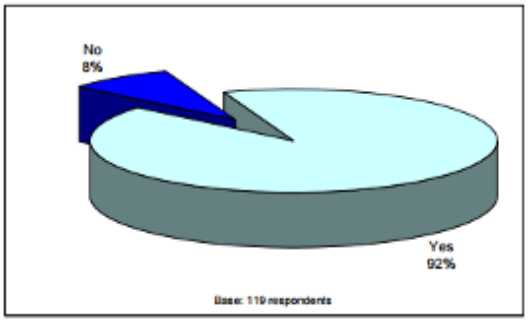


Figure 3-17 Support for a new crossing (2009 consultation)

67% of people said that a new crossing, with improved pedestrian and cycle facilities would, or would possibly, encourage them to walk or cycle for some journeys instead of driving.

63% of people said that they would, or would possibly, support tolling if that was the only way a bridge could be built.

Views of key stakeholders

Great Yarmouth Borough Council fully supports the Third River Crossing scheme. In October 2009 it asked the County Council to declare and endorse the bridge option as its preferred route.

The Highways Agency provided a written response in September 2009, stating:

"The Highways Agency has no objection to the proposal of an additional crossing of the River Yare and sees that there is likely to be benefits to the movement of people in/out and around the town and to the trunk road. The Highways Agency's preference of option would be for the one which provides the best balance between minimising disruption during construction, providing improved safe and reliable journeys, and the best value for money. On balance this currently appears to be the bridge option."

1st East, the Great Yarmouth Waterfront Regeneration Company gave its full support to a third crossing scheme in September 2009, stating:

We believe that this major investment is the single most important infrastructure requirement for Great Yarmouth. It is vital to the town's long term economic development and prosperity. A new crossing would provide connectivity to the South Denes employment area and enable the outer harbour to maximise its full potential. The crossing would also be a new gateway into the town providing a southerly access to support the seafront tourist attractions. An additional river crossing will also positively impact on the priority regeneration areas to the north, Breydon Reach and Ice House Quay, because the bridge will provide increased network capacity and route options for these waterfront developments. In particular, 1st East supports the bridge crossing option which allows for both vehicular and pedestrian access.

3.5 Preferred route (2009)

In December 2009, Norfolk County Council's Cabinet[17] considered the findings of the technical studies and the public and stakeholder consultation, and decided to adopt a preferred route for the bridge option, as illustrated in Figure 3-18 below.

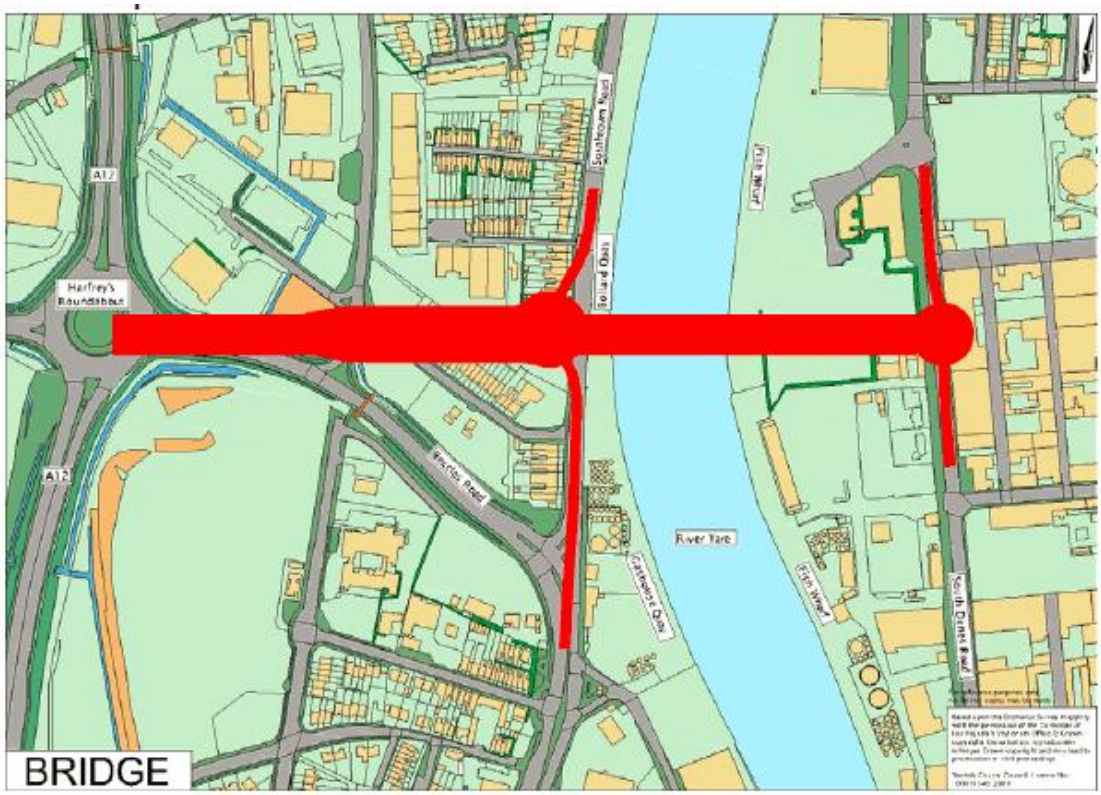


Figure 3-18 Preferred route, adopted by Norfolk County Council, November 2009

[17] Great Yarmouth Third River Crossing Preferred Route, NCC Cabinet, 7 Dec 2009

The Cabinet's conclusion was that:

"Evidence from all of the technical work to date and the results from the public consultation indicate that the bridge option with a dual carriageway link utilising a 50m span bascule bridge over the river is the best option for a preferred route.

"The decision on whether the bridge scheme has a roundabout or a T-junction on Southtown Road can be decided during the detailed design."

The Cabinet also authorised the purchase of properties subject to blight notices and agreed to investigate funding options for the scheme.

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 3B: Final Options Assessment 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

Document Reference: 6.2 – Technical Appendix 3B

Version Number: 0 – Revision for Submission

Date: 30 April 2019

Great Yarmouth Third River Crossing

Final Options Report

March 2017

Produced for

Norfolk County Council

Prepared by

Mouchel

Export House
Cawsey Way
Woking
Surrey
GU21 6QX
UK

Document Control Sheet

Project Title	Great Yarmouth Third River Crossing
Report Title	Final Options Report
Report ref no.	1076653-MOU-GEN-XX-RP-Z-0001
Version	1
Status	Final
Report Date	24th March 2017

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
1	Final	Sam Mirfin	21/11/16	Amanda Fogg	24/03/17	Ian Turvey	24-03-17

Limitations

This report is presented to Norfolk County Council in respect of the Great Yarmouth Third River Crossing and may not be used or relied on by any other person. It may not be used by Norfolk County Council in relation to any other matters not covered specifically by the agreed scope of this Report.

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

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

Contents

Table of Figures

Tables

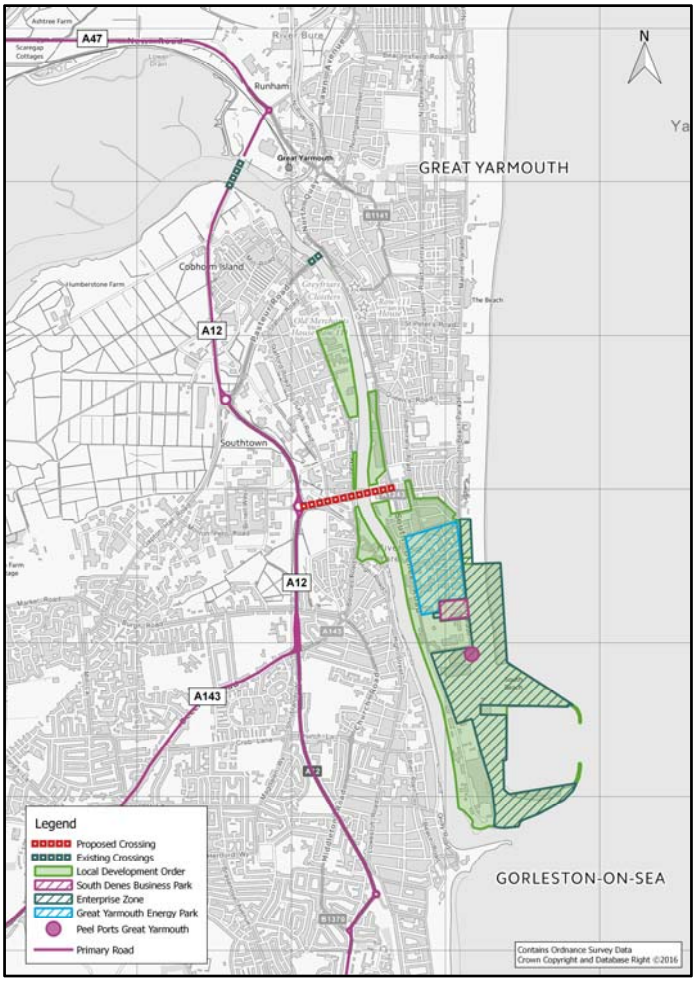
1 Introduction

1.1 Geography

Great Yarmouth is part of a larger economic sub-region with a strong economic heritage including manufacturing, food and drink processing, tourism and leisure industries.

The town itself is geographically constrained, bounded by the North Sea to the east and both the River Yare and the River Bure to the west, the latter two of which can be crossed by The Haven Bridge and Breydon Bridge respectively. The Haven Bridge crosses the River Yare along the A1243, linking in with the Strategic Road Network (SRN) to the south. The A12 Breydon Bridge crosses the River Bure from the north of the town along the A149 which becomes the A47 New Road, providing a direct route to and from Norwich as shown in Figure 1-1.

Figure 1-1 - Great Yarmouth Location



Great Yarmouth is highlighted as a key growth location within the New Anglia LEP's Strategic Economic Plan. The area has been designated one of six UK Centres for Offshore Renewable Engineering and has two Enterprise Zones designated for energy businesses, offshore engineering, ports and logistics. One is at the Port and the other at Beacon Park. In addition to the port Enterprise Zone area, a Local Development Order has been agreed for the whole of the South Denes wider area. This designation provides for greater freedoms and flexibilities in terms of planning to encourage employment growth.

1.2 Need for a River Crossing

The Great Yarmouth Area Transportation Strategy describes a Third River Crossing across the River Yare in order to relieve congestion on the existing bridges.

The Great Yarmouth Third River Crossing (GYTRC) is recognised by the Council, Norfolk and Suffolk Local Transport Body, New Anglia LEP and the A47 Alliance as a strategic priority for unlocking future economic growth in the area. It will also ease existing congestion problems and improve accessibility in Great Yarmouth, including access to the seafront, South Denes and the outer harbour areas.

The Breydon and Haven bridges currently cater for daily traffic of around 70,000 vehicles with about 5,000 vehicles using the bridges in the peak hours. There has been a steady but modest growth in traffic since 2003 when the possibility of a third river crossing was first explored. Currently, with additional development pressures, river crossing traffic is anticipated to rise to between 80,000 (Large Local Major Transport Scheme Bid Document, 2016) and 100,000 (Mott Macdonald, 2009) vehicles per day by 2030.

2 CURRENT SITUATION

2.1 Transport Policy

This chapter sets out the wider strategic and policy context against which the Great Yarmouth Third River Crossing could be developed. The strategic aims and responsibilities of the Local Enterprise Partnership for New Anglia and other policies impacting on the future situation are identified in later sections of this chapter.

National Policy

2.1.1 Investing in Britain's Future (2013, HM Treasury)

This document presents a dynamic vision for the future of British infrastructure. It includes proposals for the biggest investment in the road network since the 1970s, a plan to build and repair 200,000 affordable homes, and the long term certainty that the energy sectors need.

The paper draws upon how the road network is fundamental to the UK economy and while traffic and congestion have risen, investment over the past few decades has fallen.

Roads underpin a free-flowing and successful economy but have suffered from massive historic underinvestment. This trend, when combined with a model of delivery, has served to hold back the country's transport infrastructure for the worse.

Over the last fifty years the volume of traffic in this country has risen dramatically – from 70 billion vehicle miles travelled per year in 1960-61 to 304 billion in 2011-12. The level of public investment in the road network on the other hand has not met this increase in demand, and has fluctuated wildly over the same period as the result of short sighted decisions of successive governments.

2.1.2 Action for Roads (2013, DfT)

This command paper highlights the significant challenges faced on the road network and reiterates the need for investment. The paper underlines how the road network is vital to the UK and is a crucial part of the wider transport network.

Without investment, conditions are expected to worsen by 2040, particularly on the most important routes. By then, around 15% of the entire strategic road network may experience regular peak-time congestion and become susceptible to poor conditions at other times of the day. Workers will likely find their job opportunities are constrained by travel times and people travelling between towns and cities will face significant delays. Congestion will work against current efforts to help the economy grow with Enterprise Zones, potential housing sites and other areas of high growth being held back by bottleneck conditions. The paper also draws upon how major national arteries will start to experience stress, British businesses will find it more difficult to access export markets and the environment will suffer due to increased congestion.

2.1.3 National Infrastructure Delivery Plan (NIDP) 2016–2021

The NIDP sets out key projects and programmes, and major policy milestones, in each infrastructure sector and includes details of the government's ongoing work to improve the prioritisation, performance and delivery of infrastructure, including building a skilled workforce, reducing costs and encouraging private sector investment.

The paper identifies roads as being fundamental to modern society. They keep people connected, making it possible to travel for work and leisure. The road network brings communities closer together, providing users with freedom and flexibility that is unrivalled by any other mode of transport and are used for 90% of passenger journeys and almost 70% of freight.

The paper emphasises how local roads are a crucial element of the transport system. A reliable and high-performing road network helps improve productivity, but over decades, the quality of the network has declined and congestion, noise and poor air quality have become problems at certain hotspots. Poor or missing links mean cities which are close together do less business with one another.

Local Policy

2.1.4 Great Yarmouth Core Strategy (LDF)

The Core Strategy establishes the spatial vision and objectives for how the borough of Great Yarmouth will develop and grow. It sets out a series of strategic policies and site allocations, which provide the strategic context for future Local Plan documents, Supplementary Planning Documents and Neighbourhood Development Plans.

The core strategy's plan period is for 2013-2030. It is the planning framework for implementing the Council's aims and objectives that affect the use of land and buildings. The vision of the Core Strategy is that by 2030, the Borough of Great Yarmouth will be a more attractive and aspirational place to live, work, and play, with strong links to Lowestoft, the Broads, Norwich, rural Norfolk and the wider New Anglia (Norfolk and Suffolk) Local Enterprise Partnership area.

It is expected that 7,140 new homes will be provided by 2030. This housing will be located to take advantage of public transport accessibility and to help maintain and 9 enhance the vitality and viability of existing settlements. The majority of this new housing will be located in the main towns of Great Yarmouth and Gorleston-on-Sea, and at key service centres (Bradwell and Caister-on-Sea).

There is commitment to protect and enhance the Borough's natural and historic areas and buildings that help to create the identity of the borough. New green infrastructure will enhance the network of green corridors linking settlements to the Broads and the open countryside providing greater opportunities for healthy lifestyles.

Policy CS16 on improving accessibility and transport, refers to the Council and its partners working together to make the best use of, and improve, existing transport infrastructure within and connecting to the Borough, having first considered solutions to transport problems that are based on better management and the provision and promotion of sustainable forms of travel. It details that this will be achieved by:

a) Supporting improvements that reduce congestion, improve accessibility and improve road safety without an unacceptable impact on the local environment, in accordance with Policy CS11; and communities, in accordance with Policy CS9. High priority schemes that will assist in achieving this include:

- Working with our partners to mitigate congestion at pinch points and actively manage the road network
- Working with our partners to reduce car dependency by improving both the quantity and quality of the public transport service on offer in the borough and the wider area, including the promotion of a quality bus corridor from Great Yarmouth to Lowestoft
- Upgrading Great Yarmouth Railway and Bus Stations to provide higher quality facilities that encourage greater use of public transport
- Improving accessibility to employment, education, health, recreation, leisure and shopping facilities by enhancing linkages between existing 'green travel' routes to create a coherent network of footpaths, cycleways and bridleways
- Supporting the port and its future development as a passenger and freight intermodal interchange, with facilities to achieve efficient staging, loading and unloading and to realise the potential of the port to function as a sustainable transport corridor

b) Directing new development towards the most sustainable locations in accordance with Policy CS2, thereby reducing the need to travel and maximising the use of sustainable transport modes

c) Ensuring that new development does not have an adverse impact on the safety and efficiency of the local road network for all users

d) Seeking developer contributions towards transport infrastructure improvements, including those made to sustainable transport modes, in accordance with Policy CS14 10

e) Minimising the impact of new development on the existing transport infrastructure by encouraging applicants to:

- Produce and implement Transport Assessments and Travel Plans, as appropriate
- Improve accessibility to sustainable transport modes

The Core Strategy states that a Third River Crossing will encourage efficient patterns of movement and emphasises its importance in meeting the borough's needs.

It recognises that the two existing river crossings are subject to high traffic flows and become severely congested during peak hours. To help ease congestion and making the Borough more attractive to investors, the Core Strategy expresses support for the development of a Third River Crossing within the heritage area of North Quay and South Quay, reducing pressure on Haven Bridge and generally improving access across the River Yare and to help the Outer Harbour realise its long-term potential.

2.1.5 Great Yarmouth Waterfront Area Action Plan (LDF)

The Great Yarmouth Waterfront Area Action Plan is a statutory planning document which forms part of Great Yarmouth's Local Development Framework (LDF). It seeks to facilitate the comprehensive regeneration of Great Yarmouth's historic quaysides and provide improved linkages between the town centre and its riverfront which for many years has been subject to industrial decline and underutilisation. The Area Action Plan included a Third River Crossing as one of several preferred options to address regeneration within the town.

2.1.6 The Norfolk Local Transport Plan for 2026

Norfolk's 3rd Local Transport Plan, Connecting Norfolk, sets out the strategy and policy framework for transport up to 2026. Norfolk's Transport Vision is for a transport system that allows residents and visitors a range of low carbon options to meet their transport needs and attracts and retains business investment in the county. The six aims that support this vision will:

- Manage and maintain the transport network to an appropriate standard
- Deliver sustainable growth
- Enhance strategic connections
- Reduce emissions
- Improve road safety
- Improve accessibility

Sustainable growth - There will be significant growth in Norfolk during the period up to 2026. The Local Plan provides a framework for this to be delivered in, setting the Transport Authority's requirements. These include:

- Adequate regard is given to reducing the traffic impacts of growth to negate a detrimental effect on the road network or existing communities
- The delivery of transport infrastructure that supports growth, with focus on sustainable travel options

Strategic connections - Norfolk's key strategic connections are identified and they include the following that impact on the Great Yarmouth area;

- Connections to Norwich Airport and the Ports at King's Lynn and Great Yarmouth, including a future Third River Crossing for the River Yare

- The A47, part of the European TEN-T network, providing the main east-west road connection and route to the Midlands and north of England

Transport emissions – Importance is placed on taking measures to reduce emissions that include;

- Promoting active and healthier travel options for short journeys to schools, services and places of employment
- Enhancing integration between different travel modes, particularly at key bus and rail stations and Norwich Airport

Road safety – There is an understanding that road safety continues to be a major public concern and measures will be prioritised to reduce the number of people killed or seriously injured on Norfolk's roads

Improving Accessibility – Importance is placed on achieving efficient movement into town and urban centres, favouring short term parking for car drivers, which benefits the local economy and supports alternative travel options.

2.1.7 Great Yarmouth and Gorleston Area Transportation Strategy (2009)

The Great Yarmouth and Gorleston Area Transportation Strategy examined a wide range of strategic solutions to the areas transport problems and opportunities.

The fundamental direction of the strategy is to support the investment in public infrastructure and public services necessary to accommodate Great Yarmouth's growing population and economic activity. The strategy states that this must be done in a way that supports the LTP (Local Transport Plan) in promoting sustainable patterns of development and regeneration, and in particular underpins the renewal of Great Yarmouth's key development opportunity areas. Two of the key critical issues listed are:

- Meeting the challenge of economic and demographic growth by investing to deliver the necessary additional public transport capacity and reliability and;
- Meeting the challenge of promoting social inclusion and regeneration by providing the transport links and accessibility to underpin economic development.

The strategy mentions the Third River Crossing on several occasions citing it as a major scheme designed to overcome the problem of limited road access to the peninsula of Great Yarmouth and the congestion which this causes. It does this by offering a more direct route into the town from the south and providing relief to the two existing road bridges. As such the scheme would provide the missing link between the A12 trunk road and the expanding port facilities. In addition, it will provide accessibility benefits to the town by providing more direct routes between housing and employment areas.

2.1.8 New Anglia Strategic Economic Plan (SEP)

The central focus of the New Anglia SEP is to drive growth in high impact sectors in order to create new high value jobs and to work with existing businesses to improve their productivity and competitiveness. The energy sector offers an opportunity for rapid growth. The SEP also highlights four sectors that should be supported because they underpin the economy and form the largest employers in the region. These include Ports and Logistics, and Tourism and Culture. The SEP has identified key areas and corridors for growth in jobs, productivity and housing.

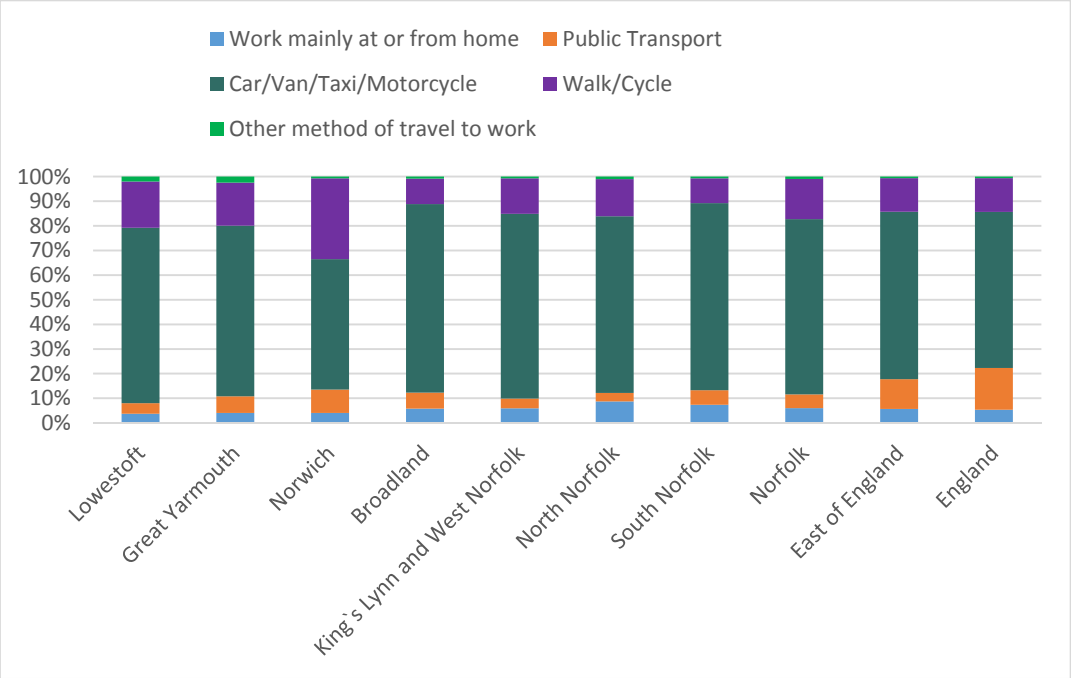
Great Yarmouth is one of the areas that is identified as needing investment in schemes that directly unlock employment and housing sites; that provide access to the trunk networks; and packages of investment in sustainable urban transport. The SEP acknowledges that connectivity and travel times are major obstacles to productivity, and that faster connections, through better strategic road and rail links, are vital to improve productivity and access to markets. In addition, the national rail and road networks need more capacity. The SEP recognises that there is a need to connect areas of growth with each other, and the rest of the country, by the rail and strategic road networks. There is a clear plan for these networks which are managed by Network Rail, the rail franchises or Highways England. There is a commitment to work more closely with them to ensure their priorities dovetail with local plans. These networks are so important to local growth, that there are a number of junctions and bottlenecks where scheme development has been funded to help support the case for their inclusion in Highways England or Network Rail capital programmes.

The SEP identifies that Great Yarmouth suffers from congestion arising from bottlenecks, at key locations, including North Quay and Haven Bridge and also how limited river crossings in the town are forcing traffic onto congested routes. The design of a third crossing in Great Yarmouth is listed as a transport priority within the report and states that it should be included in the Highways Agency national programme as soon as possible.

2.2 Travel Demand

Using the 2011 national census ‘method of travel to work’ data, a comparison can be made between the mode share at a local, regional and a national level (Figure 2-1). Driving to work is by far the most common mode of commuting in Great Yarmouth with over 69% of the working population using a private car, van, taxi or motorcycle. This is significantly higher than the national average (63%). Over 17% of the working population commute by non-motorised modes (walking and cycling) whereas only 7% travel to work using public transport.

Figure 2-1 - Mode Share Comparison



2.2.1 *Average Speed Data*

A review has been carried out of available traffic flow and average speed data based on Highways England's WebTris Phase 1. Data has been extracted from WebTris based on the average of four neutral weekdays, Monday to Thursday (26/09/2016 to 29/09/2016) at two sites (A12 and A47) (Table 2-1). Average speed and total flow data has also been extracted for the AM peak (08:00-09:00) and PM peak (17:00-18:00) hours.

Daily average speed for each link has been calculated to allow for comparison of peak and off-peak average speeds.

The average AM and PM peak speeds along the A47 eastbound indicate significant congestion.

Table 2-1 - A12 & A47 Average Speed

TMU Site	Average AM Peak Hour Speed (km/h)	Average PM Peak Hour Speed (km/h)	Daily Average Speed (km/h)	Total Recorded Flow (veh)
A12 northbound between A1243 and A47	35.9	32.3	39.6	17,117
A12 southbound between A1243 and A47	34.8	35.3	37.91	19,299
A47 eastbound between A12 and A1064	26.1	15.5	41.1	10,707
A47 westbound between A12 and A1064	45.7	45.5	46.7	11,189

2.3 Highway Safety

In the five years from 2011 to 2015, there were 394 recorded collisions in the Great Yarmouth area, involving 489 casualties (Table 2-2).

Of the 489 casualties, 99 (20%) were pedestrians and 50 (10%) were cyclists with 72 casualties (15%) involving motorcycle accidents. There are clusters of accidents on the approaches to the existing bridges, including at North Quay.

Table 2-2 – Great Yarmouth collisions and casualties 2011-2015

	Collisions	Casualties
Fatal	2	2
Serious	46	47
Slight	346	440
Total	**394**	**489**

A third crossing is expected to reduce overall vehicle kilometres travelled in and around the Town , and thereby also reduce an exposure to accident risk, and produce a net reduction in casualties.

An assessment of the accident benefits (using COBALT) has not been undertaken at this time but will be included in the Outline Business case when the latest traffic forecasts are known. Accident benefits will be calculated during the next stage of detailed appraisal, following completion of the 2016 Traffic Model and it is expected benefits will be of a similar order to previous assessments.

2.4 Opportunities

The range of ongoing and planned improvements in Great Yarmouth present a number of opportunities and constraints to support growth and the need for enhancements to the transport network.

2.4.1 Investment in the Strategic Road Network

Options to improve a number of A47/A12 junctions in Great Yarmouth (including the Harfrey's Roundabout) are being explored by Highways England to significantly improve connectivity between the LDO / Enterprise Zone including the Port of Great Yarmouth, and the strategic road network. However, there remains uncertainty over the timing and delivery of these improvements, which have therefore been categorised as "reasonably foreseeable" or "hypothetical" in the latest traffic forecasts and will not be included in future do minimum scenarios in the Outline Business Case. The early estimates of traffic likely to transfer to the new bridge would amount to 1,200 vehicles in the peak periods with around the same number of trips generated by development traffic on the peninsula. These estimates give an indication of likely future demand for travel across the new bridge and will be updated as part of the current assessment

2.4.2 Investment via Local Growth Funding

Norfolk County Council has secured £11m via the New Anglia LEP Growth Deal to deliver a range of measures between 2016/17 and 2020/21. The aim of these improvements is to reduce congestion by implementing a series of sustainable transport measures in addition to improving transport linkages to assist town centre regeneration.

2.4.3 Growth in offshore energy

The renewables energy sector has established or committed investments in excess of £4bn, from Scottish Power Renewables, RWE (Galloper), and Statoil (Dudgeon).

2.4.4 Growth in the LDO area and the Enterprise Zone

Planned growth in the LDO area and both Enterprise Zones including the Energy Park and South Denes Business Park.

2.4.5 Sustainable Transport Funding

Norfolk County Council has been awarded funding from the DfT from the Sustainable Transport Transition Year fund for the 'Pushing Ahead : A to Better' programme. The programme aims to assist in Reducing single occupancy car trips; increasing active travel to reduce congestion and improve air quality; improving health; supporting access to work and learning; and improving safety.

2.4.6 Tourism

Great Yarmouth's biggest single business sector is tourism, and directly and indirectly it represents an economic impact of £532 million per annum (2011) and 29.3% of the district's employment.

3 FUTURE SITUATION

This chapter sets out the future growth aspirations, planned development and predictions of the resultant increase in levels of traffic and its subsequent impact on the strategic highway network. A review of recent and current planning applications for development sites located in the vicinity of the proposed third river crossing has been undertaken with the aim of identifying developments which could potentially have an influence on the future performance of the crossing.

3.1 Land Uses and Policies

The New Anglia Strategic Economic Plan states that 9,000 new jobs will be created in the Enterprise Zones by 2025 and a further 4,500 indirect jobs which will help reduce the unemployment rate. The aim is to support inward investment and expansion of businesses requiring access or proximity to the port and riverside.

3.1.1 South Denes Enterprise Zone and Energy Park

The 58.8 hectare South Denes Enterprise Zone site features land suitable for development, storage and laydown. The area is enveloped by a 136.3 hectare Local Development Order that includes the Outer Harbour and a long section of the river quayside and brownfield development land. The potential for creating additional employment land (up to 22 hectares) by land reclamation to the north of the Outer Harbour is currently being explored as part of the Local Plan.

Energy related development is also being promoted on the Energy Park at South Denes and Power Park in Lowestoft.

3.1.2 Beacon Park Enterprise Zone

The existing Beacon Park Enterprise Zone is a mixed-use area of both residential and commercial uses. Approximately 10-15 hectares of new employment land to the south of the new A12/A143 link road and west of the existing Beacon Business Park has been identified where approximately 1,000 new homes are planned south of Bradwell. Persimmon Homes have outline planning permission for 850 homes, a primary school, shops, open space and business space, plus detailed permission for the first phase of 150 homes, with construction already underway.

3.2 Changes to Infrastructure

There are a variety of transport schemes being implemented or considered over the period up to 2020/21. This section covers schemes that are likely to impact on sustainable transport.

3.2.1 A47 Acle Straight Dualling

A proposal by Highways England is designed to address safety concerns by making short-term and long-term improvements, potentially including installation of safety barriers and junction and road widening improvements. These will be subject to appropriate environmental mitigation, working with Natural England and the Broads Authority at all stages. Norfolk County Council continues to campaign for dualling of the A47 Acle Straight.

3.2.2 A47/A12 Vauxhall Roundabout and Great Yarmouth junction improvements

Highways England have recently completed the feasibility stage of improvements to the A47 corridor and this junction is listed within their Major Improvements Investment Plan 2015-20. This junction is one of the schemes that is at the options development phase which will include further and detailed technical assessment and appraisal of options. This will include traffic modelling to inform the initial design and operational requirements. This phase is currently predicted to last until December 2016.

3.2.3 Town Centre Congestion Relief

There will be measures to improve junction hot-spots in Great Yarmouth, namely those around the one-way gyratory system and at the Southtown end of Haven Bridge. These schemes are at an assessment stage and some microsimulation modelling is being conducted as part of the third crossing traffic modelling, which may assist in developing solutions. Any possible improvements will aim to reduce congestion and delays to motorists, whilst also improving conditions for pedestrians and cyclists where appropriate. The following are currently being progressed:

Southtown Road/Pasteur Road/Bridge Road/Mill Road scheme

This scheme is yet to be determined and various options are being tested which require additional microsimulation modelling which currently being carried out with an aim to be completed over the coming 2 to 3 months. Detailed design and statutory processes could be carried out in 2017/18 with a view to construction in 2018/19. Due to the early stage of development of this scheme it is not included in the microsimulation modelling.

Fullers Hill Roundabout

An improvement to the roundabout to provide two parallel right turn lanes from North Quay to Acle New Road. This will have a significant impact on reducing queues and delays (particularly on the southbound approach to the roundabout) and not cause and strategic re-routeing. This is currently at detailed design stage for implementation in 2017/18 and is included in the microsimulation modelling. The trunk road programme will also include improvements to the train station and supermarket right turn junction.

3.2.4 Trafalgar Road linking St. George's Park west to South Quay

This scheme will improve the important link between the South Quay, town centre and seafront. A Feasibility Study Preferred Option for St Georges Park and the area around the theatre has been successful in reinvigorating the area. These improvement measures include cycle links (east/west link from St Georges Park to Marine Parade).

Cycle paths have been created from the South Quay through the library up to the theatre, through to the park and along Marine parade on the seafront. This scheme aims to complete the missing link on Trafalgar Road.

3.2.5 Market Place to Rail Station Foot and Cycle Links

Pedestrian and cycle improvements to Vauxhall Bridge have improved links from the train station to the Conge, and provides the start of a route through to the Town Centre. The proposed scheme delivers on the Great Yarmouth Town Centre Masterplan objectives and aspirations to improve the Waterfront area. Proposals include the creation of shared footways, landscape improvements and improved road markings to separate pedestrians and cyclists at the signal crossing on North Quay. The scheme is funded through the Local Growth Fund, and is planned to be implemented 2017-19.

4 NEED FOR INTERVENTION

The need for a third river crossing in Great Yarmouth, to provide direct access to the southern end of the peninsula, was first identified in the mid-1980's and has long been an ambition for the County Council and other partners including Great Yarmouth Borough Council, however, limited work has been undertaken since 2009. Circumstances are now more favourable for the scheme to become reality due to:

- The Great Yarmouth Third River Crossing (GYTRC) has a good strategic fit with the East of England Regional Assembly's Regional Spatial Strategy and Norfolk County Council's Corporate Plan.
- The GYTRC has been assigned a priority of 1b in the Regional Funding Allocation.

The Urban Regeneration Company for the waterfront areas of Great Yarmouth and Lowestoft, 1stEast, has produced a summary of main land use proposals for Great Yarmouth which is currently the subject of public consultation. It is recognised by 1st East that the GYTRC is key to facilitate access to these proposed developments.

The scheme is designed to overcome the problem of limited road access to the peninsula of Great Yarmouth and the congestion which this causes. It offers a more direct route into the town from the south and provides relief to Haven and Breydon Bridges in addition to enabling traffic travelling to the port and South Denes Enterprise Zone to avoid the town centre.

The Core Strategy recognises the challenges of Great Yarmouth's unique geography, noting that the seafront, central shopping area and outer harbour are geographically separated from a high percentage of the resident population by the River Yare. The two existing river crossings; Breydon Bridge and Haven Bridge are subject to high traffic flows and become severely congested during peak hours. Great Yarmouth and Gorleston also experience a dramatic increase in traffic flows during the holiday season. This additional seasonal traffic combines with town centre, port and commercial traffic, creating congestion problems on both the local and strategic road network, particularly on the A47 and A12, South Quay, North Quay, Fullers Hill and Lawn Avenue.

There is a dependency on the tourist industry, which has an estimated worth of over £530 million per year, and 78 per cent of the jobs in the Borough are service-based. In the summer months the population of the town effectively doubles, further adding to the demands on the transport network.

For the Peninsula, the New Anglia Strategic Economic Plan estimates that 9,000 new jobs will be created in the Enterprise Zones by 2025 and a further 4,500 indirect jobs will be created in the Town thereby supporting inward investment and the expansion of businesses requiring access or proximity to the port and riverside.

The Breydon Bridge, constructed in 1985, enables A12 traffic to bypass the centre whereas the Haven Bridge provides access into the northern part of the town centre. There are, however, no bridges further south than this. As a result, the southern part of Great Yarmouth, which is built on the peninsula, is effectively isolated from the rest of the Borough.

5 OBJECTIVES

In response to the identified transport issues, clear objectives have been identified by the Council for the scheme.

5.1 Strategic

The strategic **high level objectives** for the scheme are:

- To support the creation of new jobs especially in the South Denes Local Development Order area and the Enterprise Zone by being a catalyst for investment
- To support Great Yarmouth as a Centre for Offshore Renewable Engineering, and as a Port
- To support the regeneration of Great Yarmouth, including the town centre and the seafront, helping the visitor and retail economy
- To improve strategic connectivity and reduce community severance
- To protect and improve the environment

5.2 Specific and Operational

The **specific and intermediate objectives** of the scheme are:

- To provide traffic relief to Breydon Bridge and Haven Bridge
- To reduce congestion and delay in the town centre
- To improve journey time reliability
- To reduce traffic in historic areas, especially North Quay and Hall Quay
- To improve vehicular access to South Denes and the outer harbour, especially from the A12
- To improve access to the Great Yarmouth peninsula for buses
- To improve access to the Great Yarmouth peninsula for cyclists
- To improve access to the Great Yarmouth peninsula for pedestrians
- To reduce road accident casualties
- To reduce emissions of greenhouse gases
- To improve the resilience of the local road network

The **operational objectives** of the scheme are:

- To provide an additional crossing of the River Yare for vehicles, cyclists and pedestrians
- To reduce overall journey times and vehicle kilometres in Great Yarmouth
- To minimise environmental impact, compulsory purchase and demolition of residential and commercial property.
- To achieve a balance between the needs of road and river traffic

6 AREA OF IMPACT

This section will look at the geographic areas of impact to be addressed by the intervention.

6.1 Peninsula

The new crossing is designed to overcome the problem of limited road access to the peninsula of Great Yarmouth and the congestion which this causes. It offers a more direct route into the town from the south and provides relief to Haven and Breydon Bridges. The preliminary operational assessment work has shown significant congestion relief and other transport benefits such as improving accessibility for buses.

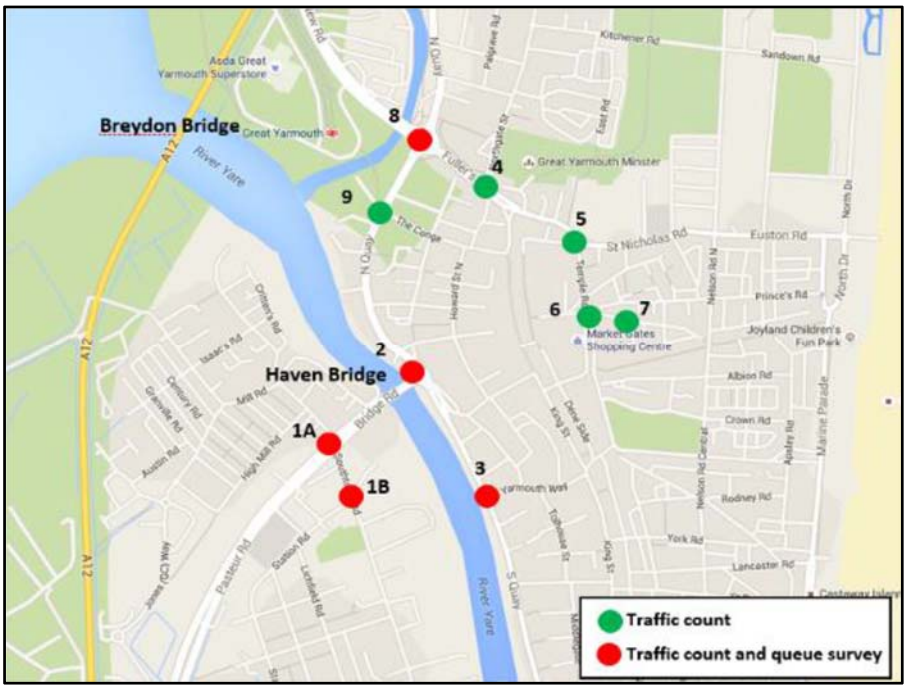
The crossing provides improved scope to better manage traffic movements and it would enable traffic at the port and South Denes regeneration area to avoid the town centre. The South Denes regeneration area is subject to a Local Development Order includes an Enterprise Zone at the port which is likely to generate more traffic movements. The impact of this traffic growth will be mitigated by the new bridge. In addition to the direct congestion and accessibility benefits to the town, the scheme will provide the missing link between the UK trunk road network and the new and expanding port.

6.2 Town

Congestion around the existing bridges currently restricts access into the town centre which has been experiencing decline. Great Yarmouth remains a popular seaside resort and in the summer months the population effectively doubles, adding to the demands on the transport network. However, the seafront can only be accessed via the congested bridges at the northern end of the peninsula. Recent investment in the public realm has led to major improvements to the northern part of the seafront; by contrast, the southern, less accessible part, is isolated and unfrequented by visitors. A third crossing would be an opportunity to complement the recent and planned investment by improving access for all modes of transport, whilst reducing the impact of traffic in key areas.

Detailed classified traffic counts and queue length surveys were undertaken by Norfolk CC at key locations in the vicinity of the Haven Bridge and the town centre (Figure 6-1) on Thursday 15 October 2015.

Figure 6-1 – MCC and Queue Length Survey Locations



Results from the survey (Table 6-1) illustrate the high levels of traffic on key roads in the centre of Great Yarmouth, especially around the existing bridges, and the high levels of queuing which result from the limited capacity of the local road network. One consequence of this for road users is that journey times in peak periods are significantly longer than in the off peak.

Table 6-1 - Survey Results

Location	Direction	Maximum queue (veh)
1A	From Pasteur Road	>150
1A	From Bridge Road	>150
1A	From Southtown Road	100
2	From North Quay	127
2	From South Quay	>150
2	From Bridge Road	142
3	From the north	137
3	From the south	92
8	From Acle New Road	>150
8	From North Quay (north)	>150
8	From Fullers Hill	40
8	From North Quay (south)	>150

The analyses of queuing illustrates and supports the body of anecdotal evidence which has consistently highlighted the problems of congestion in Great Yarmouth, especially that which is associated with the constrained access to the peninsula. These problems are further exacerbated by the large seasonal variation arising from

Yarmouth's role as a major resort attracting both staying and day visitors at holiday times.

6.3 Wider Area

The scheme would provide a much needed additional link across the River Yare to connect the strategic road network and wider urban area to the key economic growth hub in the southern part of Great Yarmouth. The scheme will result in better integration of freight and local traffic with the strategic road network which is a key element of achieving a sustainable distribution of freight journeys to and from the port.

7 OPTIONS

7.7.1 Option Assessment

The Option Assessment Report previously prepared and submitted considered a range of locations for the Great Yarmouth Third River Crossing (GYTRC), as well as whether the crossing should be a bridge or tunnel. Within the area of interest, three broad alignment corridors were considered: northern, central and southern. In each corridor, a high level and low level bridge option (on similar alignments) and a tunnel option were devised, giving nine different main options. Both the high and low level bridge options were to be for lifting bridges.

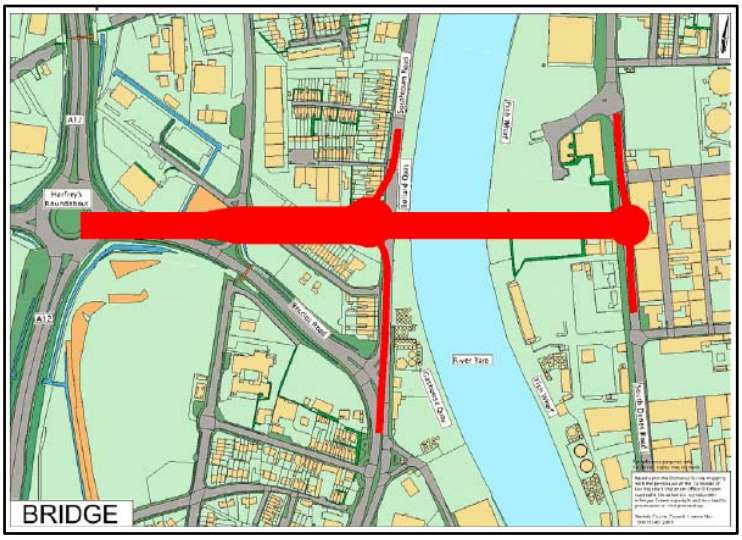
Results from the economic assessment carried out in the Option Assessment Report (OAR) showed that although the economic benefits of the tunnel option are nearly as high as those for the bridge options, its cost is much higher at three times that of the bridge. The resulting Benefit to Cost Ratio (BCR) was less than 2.0, confirming that a tunnel option is unlikely to become a viable solution.

A Stage 2 Assessment gave further consideration to the options which had emerged from the Stage 1 Assessment.

It was found that a bridge in the southern corridor was found to offer the greatest monetised benefits and, because it was also likely to be the least expensive option, generated the highest BCR. Further to this, detailed data on commercial vessel movements within the inner harbour were used to determine the likely number of bridge openings required for different locations. It concluded that a bridge on the shortest route across the river, would require about 6 openings each day. Further south, the number of openings would be greater. Further north, the cost of construction would be higher.

The OAR therefore concluded that the crossing should be located between Harfrey's Roundabout and South Denes Road (Figure 7-1).

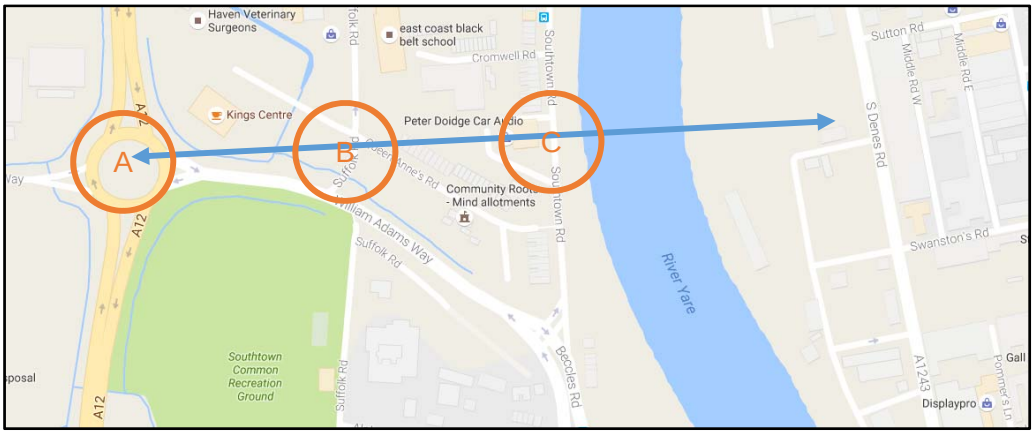
Figure 7-1 - Preferred Route



Based on this location, a long list of 40 options has subsequently been produced based on different criteria including the location, form and geometry of the western and eastern tie-ins to the local road network, bridge height and carriageway standard.

These 40 options were predominantly variants at three different tie-in locations (Figure 7-2)

Figure 7-2 - Three possible western tie-in locations



8 SIFTING

8.1 Process

Each of the options in the long list were put through an initial sift in order to narrow down to a selection of preferred options. This approach quickly reduced the initial list of options by removing those that did not make significant contributions to meeting the defined objectives, did not resolve the identified problems, or are not deliverable or feasible.

For each objective and identified problem, a score was allocated based on the anticipated impact of the option being assessed. The total score for each option was then calculated by summing the individual scores for each function, thus enabling a comparison between options.

The long list then became 9 primary options following the initial sift which are variants of 3 different western tie-in forms and locations outlined in the OAR and are summarised in Section 8.2 (Table 8-1).

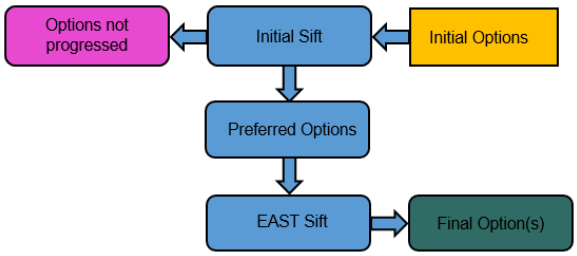
8.2 EAST

DfT's Early Assessment Sifting Tool (EAST) is a decision support tool that has been developed to quickly summarise and present evidence on options in a clear and consistent format. It provides decision makers with relevant, high level, information to help them form an early view of how options perform and compare.

EAST has been designed to be consistent with Transport Business Case principles and follows the same five cases as the DfT Business Case model.

The 9 options which successfully met the evaluation criteria within the initial sifting process were taken forward to the final stage of sifting, using the EAST decision support tool. This assessment identified the high level economic, environmental and social impacts of all nine options based on DfT's five case model approach.

Figure 8-1 - Sifting Process



It is considered poor practice to sum scores across each of the cases and assess an average score for each scheme. Reviewing a scheme's performance across all of the cases is the preferred approach and therefore a Red/Amber/Green (RAG) score was applied to each of the top nine options to provide a visual guide to the respondent as to the option's impact (Table 8-1).

Table 8-1 - 9 Preferred Options

Option	Width	Tie-in location (West)	Tie-in form (West)	Tie-in location (East)	Tie-in form (East)	Cost (£M)	Sifting RAG Score
4	Single Carriageway	A12 Harfrey's Roundabout	Existing four-arm Roundabout	South Denes Road	T-junction	**£65**	
5	Dual Carriageway	A12 Harfrey's Roundabout	Existing four-arm Roundabout	South Denes Road	T-junction	**£102**	
6	Three-lane Carriageway	A12 Harfrey's Roundabout	Existing four-arm Roundabout	South Denes Road	T-junction	**£87**	
31	Single Carriageway	Suffolk Road	New four-arm roundabout	South Denes Road	T-junction	**£62**	
32	Dual Carriageway	Suffolk Road	New four-arm roundabout	South Denes Road	T-junction	**£97**	
33	Three-lane Carriageway	Suffolk Road	New four-arm roundabout	South Denes Road	T-junction	**£83**	
37	Single Carriageway	Southtown Road	At-grade junction	South Denes Road	T-junction	**£62**	
38	Dual Carriageway	Southtown Road	At-grade junction	South Denes Road	T-junction	**£95**	
39	Three-lane Carriageway	Southtown Road	At-grade junction	South Denes Road	T-junction	**£81**	

It should be noted that this method is not intended for the purposes of aggregating or averaging to provide a final RAG status for each economic indicator. The overall impact will depend on the strength of individual impacts and the final recommendations balance the individual RAGs and form a view as to the likely overall impact of each option.

8.3 Summary

The EAST sifting process is intended to inform a decision, not to make one. As the nine primary options are fundamentally variants of the three eastern tie-in form and locations, there is little to differentiate between them at this stage of the process in advance of detailed modelling, other than considerations of cost and operational performance. Options 5, 32 and 38 are all dual carriageway options and received a higher score in the Strategic Case (scale of impact) than the single lane and three lane variants, however, these are amongst the most expensive options with estimated construction prices ranging between £95m and £102m. Option 37 is the cheapest option and therefore scores higher than all other options in the Financial Case. Option 32 scored better than Options 5 and 38 in the Managerial and Financial cases and was therefore provided with a higher RAG score.

For the current EAST assessment cost decisions are made on the basis of a £100m threshold and on that threshold it appears that the low level bridge option falls below that level and the high level option above it.

9 ENGINEERING

9.1 Mode Consideration

A third crossing would be an opportunity to improve access to the town centre for all modes of transport. Currently, without the scheme, non-motorised users travelling between Southtown Road and South Denes Road (in the vicinity of the proposed bridge location) would be required to travel over 3km via Haven Bridge. With an additional crossing on the other hand, non-motorised users would only be required to travel approximately 250m, a significant time and distance saving.

9.2 Public Transport

Bus priority at the crossing and at the terminal junctions will need to be considered along with the necessary public transport infrastructure and signage close to the bridge. A key consideration will be how any bus priority fits within the future wider strategy within the town.

Additional public transport services along with existing public transport routes would be provided to take advantage of the new proposed crossing.

9.3 Road Freight

The development of the Outer Harbour is of strategic importance to the borough's economy and is a key driver for the regeneration of Great Yarmouth. It complements the existing river port and increases its overall operating capacity.

Both the Area Action Plan (AAP) and the Local Transport Plan (LTP) note that a third river crossing would provide a further opportunity to access the port from the strategic network (A12 / A47) without the need for port-related traffic to pass through the town centre and with a focus on achieving a sustainable distribution of freight journeys to and from the port.

9.4 Docks

Jobs are anticipated to be created on the Peninsula as a result of an expansion of the Port and surrounding industrial area and travel demands from the tourist industry in the town continuing to rise. The new bridge crossing will therefore not only allow these industries to continue to develop but will also facilitate easier movement within the Town because of the operational benefits that arise from reduced congestion.

It is estimated that the Enterprise Zone as a whole will create up to 9,000 direct jobs and 4,500 indirect jobs by 2025. A third crossing, providing a direct, high standard access into the employment areas and Enterprise Zone, presents an opportunity to attract more investment, and could be a catalyst for much needed regeneration and further growth which would also help to re-balance the local economy and the reliance on tourism.

9.5 Cars

Manual Classified Count (MCC) 2016 data has been acquired from AECOM providing AM Peak, PM Peak and 12 hour weekday traffic flows (with seasonal variations). These data were converted to a weekday of the neutral month of May. The AM peak hour flow is 2,001 vehicles across the A1243 Haven Bridge and 2,382 vehicles across the A12 Breydon Bridge. The PM peak hour flow is 2,321 vehicles across the A1243 Haven Bridge and 2,972 vehicles across the A12 Breydon Bridge. With a new crossing close to Harfrey's Roundabout and connecting to South Denes Road, there would be an anticipated transfer of traffic (around 1,000 and 200 vehicles on Haven Bridge and Breydon Bridge respectively) from the existing two bridges during the AM and PM peak hours, resulting in a significant reduction in the peak hour traffic at these locations. The Outline Business Case will detail these aspects.

9.6 Pedestrians and Cyclists

Currently, pedestrians and cyclists travelling from the south or west have to use the existing bridges to access the town centre, sea front and employment areas. The area immediately to the west of Haven Bridge is dominated by a heavily trafficked dual carriageway, Bridge Road, with a poor pedestrian and cycle environment. Similarly, Breydon Bridge has a lack of cycling and walking provision and is not a viable route for non-motorised users.

Pedestrians and cyclists would benefit from the construction of a new bridge across the river, and journeys by foot or cycle are likely to replace some of those currently made by car. The new proposed crossing will provide shared use footway/cycle paths in both directions. Existing routes would generally experience negligible impacts.

A third crossing with dedicated cycle facilities could enable existing cycle routes to be linked in the future to form a greatly improved cycle network, offering potential relief from the existing severance that the River Yare creates.

9.7 Crossing Options

The three possible locations where new bridge infrastructure could be connected to the existing highway network on the western side of the river are as follows:

- Location A: Harfrey's Roundabout
- Location B: Suffolk Road
- Location C: Southtown Road

Connecting the bridge infrastructure directly to the existing junction (Location A) offers the most direct access to the Strategic Road Network (SRN), but may make local connections difficult.

A connection to a new roundabout at Location B would enable more direct access to the local road network whereas tying the bridge in at Location C would provide immediate connection to the local road network.

Two different likely bridge heights were identified in the OAR for the three different tie-in locations. Both bridge options that tie-in to the existing A12 Harfrey's roundabout and a new roundabout on Suffolk Road (on the eastern side of the scheme) have a proposed height of circa 7.0 metres above the mean high level water. These are both high level bridge options as a connection at this location would require the bridge to oversail Southtown Road. The option that ties in at grade to Southtown Road only requires a proposed bridge height of circa 3.0m above mean high level water, providing immediate connection to the local road network.

Whilst the location of the tie-in on the western side of the river will inform the likely junction form, the decision as to whether to provide a roundabout or traffic signal connection on the eastern side to connect into South Denes Road is a stand-alone consideration. All 9 high priority options assume that the junction form on the eastern side of the scheme are all signalised junctions.

It should be noted that prior to discounting as an alternative, the location of the central tunnel option that was assessed as part of the Stage 1 work in the OAR crossed the river in a north-west to south-east direction between Beccles Road and Salmon Road/South Beach Parade.

Consideration was given to realigning the tunnel into a southwest to northeast alignment during the stage 2 assessment. The purpose of this was to better fit the desire line of traffic wishing to access the peninsular, although it is recognised that the desire lines may change if a potential opening of the outer harbour for development is realised.

9.8 Land Availability

There would be an additional requirement for bridge or embankment structures to be constructed between Harfrey's roundabout and the river (Location A)

Similarly, a bridge at Location B would require bridge or embankment structures to span from Harfrey's roundabout to the river on the west bank and the bridge structure on the eastern side of the river would also be extended to ensure acceptable gradients.

Tying the bridge at Location C would require additional road infrastructure to be built to connect in to William Adams Way, in order to provide effective connection to the strategic road network and also to enable long vehicles to travel to/from the west.

9.9 Structures

The proposed low level double-leaf Bascule Bridge with underslung counterweights requires chambers in order to accommodate counterweight and the mechanical and electrical systems below deck level at either end. The construction of chambers/pits and their foundations below ground and below water level will lead to more complicated construction methods and are relatively expensive in comparison to the construction of chamber above or at ground level. This also imposes increased level of health and safety risks and may impact on the construction programme. It may

also lead to further design considerations for maintenance issues within the bascule chamber/pit in the future.

A bascule bridge at-grade or with an elevated approach, where chambers can be built above or around the existing ground level, mitigates the above issues.

An elevated approach is considered more practical in terms of buildability, despite the requirement for an increased length of earth retaining structures.

9.10 Environmental Assessment

An initial assessment has now been carried out to identify potential townscape and visual constraints relating to two of the potential tie-in locations being considered for the scheme (at-grade on Southtown Road and the new roundabout at Suffolk Road). This early desk top assessment has been undertaken in order to inform the design and to identify opportunities for the development of options. Townscape

Both alternatives pass through an area of relatively low quality industrial townscape with low sensitivity and would result in similar townscape impacts.

The demolition of properties along Queen Anne's Road and Southtown Road applies to both option locations and would have an impact on the perception of the immediate local residential townscape. However at a broader scale, the demolition of these residential properties alone would not significantly alter the feeling of the surrounding environment of Great Yarmouth.

A crossing at the Suffolk Road tie-in would require a larger land take at the junction with William Adams Way and more extensive loss of existing mature vegetation than a tie-in at Southtown Road. The elevated crossing would be more prominent along the waterfront and create a greater barrier to the open nature of the river. This would alter the linear appreciation of the River Yare looking north and south, albeit along an industrial waterfront. Although there would be the removal of rows of residential properties there is a low likelihood this would result in significant adverse townscape effects overall.

A tie-in at Southtown Road would also create a new feature on the river but would not be as prominent as a tie-in at Suffolk Road. The new road being at grade would also have less of a townscape impact. As a result of the low elevation of the proposed bridge there is a reduced likelihood of views up and down the river being significantly impacted when compared to a tie-in at Suffolk Road. There would be a low likelihood overall of significant adverse effects on townscape character.

For both alternatives, there is a high capacity for the existing townscape character to accept change of the type and scale that is proposed. The existing components of residential terraced properties and roadside vegetation would not represent a significant degradation to the character of the broader Great Yarmouth townscape and the likely effect on townscape for both option locations based on their current design would be no more than Slight Adverse.

9.10.1 Visual

It is anticipated that there would be a low likelihood of significant adverse visual effects on receptors at the eastern side of the River Yare, as the associated sensitivity is relatively low. Whilst the bridge options would be conspicuous, the magnitude of impact would likely be moderate. The combination of low sensitivity and moderate magnitude of impact is therefore unlikely to give rise to significant effects. This conclusion is consistent with the earlier work that identified significant likely environmental impact with a bridge option to the north of the Town.

10 ASSESSMENT OF OPTIONS

10.1 Description

A range of options have been considered from bridge and tunnel alternatives, north and south of Town alignments and junction, bridge height and capacity variants. Historic traffic and highway evidence has been assessed to help evolve a series of likely alternatives that have then been sifted to derive the preferred solution.

Following the initial option development (OAR, 2016), consideration of engineering constraints and outputs, initial sifting and EAST assessment, 9 primary options were considered for further appraisal, all assuming an eastern tie-in to a signalised junction at South Denes Road:

- Option 4: A12 Harfrey's Roundabout tie-in; min 7.0m clearance; single carriageway
- Option 5: A12 Harfrey's Roundabout tie-in; min 7.0m clearance; dual carriageway
- Option 6: A12 Harfrey's Roundabout tie-in; min 7.0m clearance; 3-lane carriageway
- Option 31: Suffolk Road tie-in; min 7.0m clearance; single carriageway
- Option 32: Suffolk Road tie-in; min 7.0m clearance; dual carriageway
- Option 33: Suffolk Road tie-in; min 7.0m clearance; 3-lane carriageway
- Option 37: Southtown Road tie-in; min 3.0m clearance; single carriageway
- Option 38: Southtown Road tie-in; min 3.0m clearance; dual carriageway
- Option 39: Southtown Road tie-in; min 3.0m clearance; 3-lane carriageway

10.2 Appraisal Methods

The initial stage of appraisal involved identifying the need for an intervention, and developing options to address a clear set of locally defined objectives. These options were subsequently put through an initial sift to enable the better performing options to be taken on to further, more detailed, appraisal.

In the early stages of appraisal, it is not cost-effective or feasible to assess a large number of options in great detail as informed by DfT guidance. The option assessment process ensured that proposals were developed in a robust manner, supported by a fit-for-purpose and proportionate analysis.

Stage 1 appraisal was a limited exercise, based on advance design work and a number of simplifying assumptions. Land costs were excluded. Only a representative sample of options was subject to modelling and economic assessment at Stage 1.

Though simplified, Stage 1 appraisal served to show that a third river crossing was feasible, and highlighted the main design and environmental issues involved. Although a bridge was likely to be more cost-effective than a tunnel, the appraisal showed that both bridge and tunnel options would produce benefits in excess of their likely costs.

Stage 1 appraisal did not differentiate between high and low bridge heights, nor did it assess the impact of the higher frequency of openings required for a southern bridge option.

The next stage of the appraisal is described in detail in the Stage 2 Assessment Report1 (2009) and dealt with alternative forms of crossing. The detailed investigation of these options was described in a Structural Options Working Paper2 (2009), and summarised in the OAR (2016).

This investigation led to the rejection of the fixed bridge, swing bridge and lift bridge options on grounds including construction and maintenance costs, visual impact, and risks from collision by ships. The study concluded that a bascule bridge would the most appropriate type of bridge for this scheme.

Following the development of the 9 primary options, further operational appraisal was carried out as described in the modelling and forecasts section of this report.

10.3 Value for Money

Although no in-depth economic appraisal has yet been undertaken, as reported in the previous Stage 2 Scheme Assessment Report (2009), estimates from the economic assessment showed that a bridge option at the proposed corridor location produces a BCR greater than 4.0. Based on the criteria in the DfT guidance, the scheme was found to offer a very high value for money.

10.4 Financial Case

Given that the level of scheme detail confirmed at the early stages of sifting is at concept-level, it was only possible to identify indicative costs, and it is therefore premature to make detailed comparison of all option variants in respect of the value for money and financial assessments.

However, for the current work preliminary scheme costs for the preferred options have been compared based on unit costs for bridge construction and junction form and the aggregates used to inform the EAST process relative to the earlier cost – benefit work and in advance of the current update of the transport and economic models. This is the appropriate level of detail required by the EAST process and the

[1] Great Yarmouth Third River Crossing – Stage 2 Scheme Assessment Report, September 2009. Mott Macdonald for Norfolk County Council

[2] Great Yarmouth Third River Crossing – Structural Options Working Paper, 2009. Mott Macdonald for Norfolk County Council

estimates will then be refined for the preferred option in the presentation of the Outline Business Case.

The current scheme costs estimates are summarised in Appendix G.

10.5 Delivery Case

The construction programme is based on a forecast start of works in 2020 leading to the bridge opening in 2023. The construction activities and programme would be subject to modification during both the detailed design and the construction phases. The timings indicated are a best estimate based on the current stage of planning and design activity and are used as a guide to highlight any constraints or opportunities for the options that are considered.

In the interim, over the next six years, the construction programme and planned sequence of operations will include:

- Land purchase
- Land clearance/planning/detailed design
- Early construction/piling
- Main construction
- Scheme opening

11 MODELLING AND FORECASTS

Following completion of the EAST assessment, and in accordance with the earlier work that indicated that a dual carriageway may be preferable. Options 32, 5 and 38 were taken forward for further consideration.

- Option 32 – Suffolk Road tie-in
- Option 5 – Harfrey's roundabout tie-in
- Option 38 – Southtown Road tie-in

The next step of the DfT's Transport Appraisal process is to consider these higher priority options in more detail and make recommendations within the DfT's Option Assessment Framework.

Based on existing traffic projections, junction design tools have been used to explore the operational aspects of the three key options.

Preliminary network performance testing has been undertaken using the Mott MacDonald 2008 SATURN model, with adjustments to the network coding to reflect the alternative bridge tie-in arrangements on either side of the river.

SATURN model outputs relating to overall journey times, distance travelled, queueing and total trips on the network for morning, evening and inter-peak periods for 2030 are summarised in **Error! Not a valid bookmark self-reference.**.

Table 11-1 - Do-min v Options 32, 5 & 38 (2030) Forecast Year

Period	Scenario	Total Distance Travelled (pcukm)	Total Travel Time (pcuhr)	Transient Queueing (pcuhr)	Over-Capacity Queueing (pcuhr)	Total Trips on Network (pcu)
AM	Do-min	131,869	2,948	458	280	19,363
	Option 32	131,363	2,709	454	65	19,363
	Option 5	131,092	2,727	466	77	19,363
	Option 38	130,090	2,830	454	217	19,363
IP	Do-min	127,824	3,165	495	501	21,171
	Option 32	128,981	2,882	503	192	21,171
	Option 5	128,980	2,888	516	189	21,171
	Option 38	127,210	3,093	480	464	21,171
PM	Do-min	143,393	3,853	542	870	22,553
	Option 32	145,664	3,360	579	299	22,553
	Option 5	145,734	3,386	597	307	22,553
	Option 38	143,150	3,716	533	764	22,553

Notes: The data contained in the table are presented as passenger car units (pcu's) as per the industry standard methodology.
The data contained in the table refer to the simulated time periods only.

For all options, total travel time is reduced compared with a "do minimum" position. Total distance travelled is also reduced for the morning peak period for all options, although this trend is not reflected during the other time periods. It is considered that these apparently counter-intuitive results can be attributed to sub-

optimal signal timing optimisation at specific junctions in the town centre to the east of the Haven Bridge and this issue will be addressed in the updated traffic model.

In addition Option 32 was developed to reflect different carriageway standards for the bridge, as summarised in Table 11-2. The results, based on the current as yet unimproved traffic model, show little variation and confirm that the final choice of carriageway standard will need to be made in wide consideration of cost and of the traffic management potential of each variant once traffic issues in relation to the local roads and most importantly the strategic road network have been assessed and particularly in respect of the need to accommodate queuing traffic when the bridge is open.

Table 11-2 - Option 32 Lane Tests (2030 forecast year)

Period	Scenario	Total Distance Travelled (pcukm)	Total Travel Time (pcuhr)	Transient Queueing (pcuhr)	Over-Capacity Queueing (pcuhr)	Total Trips on Network (pcu)
AM	4 lanes (2EB, 2 WB)	131,363	2,709	454	65	19,363
	3 lanes (2 EB, 1 WB)	131,417	2,700	457	53	19,363
	2 lanes (1 EB, 1 WB)	131,326	2,697	463	46	19,363
IP	4 lanes (2EB, 2 WB)	128,981	2,882	503	192	21,171
	3 lanes (2 EB, 1 WB)	129,063	2,887	509	190	21,171
	3 lanes (1 EB, 2 WB)	129,090	2,900	513	198	21,171
	2 lanes (1 EB, 1 WB)	129,036	2,894	511	196	21,171
PM	4 lanes (2EB, 2 WB)	145,664	3,360	579	299	22,553
	3 lanes (2 EB, 1 WB)	145,782	3,373	591	299	22,553
	2 lanes (1 EB, 1 WB)	145,817	3,385	600	301	22,553

Notes: The data contained in the table are presented as passenger car units ('pcu's) as per the industry standard methodology.
The data contained in the table refer to the simulated time periods only.

11.1 Operational Performance of Junctions

Further detailed operational assessment has been completed for Options 5, 32 and 38 (all four-lane variants).

- Option 5 – Harfrey's Roundabout dual Carriageway tie-in
- Option 32 – Suffolk Road dual carriageway tie-in
- Option 38 – Southtown Road dual Carriageway tie-in

Junction designs have been adjusted to accommodate forecast peak hour turning flows. Both roundabouts and signalised junctions were tested as variants of the 3 options for the purposes of comparing how the performance of the eastern tie-in junction forms compared. A summary table has been included for the AM Peak in Appendix H and the PM Peak in Appendix I.

In order to ensure a robust approach, forecast demand flows from the historic SATURN models have been extracted and a 5% uplift applied to mimic future traffic growth. In addition, the junction designs have been developed to ensure that they operate comfortably within practical capacity under the forecast peak hour turning flows.

Results show that all models predict a future operation within 90% of junction capacity which indicates that conditions across the local road network should experience no additional congestion as a result of the scheme.

However, Option 32 generally performs better than Options 5 and 38 in both the AM and PM peak.

11.2 Consideration of Impact of Bridge Opening

As part of the preliminary operational network performance testing, estimates of the likely length of queues during a 15 minute off peak bridge opening were made. This is based on outputs from the Motts SATURN model at 2030 (with a 5% uplift to account for likely traffic increases to 2038 which is consistent with approach used for operational tests).

Two scenarios were considered (assuming a 4 lane bridge and two stacking lanes on either side) for each of the three main tie-in options:

- only HGVs choose to queue OR
- all traffic chooses to queue

Results show that if only HGVs queue, this can be accommodated fairly comfortably. However, if all traffic queues, this has a significant impact with queues forecast to block back onto the strategic road network and a long way along South Denes Road on the peninsula. Clearly if it is preferred to provide a bridge with 2 or 3 lanes, this would have an additional impact on queueing and dissipation of queueing.

11.3 Outcome of Preliminary Testing

Following the option assessment and findings of the preliminary operational performance testing, Options 32, 33 and 37 are recommended to be carried forward to next stage for further appraisal as discussed below.

Both options 32 and 33 meet all specific, intermediate and operational objectives of the scheme and address a balance of benefits to both the local and strategic road network. Cost estimates show that option 33 is a significantly cheaper scheme than Option 32 and was progressed to the next stage largely for this reason. A three lane option at this preferable western tie-in location will potentially provide many benefits of a four lane scheme and due to it being cheaper, it may also result in a higher BCR. However, there are other considerations including the capacity if the surrounding road network to absorb queueing traffic when the bridge is open and also the ability of the lane management system to safely operate in a tidal manner should traffic forecasts require such an intervention. These aspects will be reflected in the findings of Road Safety Audits at the appropriate later stage.

Option 37 which is a two-lane low bridge that ties in at-grade to Southtown road is to be carried forward as the low cost option. It should be noted however that the assessment thus far does not take full account of the constraints that may be realised with this option, particularly in respect of freight traffic travelling to and from

the Port and the impact of increased traffic on the local roads on route to the A12. Such matters will be addressed in detailed traffic modelling, when the 'stacking' benefits of a dual carriageway for queuing traffic may still warrant further appraisal.

SATURN model outputs for Option 38 indicate that whilst the total travel time and distance is likely to be reduced in comparison to the "do minimum" scenario, there may be significant over-capacity queueing issues that arise. During the AM and PM peaks, over-capacity queuing appears much higher than the two-lane scheme which ties in at Suffolk Road (Option 32) and should therefore be withdrawn from any further assessment. Similarly Option 39, would be expected to experience comparable over-capacity queuing issues at the AM and PM peak and again should be discarded.

Structurally, it is also noted that the low-level bridge Options (37, 38 and 39) involve complicated construction methods and are relatively expensive in comparison to the proposed high-level schemes which have a chamber above or at ground level.

Options 4, 5 and 6 tie-in at Harfrey's roundabout and have been ruled out because of significant disbenefit to the wider road network and by not meeting specific operational objectives (to achieve a balance between the needs of road and river traffic and to minimise environmental impact, compulsory purchase and demolition of residential and commercial property).

It is also understood that Highways England is in the process of preparing an improvement scheme for the Harfrey's roundabout with an expected value of £8m to £10m (A47/A12 Corridor Feasibility Study, 2015). The need for the improvements and the nature of the final scheme is unknown, but peak period congestion and traffic signalisation of the roundabout as a solution would seem to be likely. Therefore, because of this possible intervention, its cost and operational inflexibility, further modification of the junction to accept a third river crossing as a direct connection would be less desirable.

Operationally, there may be benefit in having 4 lanes crossing the River Yare which will likely determine the high level tie-in at Suffolk Road (Option 32) to be the best performing solution. It is therefore unlikely that Option 37 will perform as consistently in the next stage of appraisal as the other two options and is expected to be discarded following the microsimulation model assessment.

Despite performing well during the junction assessment, Option 31 should not be taken forward because the four and three lane variants (Options 32 and 33) that tie-in to the same location on Suffolk Road are expected to deliver better resilience to the network and to provide more benefits to the local road network as opposed to a two lane carriageway standard.

The next steps will involve utilising the updated SATURN and microsimulation models to test the operational aspects of three Options (32, 33 and 37) but to concentrate for the OBC on a clear preferred solution.

- **Preferred Option 32** - Suffolk Road tie-in to the west (four lane high level bridge , roundabout as west tie in and traffic signals to the east at South Denes Road)

- **Alternative Option 33** - Suffolk Road tie-in to the west (three lane high level bridge, roundabout as west tie in and traffic signals to the east at South Denes Road)

- **Alternative Option 37** - Southtown Road tie in to the west (Single Carriageway two lane low level bridge with traffic signal junctions to the west and the east at South Denes Road)

12 OPERATIONAL MODELLING OF OPTIONS

12.1 Methodology

The operational performance of the options 32, 33 and 37 has been assessed using a microsimulation model developed by Mouchel utilising Paramics Discovery software.

In order to provide preliminary traffic flow forecasts for the future years both with and without the scheme, the preferred schemes have been coded into the existing SATURN model, which was previously developed by Mott Mac Donald. Cordon matrices have been extracted from the SATURN model and used as a basis to derive future year matrices for 2023 and 2038.

These early microsimulation forecasts help to understand the operational aspects of the three preferred options including the likely build up and dispersal of queues during bridge closures, and to assist in identifying a single preferred option to be taken forward into the SATURN modelling and economic appraisal and reported in the OBC.

It is intended that, following the completion of the SATURN modelling, updated cordon matrices will be fed back into the Paramics model in order to further refine and optimise the design of the preferred option for the OBC.

12.2 SATURN Model updates

Preliminary network performance testing has been undertaken using the Mott MacDonald 2008 SATURN model, with adjustments to the network coding to reflect the alternative bridge tie-in arrangements on either side of the river for the three preferred options 32, 33 and 37. The previously assumed forecast year of 2030 has been retained at this stage.

SATURN model outputs relating to overall journey times, distance travelled, queueing and total trips on the network for morning, evening and interpeak periods for 2030 are summarised in Table 12-1.

The results show that Option 32 has a marginal benefit overall in respect of the total distance travelled in the modelled road network.

Table 12-1 - Do-min v Options 32, 33 & 37 (2030) Forecast Year

Period	Scenario	Total Distance Travelled (pcukm)	Total Travel Time (pcuhr)	Total Trips on Network (pcu)
AM	Do-min			
	Option 32	44920.6	1387.6	14809.5
	Option 33	44988.9	1380.9	14809.5
	Option 37	44857.4	1407.7	14809.5
IP	Do-min			
	Option 32	49019.8	1676.7	17208.2
	Option 33	48129.3	1746.7	17208.2
	Option 37	48271.5	1869.4	17208.2
PM	Do-min			
	Option 32	51424.8	1851.1	17401
	Option 33	51484.5	1853.4	17401
	Option 37	51490.1	2198.2	17401

Notes: The data contained in the table are presented as passenger car units (pcu's)

The data contained in the table refer to the simulated time periods only.

12.3 Microsimulation Model

A summary of the model build processes and working assumptions is summarised below and documented in further detail in the Paramics Discovery LMVR3 and Paramics Discovery Forecasting report[4].

Figure 12-1 shows the microsimulation model area, which includes the town centre, peninsula, existing river crossings and parts of the Highways England network in the vicinity of the town, in order to allow sufficient route choice to model the reassignment impacts of the proposed scheme.

Figure 12-1- Geographic Scope of Microsimulation Model

[3] Document reference 1076653-MOU-GEN-XX-TN-TP-002

[4] Document reference 1076653-MOU-GEN-XX-TN-TP-005

In order to produce the 2016 base model, traffic data from a variety of sources was utilised, including manual classified counts, queue surveys, automatic traffic counts and HE TRADS and journey time data and information on operation of traffic signal junctions. The following time periods were modelled for a neutral weekday:

- Morning peak – 07:30-09:30;
- Inter peak – 12:00-15:00;
- Evening peak- 16:00 – 18:00.

In order to produce preliminary future year forecasts for the anticipated opening year of 2023 and future design year of 2038, Tempro growth factors have been applied to the 2016 traffic data. In order to allow a comparison with SATURN, a 2030 forecast has also been produced, using a cordoned matrix from SATURN.

The highway network and zoning system for the Paramics model is based upon that of the SATURN model, with further disaggregation of zones and additional links and nodes in order to provide more accurate forecasts of turning flows within the model area.

Data relating to actual river vessel movement for a typical day (average case scenario) and high usage day (worst case scenario) have been obtained from the Port Authority and used to derive a timetable of likely opening timings, frequencies and durations for the Third River Crossing.

A detailed description of the model outputs is included in the Paramics Forecasting Report5. In summary, all key indicators suggest that Option 32 performs better than either option 33 or 37.

The predicted maximum queue lengths for the three options are shown as follows:

Table 12-2 - 2023 Max Queue (m) for Average Case Scenario and Worst Case Scenario

ACS 2023	Option 32	Option 33	Option 37
Western side	154	341	407
Eastern side	189	182	397

WCS 2023	Option 32	Option 33	Option 37
Western Side	296	329	424
Eastern Side	245	249	445

Similarly, Table 12-3 and Table 12-4 demonstrate that option 32 provides the highest forecast journey time and distance savings.

[5] Document reference 1076653-MOU-GEN-XX-TN-TP-0005

Table 12-3 - Forecast Journey Time and Distance Savings 2023

2023	Vehicles	Total Distance (m)	Reduction (m)	Total Journey Time (s)	Reduction (s)
Do Min	109,170	284,144,403	-	30,656,804	-
Option 32	109,267	277,221,279	6,923,124	29,375,070	1,281,734
Option 33	109,281	277,366,867	6,777,536	29,400,413	1,256,391
Option 37	109,246	276,572,017	7,572,386	30,231,789	425,015

Table 12-4 - Forecast Journey Time and Distance Savings 2038

2038	Vehicles	Total Distance (m)	Reduction (m)	Total Journey Time (s)	Reduction (s)
Do Min	121,984	319,680,152	-	40,219,537	-
Option 32	122,756	313,060,558	6,619,593	35,786,851	4,432,686
Option 33	122,738	312,980,112	6,700,039	35,872,101	4,347,436
Option 37	122,424	312,103,104	7,577,048	38,090,568	2,128,968

13 CONCLUSIONS

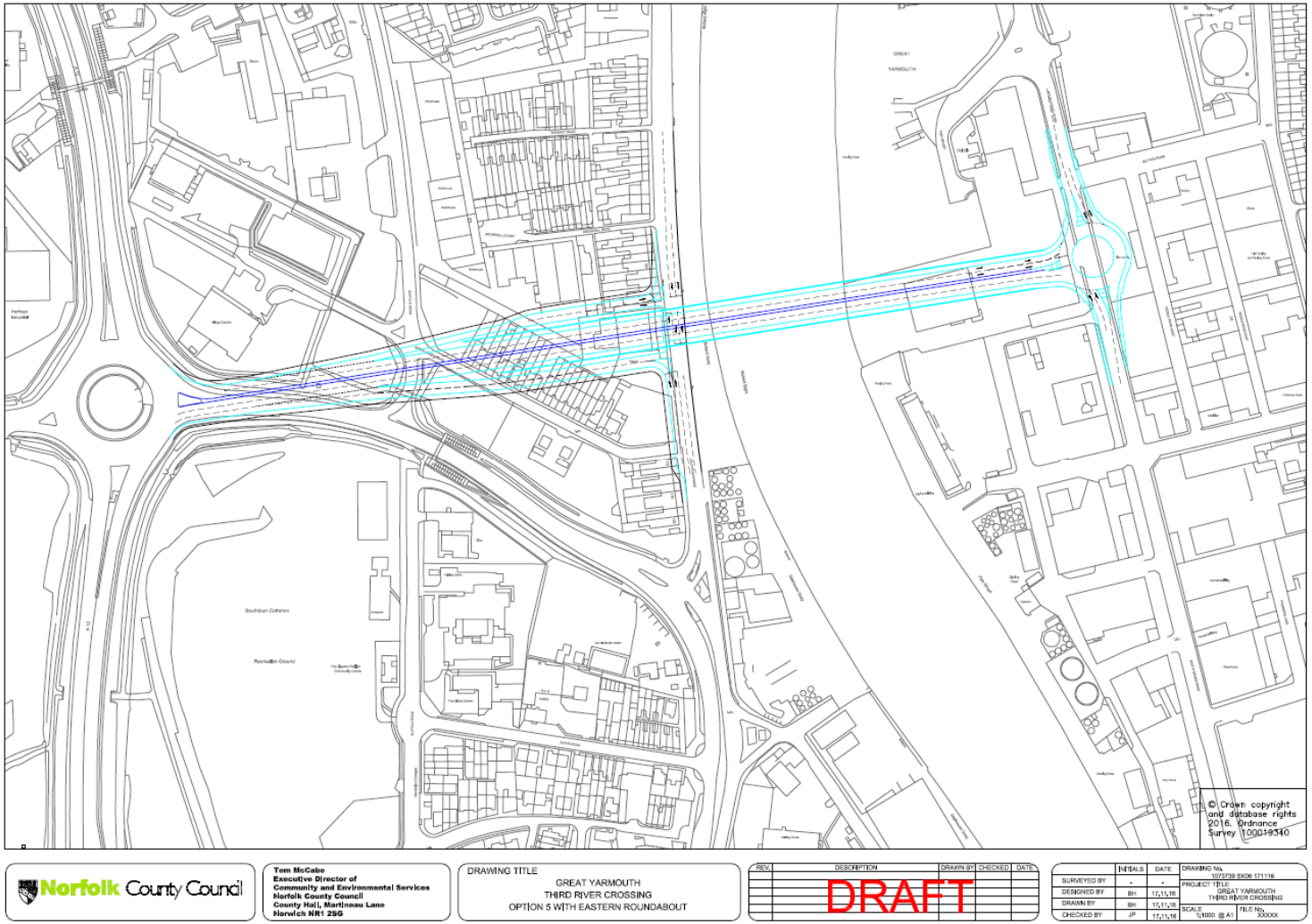
An extensive option sifting and selection process has been undertaken in order to identify the preferred option to be carried forward into the Outline Business Case for the Proposed Great Yarmouth Third River Crossing.

The initial long list of forty options were reduced down to a list of nine by removing those that were not deliverable or feasible, or did not significantly contribute to meeting the defined scheme objectives.

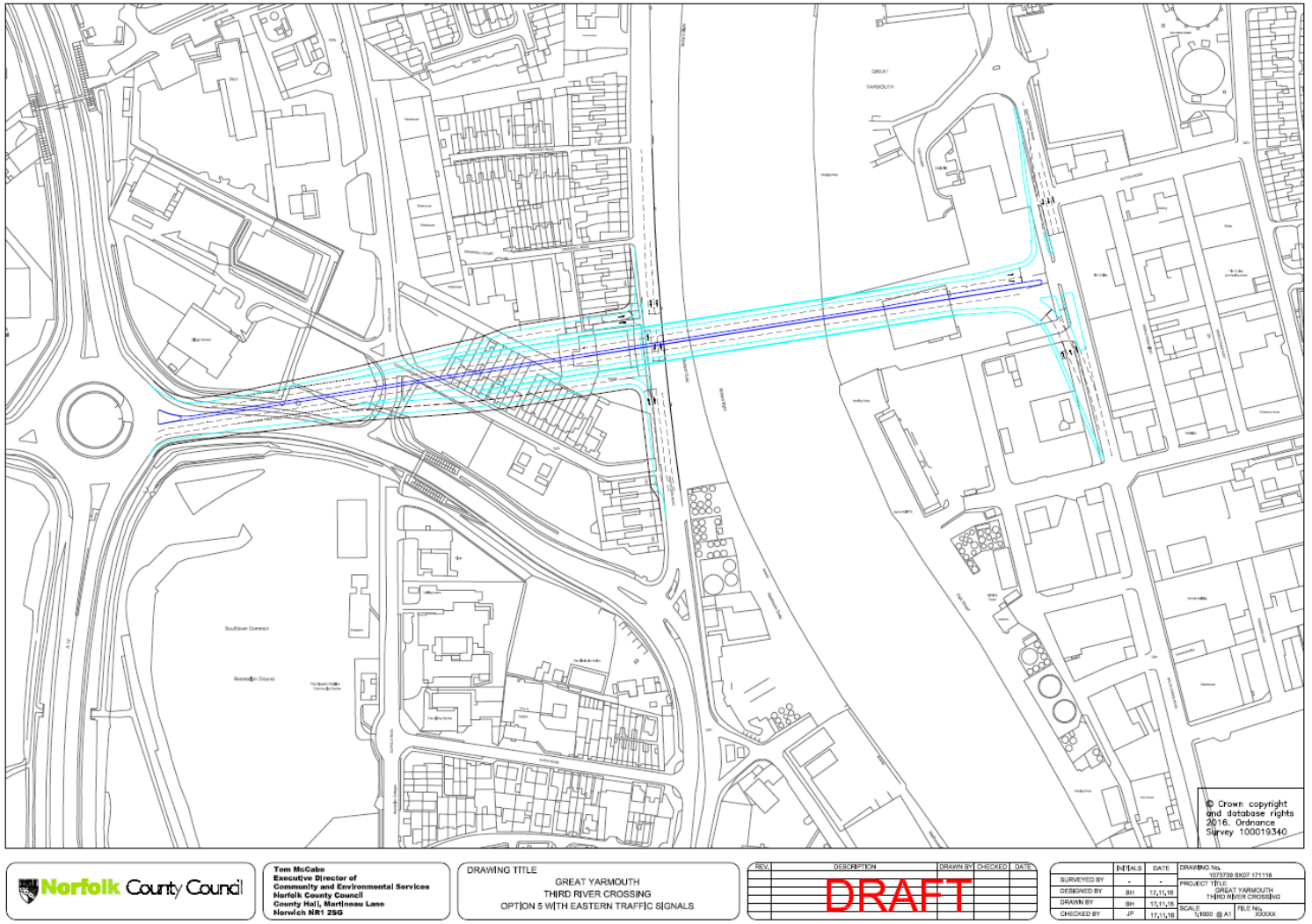
The DfT Early Assessment Sifting Tool (EAST) was then applied to inform the decision to further reduce the list. Consideration was given to financial, engineering, land and environmental constraints and the likely benefits and impact of the scheme options for potential users and stakeholders.

The shortlisted options were subjected to preliminary operational testing using both SATURN and Paramics Discovery model platforms. The results showed that Option 32 was forecast to provide the greatest potential benefit in terms of total travel distance and time saved across the modelled road network. In addition, Option 32 was also forecast to present the best operational performance at the junctions adjacent to the bridge, with the lowest levels of queueing and most efficient dissipation of these queues once the bridge re-opens for vehicular traffic.

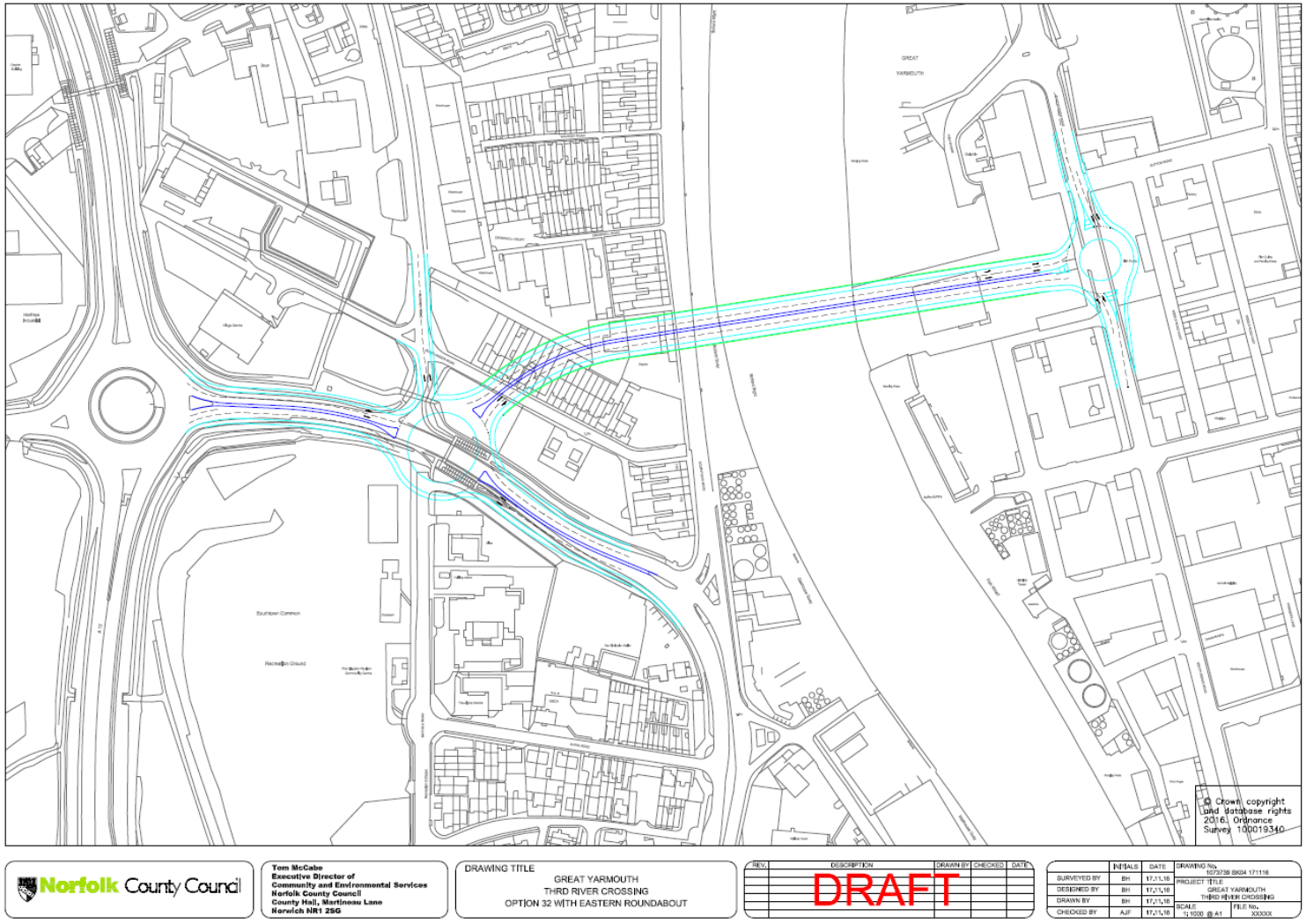
Appendix A - Option 5 with roundabout on eastern side of scheme



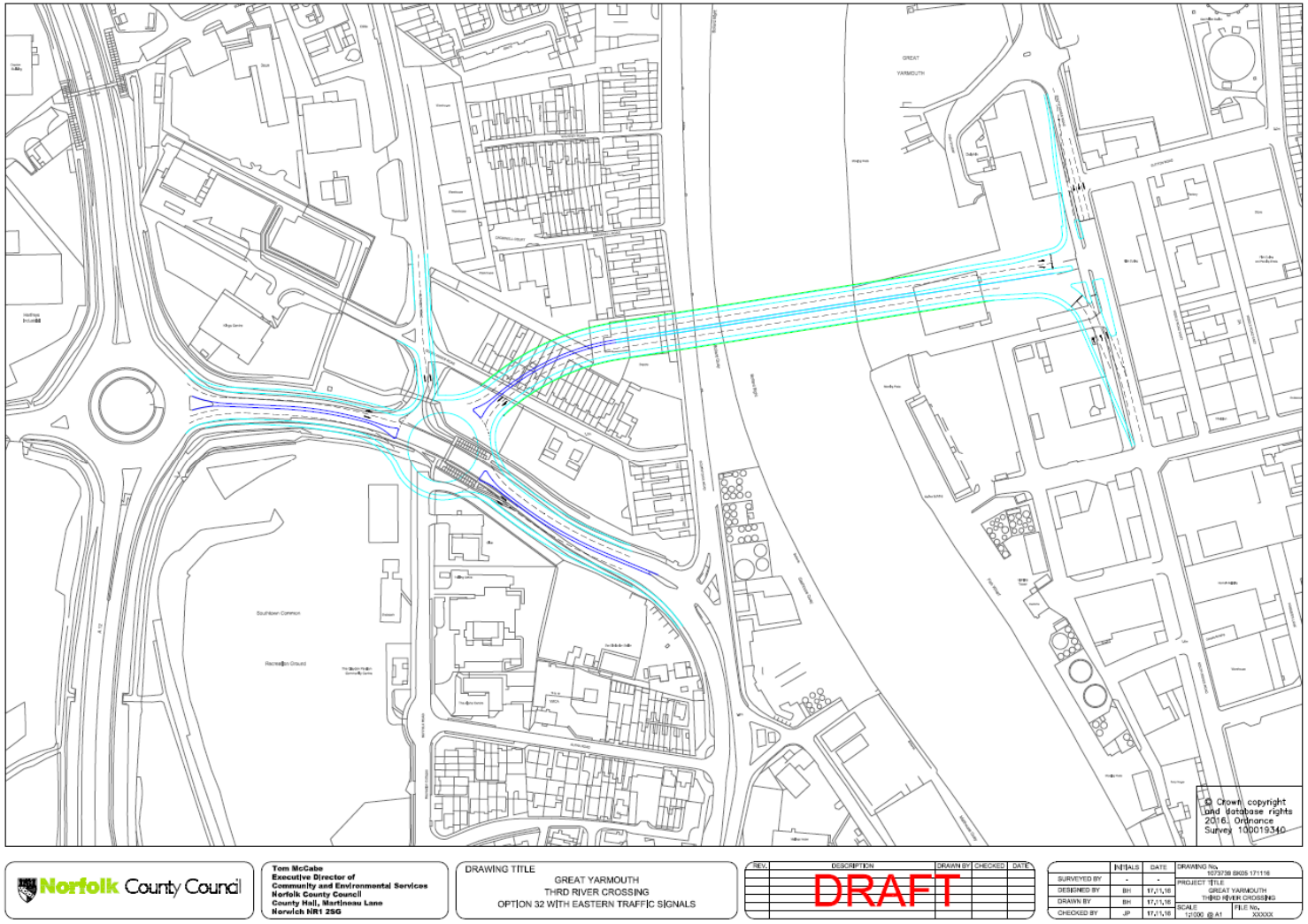
Appendix B - Option 5 with signals on eastern side of scheme



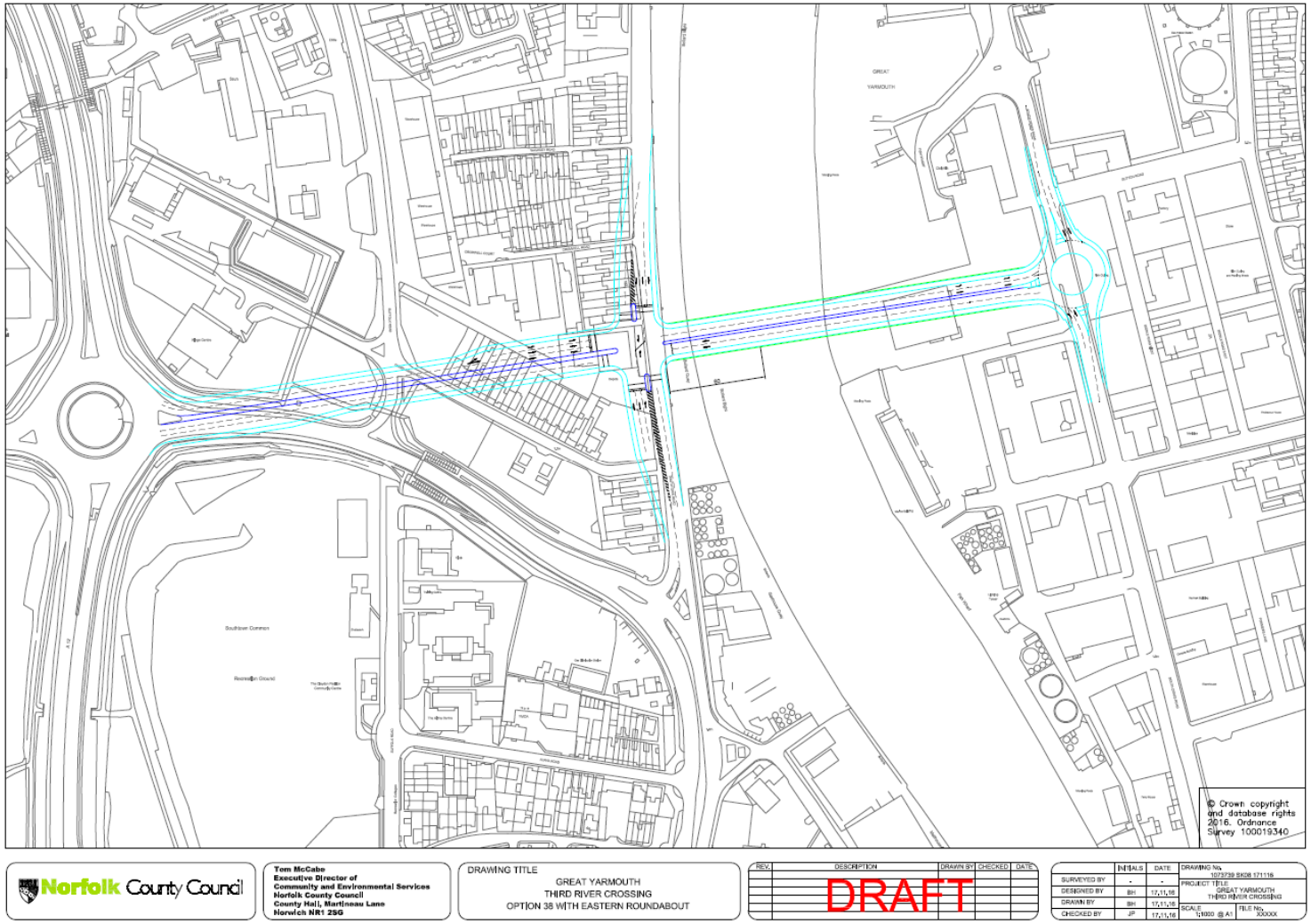
Appendix C - Option 32 with roundabout on eastern side of scheme



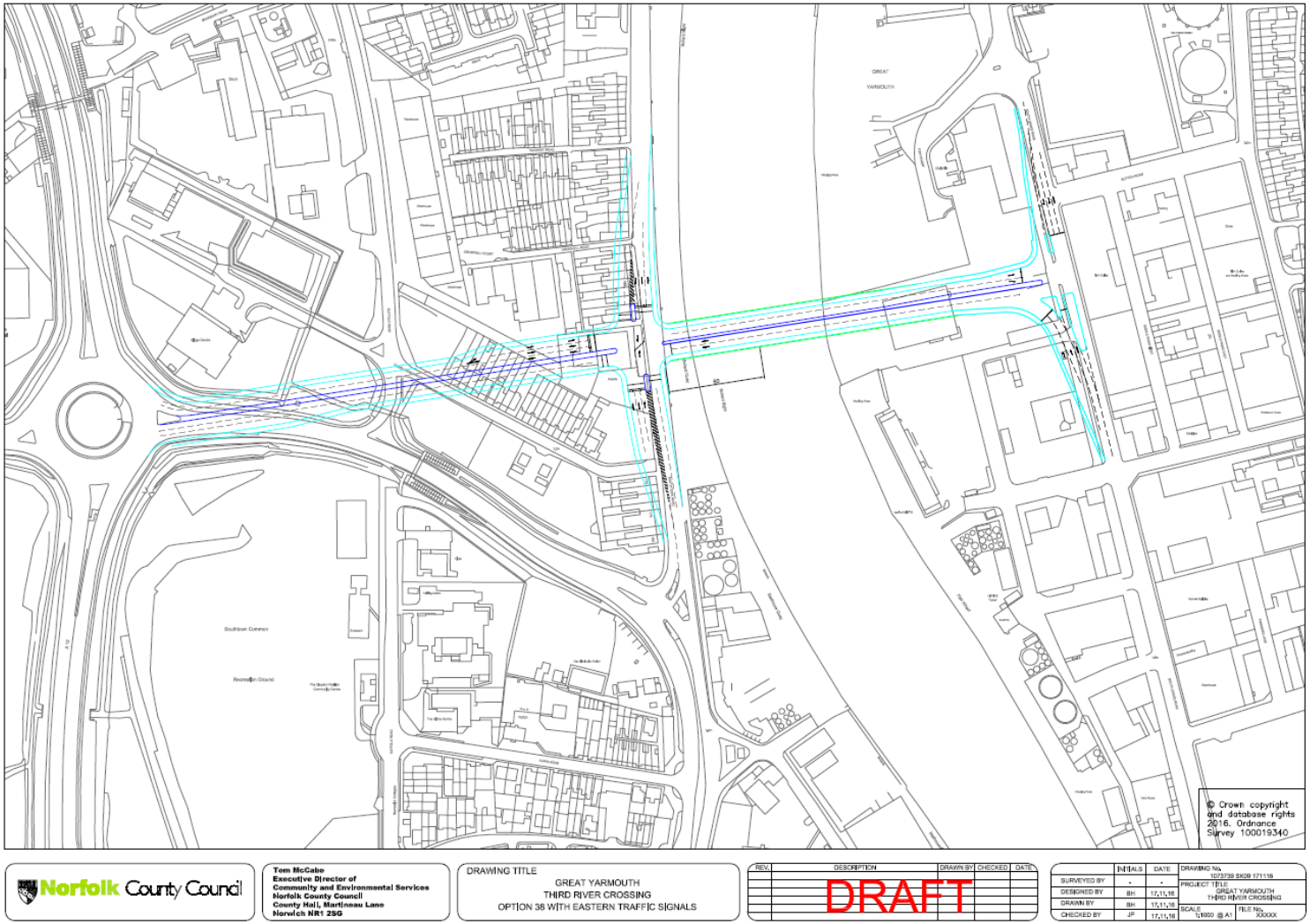
Appendix D - Option 32 with signals on eastern side of scheme



Appendix E - Option 38 with roundabout on eastern side of scheme



Appendix F - Option 38 with signals on eastern side of scheme



Appendix G – Cost Estimates

Scheme Element	Option Estimate				
	Option 4 - Single Carriageway from A12 Harfrey's Roundabout Existing Four-Arm Roundabout to South Denes Road T-Junction	Option 5 - Dual Carriageway from A12 Harfrey's Roundabout Existing Four-Arm Roundabout to South Denes Road T-Junction	Option 6 - Three-Lane (Tidal) Carriageway from A12 Harfrey's Roundabout Existing Four-Arm Roundabout to South Denes Road T-Junction	Option 31 - Single Carriageway from Suffolk Road New Four-Arm Roundabout to South Denes Road T-Junction	Option 32 - Dual Carriageway from Suffolk Road New Four-Arm Roundabout to South Denes Road T-Junction
	High	High	High	High	High
Approximate base construction costs;					
West Section (including bridge approach)	£5,296,000	£7,271,000	£6,349,000	£3,310,000	£4,380,000
Bascule Bridge	£22,018,000	£36,030,000	£30,410,000	£22,018,000	£36,030,000
East Section (including bridge approach)	£2,496,000	£3,143,000	£2,886,000	£2,590,000	£3,260,000
Sub-total	**£29,810,000**	**£46,444,000**	**£39,645,000**	**£27,918,000**	**£43,670,000**
Work by Statutory undertakers and others	£2,982,000	£4,644,000	£3,965,000	£2,792,000	£4,367,000
Survey/Investigate/Design/Procure/ Supervise/Manage & Liaise	£4,769,000	£7,431,000	£6,344,000	£4,467,000	£6,988,000
Sub-total including Stats/Others & Design etc. but excluding Risk	**£37,561,000**	**£58,519,000**	**£49,954,000**	**£35,177,000**	**£55,025,000**
Risk/Optimism Bias/Contingency	£18,782,000	£29,260,000	£24,978,000	£17,590,000	£27,513,000
Approximate Indicative Total Budget Estimate	**£56,343,000**	**£87,779,000**	**£74,932,000**	**£52,767,000**	**£82,538,000**
Land (see note below)	£8,985,875	£14,000,000	£11,950,521	£8,950,126	£14,000,000
Estimated Scheme Cost	**£65,328,875**	**£101,779,000**	**£86,882,521**	**£61,717,126**	**£96,538,000**

Scheme Element	Option Estimate			
	Option 33 - Three-Lane (Tidal) Carriageway from Suffolk Road New Four-Arm Roundabout to South Denes Road T-Junction High	Option 37 - Single Carriageway from Southtown At-Grade Junction to South Denes Road T-Junction Low	Option 38 - Dual Carriageway from Southtown At-Grade Junction to South Denes Road T-Junction Low	Option 39 - Three-Lane (Tidal) Carriageway from Southtown At-Grade Junction to South Denes Road T-Junction Low
Approximate base construction costs;				
West Section (including bridge approach)	£3,964,000	£4,987,000	£6,015,000	£5,650,000
Bascule Bridge	£30,410,000	£21,217,000	£34,720,000	£29,303,000
East Section (including bridge approach)	£2,994,000	£1,525,000	£1,907,000	£1,758,000
Sub-total	**£37,368,000**	**£27,729,000**	**£42,642,000**	**£36,711,000**
Work by Statutory undertakers and others	£3,736,000	£2,774,000	£4,265,000	£3,671,000
Survey/Investigate/Design/Procure/Supervise/Manage & liaise	£5,979,000	£4,437,000	£6,822,000	£5,873,000
Sub-total including Stats/Others & Design etc. but excluding Risk	**£47,083,000**	**£34,940,000**	**£53,729,000**	**£46,255,000**
Risk/Optimism Bias/Contingency	£23,542,000	£17,470,000	£26,866,000	£23,129,000
Approximate Indicative Total Budget Estimate	**£70,625,000**	**£52,410,000**	**£80,595,000**	**£69,384,000**
Land (see note below)	£11,979,666	£9,103,841	£14,000,000	£12,052,765
Estimated Scheme Cost	**£82,604,665.67**	**£61,513,841**	**£94,595,000**	**£81,436,765**

Exclusions
Demolitions
Geotech to existing ground band drains stone piling etc. cost assessment ongoing currently to be in next issue
Any works to river beds
Major Stats diversions
Major contamination/ground condition issues
VAT
Legal issues
Inflation

Note
Land cost for options 5, 32 and 38 based on update to previous land cost of £13.7m for Bridge Option 1 (Dec '15) plus allowance of 2.5% for inflation
Land cost for single and three lane options have been adjusted proportionally to the difference in base construction costs for those options

Cost estimates are based on the following:
Option 5 - Drawing No. 1073739-SK07-171116 (with assumptions made for options 4 and 6) and Bridges Drawing Option 2 (with adjusted deck widths for options 4 and 6)
Option 32 - Drawing No. 1073739-SK05-171116 (with assumptions made for options 31 and 33) and Bridges Drawing Option 1 (with adjusted deck widths for options 31 and 33)
Option 38 - Drawing No. 1073739-SK09-171116 (with assumptions made for options 37 and 39) and Bridges Drawing Option 3 (with adjusted deck widths for options 37 and 39)

Appendix H – AM Peak Junction Assessment Summary

AM Peak (incl 5% uplift)													
Option 32		**West - roundabout**					**East - signals**				**East - roundabout (42m ICD)**		
		Queue		**Max RFC**			**MMQ**		**Max DoS**			**Queue**	**Max RFC**
	Bridge Crossing	0.07		0.156		Bridge Crossing	14.4		75.2%		Bridge Crossing	1.36	0.619
	William Adams Way S	0.66		0.430		South Denes Road NB	6.9		57.9%		South Denes Road NB	0.27	0.348
	William Adams Way W	1.27		0.641		South Denes Road SB	12.7		75.2%		South Denes Road SB	2.04	0.728
	Suffolk Rd Exit	Exit Only				**JUNCTION PRC**	**19.6%**						
Option 5		**West - signals**					**East - signals**				**East - roundabout (42m ICD)**		
		MMQ		**Max DoS**			**MMQ**		**Max DoS**			**Queue**	**Max RFC**
	Bridge Crossing	Unsignalised				Bridge Crossing	12.5		79.4%		Bridge Crossing	1.21	0.588
	Southtown Road NB	10.7		87.1%		South Denes Road NB	12.5		62.4%		South Denes Road NB	0.26	0.344
	Southtown Road NB Internal	4.9		68.4%		South Denes Road SB	11.2		76.2%		South Denes Road SB	1.95	0.730
	New Road On-Slip WB -giveway	3.3		58.0%									
	New Road Off-Slip EB	7.4		77.2%									
	Southtown Road SB	5.1		43.4%									
	Southtown Road SB Internal	1.9		42.4%									
	JUNCTION PRC	**3.4%**				**JUNCTION PRC**	**13.3%**						
Option 38		**West - signals**					**East - signals**				**East - roundabout (42m ICD)**		
		MMQ		**Max DoS**			**MMQ**		**Max DoS**			**Queue**	**Max RFC**
	Bridge Crossing	2.7		41.3%		Bridge Crossing	11.1		71.2%		Bridge Crossing	1.79	0.666
	Southtown Road NB	14.4		68.0%		South Denes Road NB	11.2		71.9%		South Denes Road NB	0.34	0.391
	Southtown Road SB	7.5		69.1%		South Denes Road SB	15.1		68.0%		South Denes Road SB	2.28	0.751
	New Road EB	11.4		71.2%									
	JUNCTION PRC	**26.4%**				**JUNCTION PRC**	**25.1%**						

Appendix I – PM Peak Junction Assessment Summary

PM Peak (incl 5% uplift)													
Option 32		**West - roundabout**					**East -signals**				**East - roundabout (42m ICD)**		
		Queue		**Max RFC**			**MMQ**		**Max DoS**			**Queue**	**Max RFC**
	Bridge Crossing	0.93		0.556		Bridge Crossing	14.4		75.2%		Bridge Crossing	0.48	0.360
	William Adams Way S	0.50		0.435		South Denes Road NB	6.9		57.9%		South Denes Road NB	0.93	0.562
	William Adams Way W	1.12		0.606		South Denes Road SB	12.7		75.2%		South Denes Road SB	1.90	0.729
	Suffolk Rd Exit	Exit Only				**JUNCTION PRC**	**19.6%**						
Option 5		**West - signals**					**East -signals**				**East - roundabout (42m ICD)**		
		MMQ		**Max DoS**			**MMQ**		**Max DoS**			**Queue**	**Max RFC**
	Bridge Crossing	Unsignalised				Bridge Crossing	9.9		76.6%		Bridge Crossing	0.50	0.374
	Southtown Road NB	16.3		76.1%		South Denes Road NB	7.8		78.6%		South Denes Road NB	0.68	0.518
	Southtown Road NB Internal	3.1		69.8%		South Denes Road SB	9.6		77.0%		South Denes Road SB	1.47	0.682
	New Road On-Slip WB -giveway	0.5		17.7%									
	New Road Off-Slip EB	11.9		81.6%									
	Southtown Road SB	19.1		77.8%									
	Southtown Road SB Internal	1.2		61.8%									
	JUNCTION PRC	**10.2%**				**JUNCTION PRC**	**14.5%**						
Option 38		**West - signals**					**East -signals**				**East - roundabout (42m ICD)**		
		MMQ		**Max DoS**			**MMQ**		**Max DoS**			**Queue**	**Max RFC**
	Bridge Crossing	12.1		85.5%		Bridge Crossing	11.3		72.1%		Bridge Crossing	0.69	0.412
	Southtown Road NB	16.1		85.5%		South Denes Road NB	12.2		75.2%		South Denes Road NB	1.17	0.629
	Southtown Road SB	12.5		82.3%		South Denes Road SB	10.3		70.6%		South Denes Road SB	1.91	0.732
	New Road EB	10.6		65.4%									
	JUNCTION PRC	**5.3%**				**JUNCTION PRC**	**19.7%**						

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 3C: Environmental Options Appraisal 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

Document Reference: 6.2 – Technical Appendix 3C

Version Number: 0 – Revision for Submission

Date: 30 April 2019

Great Yarmouth Third River Crossing

Options Environmental Appraisal Report

Produced for:

Norfolk County Council

Prepared by

mouchel
building great relationships

St John's House
Queen's Street
Manchester
M2 5JB
UK

Document Control Sheet

Project Title:	Great Yarmouth Third River Crossing
Report Title:	Environmental Appraisal Report
Document No:	1076653-MOU-GEN-XX-RP-EN-0001
Revision:	1
Status:	Final
Control Date:	March 2017

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
1	Final	O Emezi	24/03/2017	R Atuah	24/03/2017	R Atuah	27/03/2017

Distribution

Organisation	Contact	Copies

This report is presented to Norfolk County Council in respect of the Great Yarmouth Third River Crossing Project and may not be used or relied on by any other person. It may not be used by Norfolk County Council in relation to any other matters not covered specifically by the agreed scope of this report.

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

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

Contents

List of Figures

Main Report Figures

List of Tables

Acronyms

Acronym	Description
AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersal Modelling Software
AM	Ante-Meridiem
AQMA	Air Quality Management Area
ARN	Affected Road Network
AST	Appraisal Summary Table
BAP	Biodiversity Action Plan
BGS	British Geological Society
CA	Conservation Area
Defra	Department of Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DM	Do Minimum
DS	Do Something
EA	Environment Agency
EPS	European Protected Species
FBC	Full Business Case
GIS	Geographical Information Systems
GWDTEs	Groundwater Dependent Terrestrial Ecosystems
HSI	Habitat Suitability Index Survey
HA	Highways Agency (now Highways England)
HDV	Heavy Duty Vehicle
IP	Inter Peak
LDF	Local Development Framework
NHER	Norfolk Historic Environment Record
NVZ	Nitrate Vulnerable Zone
LNR	Local Nature Reserve
MAGIC	Multi-Agency Geographical Information for the Countryside
NEPG	Norfolk Environmental Protection Group
NIA	Noise Important Areas
NPPF	National Planning Policy Framework
NPSNN	National Policy Statement for National Networks
NPV	Net Present Value

Acronym	Description
OBC	Outline Business Case
OS	Ordnance Survey
PCM	Pollution Climate Mapping
PM	Post meridiem
pSPA	Potential Special Protection Area
SPA	Special Protection Area
SAC	Special Area of Conservation
SuDs	Sustainable Drainage Systems
NCC	Norfolk County Council
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
TAG	Transport Appraisal Guidance
WFD	Water Framework Directive
WIMBY	What's in My Backyard

Units	Description
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
KM	Kilometre
M	Metre
MBGL	Metres Below Ground Level
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
PM_{10}	Particulate Matter with an aerodynamic diameter of 10µm or less
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter of 2.5µm or less
$\mu g/m^3$	Microgram per cubic metre
µm	Micrometre (Micron)

1 Introduction

1.1 Overview and Purpose of the Report

1.1.1 This document is the Environmental Appraisal Report, prepared in support of the Outline Business Case (OBC) for the proposed Great Yarmouth Third River Crossing (hereafter referred to as the 'scheme'). The report is prepared on behalf of Norfolk County Council (NCC) for consideration by the New Anglia Local Enterprise Partnership and the Department for Transport (DfT). The form and content of this Options Environmental Appraisal Report is informed by guidance set out in the DfT's Transport Appraisal Guidance (TAG) Unit A3 – Environmental Impact Appraisal (November 2014).

1.1.2 The report assesses the impacts on the environment of options for the proposed Great Yarmouth Third River Crossing scheme to inform its OBC. The results of the environmental impact appraisals are set out within appropriate TAG worksheets (where possible), which have then been used to complete Appraisal Summary Tables (ASTs) for the options being considered.

1.1.3 The OBC, which this environmental appraisal supports, explains why the proposed scheme should receive support and provides a clear audit trail for the purposes of public accountability.

1.2 Content of the Report

1.2.1 This report is structured as follows:

- Chapter 1: Provides an overview of the OBC and the purpose of the Options Environmental Appraisal Report.
- Chapter 2: Describes the site location, characteristics of the area and provides an overview of the options under consideration at this stage.
- Chapter 3: Provides an overview of the appraisal methodology that has been adopted for the environmental appraisal in support of the OBC.
- Chapters 4 - 10: These chapters set out the specific methodologies adopted for each of the WebTAG sub-impacts appraised. Furthermore, the chapters provide an evaluation of topic related constraints and presents the required environmental impact appraisal of each option in TAG worksheets, where possible. Summary environmental assessment scores are provided for each option appraisal, where possible.
- Chapter 11: Sets out the environmental impact appraisal inputs to the ASTs for each of the options under consideration.

2 Description of Options

2.1 Site Location and Overview of the Existing Environment

2.1.1 The proposed scheme is a new river crossing over the River Yare, a river which flows into the North Sea at Gorleston, Great Yarmouth, and 40km (25 miles) east of Norwich. River Yare is approximately 51km (32 miles) long and flows from Norwich to Gorleston-on-Sea in Great Yarmouth. River Yare is one of five major rivers within the Broadland Rivers catchment which includes Rivers Ant, Bure, Wensum and Waveney[1]. These sub-catchments drain into the Broads; a tidally dominated area of inland waterways. The catchment area is approximately 3,200km^2 and predominantly rural with the main urban conurbation of Norwich, Great Yarmouth and Lowestoft.

2.1.2 Great Yarmouth is an ancient coastal town in Norfolk and is located on a peninsula between the North Sea and the River Yare. It lies at the mouth of the River Yare and was once a thriving fishing port, mainly for herring fishery, but this industry experienced a sharp decline in the 20th century. However, the 1960's brought about the oil rig supply industry with the discovery of oil in the North Sea and in recent times, increased development of renewable energy sources has seen a shift in industries in this area.

2.1.3 The town is separated from other areas of the borough such as Gorleston and Southtown by the River Yare, with the two existing bridges; Haven Bridge and the A12 Breydon Bridge providing transport links between these areas. Both bridges lift to enable boats and ships to pass through. To the west of Breydon Bridge lies Breydon Water, a large, sheltered estuary which forms the gateway to the Norfolk Broads which is designated as a Ramsar site, a Special Protection Area (SPA), a Site of Special Scientific Interest (SSSI) and a Local Nature Reserve (LNR).

2.1.4 Great Yarmouth is connected to Norwich and Lowestoft by rail and by road. The main transport links in the area include the A12 which runs between London and Great Yarmouth town, where it terminates, the A143 which connects Great Yarmouth to Haverhill in Suffolk and the A47 which links the town to Birmingham. The Breydon Bridge serves as a bypass route for A12 traffic avoiding the town centre and the Haven Bridge provides access into the northern extents of the town centre. There are no other bridges further south of the River Yare and as a result, the southern part of Great Yarmouth, is effectively isolated from the rest of the borough.

2.1.5 The existing A12 has a speed limit of 50mph, other existing local roads within the vicinity of the scheme have a 30mph speed limit while the proposed link over the River Yare would have a speed limit of 30mph.

2.1.6 The scheme is expected to improve connectivity by improving links across the town and region, reducing congestion and attract investment which will help in the creation of thousands of new jobs.

2.1.7 Figure 1 shows the area of the scheme in relation to the town, economic areas and the local road network.

[1] http://www.catchmentbasedapproach.org/anglian/broadland-rivers [accessed October, 2016]

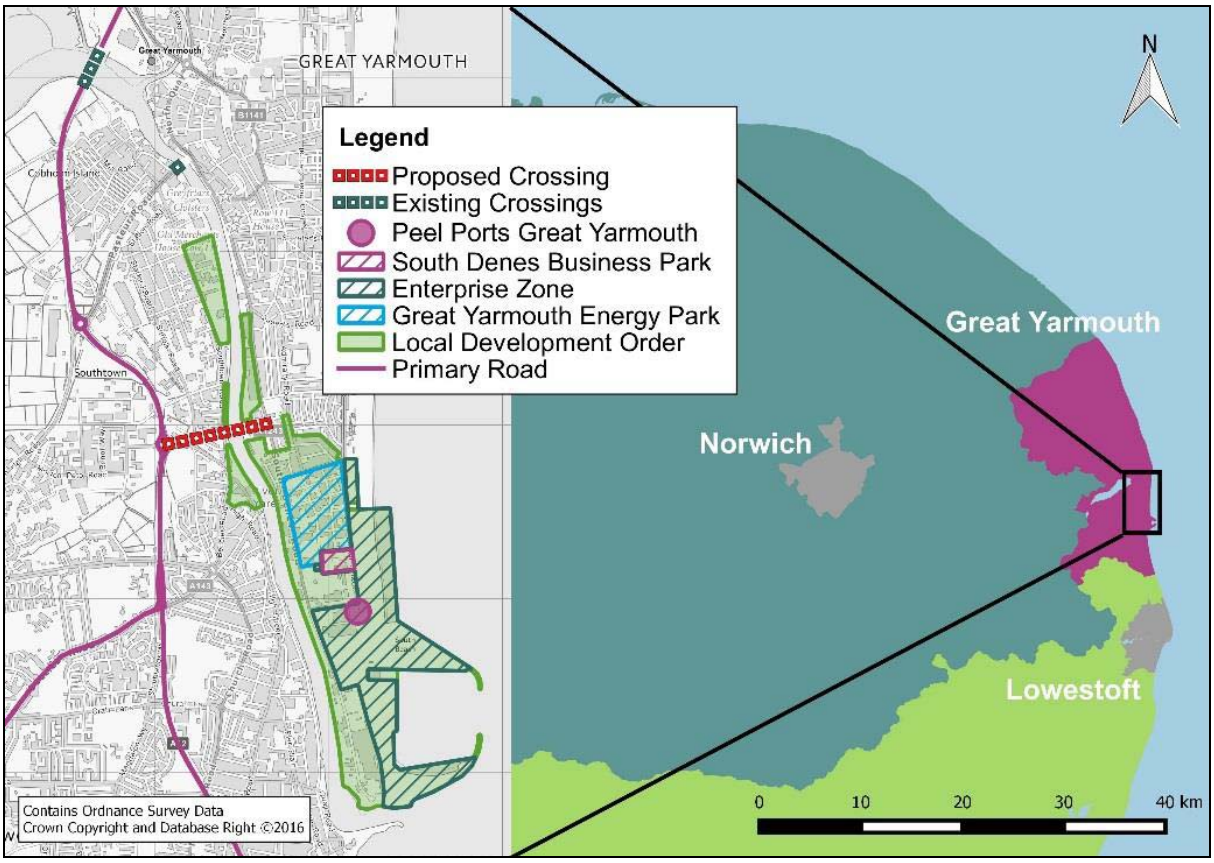


Figure 1: Location of the Scheme

2.1.8 Three options (Options 32, 33 and 37) are being considered for the scheme. These are described below and are shown on in **Appendix A**.

2.2 Options 32 and 33

2.2.1 There are a number of similarities between Options 32 and 33 with respect to design and general arrangement. Both options connect to the A12 via a new four-arm roundabout at William Adams Way to the west and link up to South Denes Road via a new traffic signal controlled junction to the east.

2.2.2 These two options also have a clear air draft height of about 4.5m above the mean high level water, and would bridge over Southtown Road, which would remain open to traffic.

2.2.3 Options 32 and 33 would connect to the A12 Hafrey's Roundabout via a new four-arm roundabout junction arrangement at William Adams Way on the western side of the River Yare. The new road would then extend east over Southtown Road, crossing the River Yare via a bascule bridge arrangement and link up to a new traffic signal controlled junction at South Denes Road on the eastern side of the River Yare, where it terminates.

2.2.4 Both options also have a number of non-motorised user provisions incorporated within the proposals at this stage, these include:

- A 4.5m wide footway and two-way cycleway link from William Adams Way, across the eastbound side of the new bascule bridge, and linking to a new on

carriageway cycle lane on Sutton Road. This route also includes new Toucan crossing facilities at the William Adams Way roundabout, and the new traffic signal controlled junction on South Denes Road;

- A 1.5m wide footway on the westbound side of the link across the new bascule bridge;
- A new footway/cycleway link from the William Adams Way roundabout to Suffolk Road, and a new pedestrian crossing on Suffolk Road; and
- A footway/cycleway link from William Adams Way to the Hafrey's roundabout on the A12.

Differences between Options 32 and 33

2.2.5 Option 32 comprises a dual carriageway with a four lane high level bridge across the River Yare, and traffic signals to the east at South Denes Road.

2.2.6 Option 33 is a three lane carriageway, with new four arm roundabout at Suffolk Road to tie-in to the west, a three lane high level bridge across the River Yare and traffic signals to the east at South Denes Road. This option would operate as a tidal flow arrangement depending on the traffic flow conditions. The tidal flow arrangement would be controlled by overhead lane signals mounted on cantilever / portal gantries.

2.2.7 These options are shown on Figures 1076653-MOU-HGN-OPT32-DR-D-0001(P1,S2) and 1076653-MOU-HGN-OPT33-DR-D-0003(P1,S2) in **Appendix A**.

2.3 Option 37

2.3.1 Option 37 is a single carriageway with an at-grade junction at Southtown Road to tie-in to the west, a two lane low level bridge with traffic signal junctions to the west and the east at South Denes Road.

2.3.2 This option would involve construction of a new at-grade junction with Southtown Road, land-take requirements impacting on Queen Anne's Road and the stopping up of the existing William Adams Way to vehicular traffic and access to be maintained only as a cycleway/footway.

2.3.3 This option is shown on Figure 1076653-MOU-HGN-OPT37-DR-D-0005(P1,S2) in **Appendix A**.

2.4 Bridge Opening

2.4.1 The opening duration of the bridge is dictated by two factors: bridge movement and vessel movement.

2.4.2 The time taken for the bridge to open and close comprises the time to clear the bridge of traffic and the time for the bridge to raise, while closing time includes the bridge lowering and the traffic controls lifting. The duration of this will vary depending on the nature of the traffic control system installed, with control of pedestrians being the probable limiting factor. In total, a time of 240 seconds may be required to allow the opening of the bridge.

2.4.3 The vessel movement time includes the transit time (that is the time it takes a vessel

to manoeuvre through the bridge passage) including the time taken for the vessel to approach the bridge following opening. The location of the bridge, on a bend in the river, will probably increase both the approach and transit times in comparison with a bridge with a straight approach.

2.4.4 Following extensive liaison with the Port Authority and analysis of current vessel movements past the proposed location of the scheme, using an assumed bridge opening pattern for an average and worst case day, it has been determined that the bridge is likely to open between 10 and 20 times daily, generally between the hours of 7am and 7pm. The majority of bridge openings will last 5 minutes or less.

3 Appraisal Methodology

3.1 WebTAG guidance

3.1.1 The WebTAG guidance for Environmental Impact Appraisals (TAG Unit A3, December 2015) provides guidance on appraising transport options against the Government's objective for transport. There are eight sub-impacts which cover the impacts upon the environment. The sub-impacts are as follows:

- Noise
- Air Quality
- Greenhouse Gases
- Landscape
- Townscape
- Biodiversity
- Historic Environment and
- Water Environment.

3.1.2 The methodology adopted for the environmental impact appraisal has been informed by the guidance provided in the relevant chapters of TAG Unit A3. Some assessment of the potential environmental impact and effect of the options, using guidance contained in the Design Manual for Roads and Bridges (DMRB) Volume 11, has been undertaken to inform the environmental impact appraisal.

3.1.3 Where a monetary assessment is not feasible, WebTAG provides guidance on the qualitative assessment of the impacts. The impacts are then assessed using the recommended seven point scale which breaks down impacts into Slight//Moderate or Large Beneficial or Adverse and Neutral. The WebTAG guidance also provide information on the type of evidence to be used when applying this scale. These units contain worksheets which allow for a description of the qualitative impacts to be provided and then summarised in the AST to help inform the overall appraisal of the options.

3.1.4 To inform the Environmental Impact Appraisal, desk-based data gathering was undertaken for each of the environmental sub-impacts. This data search involved reviewing previous studies / reports and publically available datasets from sources such as online mapping, local authority websites and Geographical Information System (GIS) digital downloads. This data gathering exercise was supplemented by site visits to confirm the condition of the baseline environment, where appropriate. An environmental constraints plan has been produced and is shown in Figure 1 in **Appendix A**.

3.1.5 A preliminary ecology survey was also undertaken to inform the scope of ecology surveys if this scheme secures the required funds following submission of the OBC. This survey has also helped identify the need for targeted protected species surveys

and inform the forward programme where these surveys are seasonally constrained. See **Appendix B** for a report on the findings of this survey.

3.2 Scope of Environmental Appraisal

3.2.1 In line with the guidance set out in Chapter 5 (Environmental Capital Approach) of TAG Unit A3, the non-traffic related environmental sub-impacts have been subjected to an initial review to identify the study area for the sub-impact, identify the key environmental resources, appraise the environmental capital and proposal's impact and determine the overall assessment score. It is worth noting that TAG Unit A3 Chapter 5, Paragraph 5.3.3 states that "*Appraisal should be no more detailed than is required to support robust decision making. Where impacts are deemed to be minimal, further analysis may be scoped out*".

3.2.2 In view of the above, due to the absence of appropriate traffic data for the options, a proportionate air quality and noise assessment has been undertaken to inform the environmental impact appraisal. This has comprised a qualitative analysis of the likely impacts using available information, such as potential number of sensitive receptors (e.g., properties), and sensitive areas (e.g. the Department for Environment, Food & Rural Affairs (Defra) Noise Important Areas (NIA) and Air Quality Management Areas (AQMA)) to be affected by the options and a high level review of potential traffic changes caused by the options. This assessment methodology does not provide a Net Present Value (NPV) as required for the environmental impact appraisal. The appraisal also scopes out the Greenhouse Gases sub-impact as it is deemed that this would not present a material change on the optioneering process at this stage. However, the assessment utilises currently available information for each of the options under consideration to enable a comparative appraisal.

3.2.3 Should the scheme progress and require a Full Business Case (FBC), detailed modelling using traffic data will be undertaken to inform the air quality and noise assessment and appraisal. This would provide quantification of the air quality and noise impacts, including the numbers of sensitive receptors likely to be impacted by the scheme and an estimated NPV.

3.2.4 The scheme would be located wholly within the urban setting of Great Yarmouth town, where the overriding character is defined predominantly through its built development and infrastructure. There are few constituent landscape types or features (for example agricultural land pattern, woodlands, farmlands, hedgerows, etc.) that would merit a separate landscape appraisal of the study area, other than through its function as a townscape setting. A review of relevant landscape characterisation and classification studies has shown that the area is classed as an "urban" landscape typology (Great Yarmouth Borough Landscape Character Assessment April 2008).

3.2.5 The Broads National Park is situated approximately 1km to the north-west of the scheme. The National Policy Statement for National Networks[2] (NPSNN) places great weight on the conservation of landscape and scenic beauty in National Parks and Areas of Outstanding Natural Beauty, where designated areas have statutory purposes which help to ensure their continued protection. Initial walk-over surveys,

[2] National Policy Statement for National Networks, Department for Transport (December 2014).

undertaken by an appropriately qualified and experienced landscape architect have concluded that none of the scheme alternatives would materially impact on the National Park, nor represent any impact on its perceived setting as a landscape.

3.2.6 In line with the guidance on the Environmental Capital Approach (Chapter 5 of TAG Unit A3), it has accordingly been concluded that, given the urban nature of the scheme, the townscape sub-impact adequately considers the potential impacts in relation to the setting and that the landscape sub-impact would not be directly relevant to the decision making process. Accordingly, the landscape sub-impact has been scoped out of the overall appraisal. This report therefore presents the findings of the appraisal of the proposed bridge options against the remaining six environmental sub-impacts.

3.3 Consultation

3.3.1 The assessment undertaken for this appraisal has involved data gathering from publicly available source and other non-publicly available sources such as the Local Historic Environment Records (Norfolk Historic Environment Record) and local biological record centre (Norfolk Biodiversity Information Service). No other consultation on the environmental assessment of the proposal has been undertaken at this stage.

3.3.2 Detailed consultation will be undertaken if this scheme progresses to the FBC stage. The following organisations will be consulted during the detailed assessments of the project scheme in order to gather further information on environmental constraints, considerations and on the scope of the environmental assessment:

- Norfolk County Council (NCC);
- Natural England;
- Environment Agency;
- Eastern Inshore Fisheries and Conservation Authority;
- Marine Management Organisation and
- Historic England.

4 Noise

4.1 Introduction

4.1.1 A high level review of the options has been undertaken to give an indication of their potential noise impacts. The options have the potential to affect traffic noise and vibration levels as experienced by potential noise sensitive receptors, such as residential properties, in the vicinity of the new carriageways.

4.1.2 At this stage it has not been possible to undertake a quantitative or monetised assessment of the potential impacts as sufficiently detailed predicted traffic data has not yet been developed to enable complete noise calculations in accordance with the DMRB, Volume 11, Section 3, Part 7 'Noise and Vibration'. As a result of this a noise WebTAG worksheet has not been provided.

4.1.3 A qualitative assessment of the potential impacts of the options has instead been undertaken based on counts of properties within a defined study area based on proximity to each of the options and noise sensitive areas - NIA. The outcome of this assessment is summarised in the ASTs for the options, provided in Chapter 10.

4.2 Appraisal Methodology

4.2.1 Due to the absence of appropriate traffic data for a detailed noise assessment it has not been possible to define a noise study area as required by the DMRB, Volume 11, Section 3, Part 7. Traffic data in the form of AM, PM and Inter-peak Period (IP) was provided for the following scenarios and scheme options:

- 2023 (Opening Year) Do Minimum (DM);
- 2023 (Opening Year) Do Something (DS) Option 32; and
- 2023 (Opening Year) DS Option 37.

4.2.2 Using the available traffic data, a high level review of traffic changes brought on by the options was undertaken.

4.2.3 A study area 300m around the options has been adopted for a count of the number of Defra NIAs within the study area of the options.

4.2.4 The 300m boundary was split into banding zones at 0-50m; 50-100m; 100-200m; and 200-300m from the scheme's road centreline and counts of the number of potential noise sensitive receptors within the bandings for each option have been made. When detailed predicted traffic flows are available this study area may be extended to include the impacts due to changes in flow, speed or composition on other roads on the local network as appropriate.

4.2.5 The Environment Agency's open source data has been studied to identify any Defra NIAs in the vicinity of the scheme.

4.3 Existing Environment

4.3.1 Noise sensitive receptors are split into residential and non-residential receptors

according to the DMRB. A review of the baseline environment showed that the west bank area around the proposed bridge crossing has a relatively low number of residential properties whilst the east bank area is predominantly industrial.

4.3.2 Non-residential sensitive receptors include:

- Community services and centres on Alpha Road, Harry Miller Court and Pegotty Road;
- Public/village halls or other community facilities including the Kings Centre/MIND on Queen Annes Road;
- Educational establishments such as Great Yarmouth Day Centre on Suffolk Road;
- Parks including recreation grounds/playgrounds on Boundary Road, Suffolk Road and Pegotty Road; and
- Residential Institutions (such as care homes).

4.4 Brief Evaluation of Topic Related Constraints

Option Sensitive Receptor Counts

4.4.1 As an indication of the potential impact, receptor counts split into distance bands have been undertaken as receptors located closer to the scheme are expected to experience the highest adverse noise impact.

4.4.2 The number of receptors within each study area distance banding are presented in Table 4-1 and Table 4-2.

Table 4-1: Noise Sensitive Receptor Counts – Options 32 and 33

Distance Bands (m)	Number of Receptors per Distance Band				
	Dwelling	Health Facility	Education	Care Home	Community facility
0 to 50	32	0	0	0	0
50 to 100	53	0	1	0	0
100 to 200	158	0	1	1	6
200 to 300	410	0	1	0	0
Totals	653	0	3	1	6

Table 4-2: Noise Sensitive Receptor Counts - Option 37

Distance Bands (m)	Number of Receptors per Distance Band				
	Dwelling	Health Facility	Education	Care Home	Community facility
0 to 50	27	0	0	0	0
50 to 100	32	0	1	0	1
100 to 200	140	0	2	0	3
200 to 300	364	0	0	1	0
Totals	563	0	3	1	4

4.5 Noise Appraisal

4.5.1 During the operational phase, the crossing is expected to impact upon those receptors located closest to it. The three options have the potential to increase noise impacts at sensitive receptors and the closer the sensitive receptors are to the scheme the larger the likely impact.

4.5.2 Sensitive receptors could experience an increase in noise impact due to an increase in traffic flows, increase in percentage of heavy vehicles, increase in traffic speeds and changes in alignment which move vehicles closer to receptors.

4.5.3 For the purposes of this noise appraisal, the potential noise impacts of Options 32 and 33 are considered to be similar as they share the same centreline, albeit having a different number of running lanes. In view of this, the aforementioned traffic provided for Option 32 (paragraph 4.2.1) has therefore been used to assess Option 33.

4.5.4 The table above shows that there is a marginal difference in the number of potentially affected noise sensitive receptors based on proximity to the options alone where Options 32 and 33 come within a closer proximity to a higher number of receptors that Option 37. A high level evaluation of potential changes in noise levels as a result of altered traffic flow, speed and compositions brought on by the options has been undertaken, however this has only covered a limited study area (see paragraph 4.2.3) and should be revised once appropriate traffic data for the noise assessment is available.

Traffic flow comparison

4.5.5 The currently available traffic data predicts changes in AM, PM and IP peak hours total vehicle flows as a result of a proposed third river crossing in the anticipated year of the scheme opening 2023. The AM and PM flows have been summed and then assessed for change to gauge the likely changes in annual average weekday traffic which is the traffic flow descriptor used to assess road traffic noise.

4.5.6 The road links with potentially significant traffic changes for noise impact, based on

changes in traffic flow, speed or composition, were the same ones for all the options and are as follows:

- Significant increases in traffic flow are anticipated on William Adams Way between the A12 roundabout and the scheme tie in point at the Suffolk Road junction;
- There are also significant increases in traffic flow predicted on St Denes Road, again at the scheme tie in point on the eastern bank of the scheme; and
- Significant decreases in traffic flow are predicted to occur on Suffolk Road and Southtown Road.

4.5.7 The above changes are broadly similar across the options – 32, 33 and 37.

Defra Noise Important Areas

4.5.8 Defra NIAs are locations where the 1% of the population are affected by the highest noise levels from major roads according to the results of Defra's strategic noise maps.

4.5.9 There are no Defra NIAs within 600m of the scheme location. There are a number of NIAs within the wider area of Great Yarmouth at distances between 600m and further away from the scheme location which are associated with high levels of road traffic noise on the A12 and the A149 to the north. The closest is NIA number 4989 for which the noise making authority is Highways England.

Options Appraisal

4.5.10 An overall adverse impact is expected as sensitive because receptors close to the options are anticipated to experience an increase in noise impact as a result of increased traffic flows and new road alignments/widening. It is worth noting that the noise impact on the wider network is unknown.

4.5.11 One of the aims of the proposed third crossing of the River Yare is to relieve congestion on the wider Great Yarmouth road network. A reduction in traffic flows could result in decrease in noise impact on the existing network. However, any improvement scheme that relieves congestion could serve to attract additional traffic to the vicinity which could result in increases in noise and vibration.

4.5.12 Option 37 is marginally further away from sensitive receptors across all banding zones (see Table 4-2), therefore, this option could be expected to result in the lowest impact of the options proposed.

4.5.13 Confirmation of changes to traffic characteristics along the scheme and the wider road network would be required to inform a more in-depth assessment.

4.5.14 The level of uncertainty in this appraisal is considered high due to the methodology being primarily based on one parameter - a count of sensitive receptors.

5 Air Quality

5.1 Introduction

5.1.1 This chapter provides a review of the options associated with the proposed Great Yarmouth Third River Crossing. A high level environmental appraisal has been conducted in accordance with the WebTAG methodology for air quality.

5.1.2 The proposed Great Yarmouth third river crossing will change the physical arrangement of the local road network and therefore result in changes to vehicle flow volumes, composition, and speeds. As such, there is the potential for local and regional concentrations of air pollutants to be affected by changes in vehicle emissions associated with the scheme.

5.1.3 Emissions of oxides of nitrogen (NO_x), nitrogen dioxide (NO_2), and particulates with an aerodynamic diameter of 10µm or less (PM_{10}) and particulates with an aerodynamic diameter of 2.5µm or less ($PM_{2.5}$) from vehicle exhausts are of primary concern with respect to air pollution within urban areas of the UK.

5.1.4 The relevant national air quality standards and objectives for NO_2, $PM_{2.5}$ and PM_{10}, as prescribed through the Air Quality Strategy and most applicable for the appraisal of air quality, are presented in Table 5-1.

Table 5-1: Relevant National Air Quality Standards and Objectives

Pollutant	Averaging Period	Air Quality Standard		Objective Date
		Concentration	Allowance	
Nitrogen dioxide (NO_2)	1-Hour	200µg/m^3	18 exceedances per calendar year (*)	31/12/05 [1 2]
				01/01/10 [3 4]
	Annual	40µg/m^3	-	31/12/05 [1 2]
				01/01/10 [3 4]
Particulates (PM_{10})	24-Hour	50µg/m^3	35 exceedances per calendar year (**)	31/12/04 [1 2]
				01/01/05 [3 4]
	Annual	40µg/m^3	-	31/12/04 [1 2]
				01/01/05 [3 4]
Particulates ($PM_{2.5}$)	Annual	25µg/m^3	-	01/01/15 [4]

* Expressed as the 99.79th percentile of hourly mean concentrations
** Expressed as the 90.41st percentile of daily mean concentrations

1) Air Quality (England) Regulations 2000
2) Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 Vol 2
3) EU Directive 2008/50/EEC on ambient air quality and cleaner air for Europe
4) Air Quality Standards Regulations 2010

5.2 Appraisal Methodology

Local Air Quality Appraisal

5.2.1 TAG Unit A3[3] presents the methodology for assessing and valuing air pollution associated with the operation of the scheme.

5.2.2 The WebTAG appraisal methodology is based upon the screening of traffic data against the criteria for local and regional air quality as defined in the DMRB, Volume 11, Section 3.

5.2.3 To define the study area for the local air quality assessment, the following criteria apply:

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

5.2.4 To define the study area for the regional emissions assessment, the following criteria apply:

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

5.2.5 The screening of traffic data against the DMRB Local and Regional assessment criteria given above determines the Affected Road Network (ARN).

5.2.6 For this high level WebTAG appraisal exercise traffic data in a format comparable with the DMRB screening criteria were not available, instead, forecast model flows for the AM and PM peak and Inter-peak Period (IP) were provided for the following scenarios and scheme options:

- 2023 (Opening Year) DM;
- 2023 (Opening Year) DS Option 32; and
- 2023 (Opening Year) DS Option 37.

5.2.7 In view of the above, a WebTAG compliant appraisal has therefore not been possible

[3] The Department for Transport (2013 as amended 2016) *Transport Analysis Guidance: WebTAG Unit A3 Environmental Impact Appraisal*

with the traffic data available at this stage. In place of screening AADT traffic data against the DMRB screening criteria to determine where local air quality is likely to be impacted by the proposal, a comparison of the DM ('without scheme') and DS ('with scheme') traffic data has been made to determine if there is a predicted increase in traffic flows as a result of the options. It has not been possible to define the ARN based upon the available traffic data therefore a high level approach has been taken focussing on the road links that are part of each scheme option and those links that are situated in the immediate surrounding area of the scheme options. If this scheme progresses, it is recommended that a full WebTAG appraisal is conducted using appropriate traffic data.

5.2.8 Traffic data for Option 33 was not available, therefore Option 33 has been assessed based on the Option 32 traffic data as advised by a traffic specialist. The air quality impact is not expected to be significantly different between Option 32 and Option 33 based upon the similarity of the two designs. It is expected that should Option 33 be selected for the Full Business Case, that traffic data, specific to Option 33 would be provided for the air quality assessment and appraisal.

5.2.9 WebTAG requires that the number of sensitive properties within 200m of the ARN is calculated, however it has not been possible to define the ARN with the traffic data available. To enable a high level comparison of the options the number of potentially sensitive properties within 200m of each option design has been calculated and split within bands of 50m using detailed OS mapping and Address Base Plus data to enable a high level assessment of the potential for local air quality impacts resulting from the change in vehicle flows associated with the DS scenario. This has enabled a comparison of the potential for the options to impact on sensitive receptors. Sensitive receptors as defined in HA207/07 Section 11.3.1 for air quality, include:

- Residential dwellings;
- Designated ecological sites;
- Locations of the young and elderly (nurseries and care homes);
- Hospitals; and
- Schools.

Regional Air Quality Appraisal

5.2.10 For regional air quality, the key pollutant for appraisal purposes is NOx, which can be transported in the lower atmosphere over large distances, having the potential to contribute to regional air pollution through the formation of ozone. Carbon dioxide (CO_2), emissions can also be transported over large distances within the atmosphere and has a high atmospheric residence time, are considered within the greenhouse gases appraisal.

5.2.11 WebTAG requires that the potential implications for regional air quality, as a result of each option are assessed on the basis of screening traffic data for the DM and DS scenarios against the DMRB regional air quality criteria given in paragraph 5.2.2, to identify the number of road links predicted to experience an increase in traffic flows. In absence of traffic data that is suitable for DMRB Regional screening, a traffic comparison exercise has been conducted to identify the number of road links

predicted to experience an increase or decrease in traffic. A high level assessment of potential regional air quality impacts related to traffic emissions as a result of the scheme options has been undertaken for the purposes of the OBC based upon increase and decrease in traffic flows.

Future Modelling

5.2.12 The above approach to appraising air quality represents an initial, high-level qualitative review of potential air quality impacts associated with the scheme options. The FBC will include a detailed air quality modelling study, which will enable a comprehensive assessment of local and regional air quality impacts and air pollution valuation to be completed, in accordance with DMRB HA207/07 and WebTAG Unit A3.

5.2.13 The FBC WebTAG appraisal will consider the scheme Opening Year (2023) and Design Year which is 15 years after opening (2038).

Baseline Review

5.2.14 A desk study was undertaken to inform the appraisal of options developed for the OBC. The desk study comprised a review of baseline air quality at the location of the scheme and the surrounding area.

5.2.15 This section provides a brief review of local air quality associated with the scheme location and surrounding area and within the context of relevant national air quality standards and objectives.

5.2.16 The following data and information were used to inform the baseline review of air quality:

- Presence of AQMAs within Great Yarmouth Borough – designated as locations where a national Air Quality Strategy Objective(s) is not being and / or not likely to be achieved;
- Defra's local air quality background data for the 1 x 1km^2 grids covering the scheme and surrounding area[4];
- Identification of Defra Pollution Climate Mapping (PCM) model links within study area. PCM links are roads that are included in the Defra model used in conjunction with measured concentrations from Defra's national monitoring network to provide an air quality assessment that is reported to the European Commission in accordance with European Directives;
- Presence of ecologically designated sites (Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar, and SSSIs) that could be affected by NO_x within 1km of the scheme's location; and
- Local Authority air quality monitoring data as contained within the Great Yarmouth Borough Council's local air quality review and assessment reports

[4] Defra (2015) Air Pollution Background Maps [online] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html as accessed on the 14/10/16.

provided by the Environmental Health Officer for Great Yarmouth Borough Council.

5.3 Existing Environment

Air Quality Management Areas

5.3.1 Great Yarmouth Borough Council does not have any AQMAs[5]. This is an indication that the baseline air pollutant levels within Great Yarmouth Borough and in proximity to the scheme location are not likely to be exceeding the respective national air quality objective concentrations in Table 5-1.

Designated Sites Sensitive to NO_x

5.3.2 DMRB HA207/07 states that statutory designated conservation sites may be sensitive to NOx and nitrogen deposition, which can have direct and indirect impacts upon vegetation, affecting species composition and ecosystem health.

5.3.3 The Defra Multi Agency Geographical Information System for the Countryside (MAGIC) website[6] was used to identify statutory designated ecological sites such as SSSIs, SACs, SPAs and Ramsar sites in the vicinity of the scheme. In accordance with DMRB HA207/07, designated ecological sites within 200m of the ARN should be assessed with respect to changes in air quality. As the ARN could not be defined at this stage a search for designated sites situated within 200m of the scheme options has been completed. There are no designated sites which fall under the definition prescribed by DMRB HA207/07, which may be affected by NO_x emissions as a result of any of the options.

Air Quality Monitoring in Great Yarmouth Borough

5.3.4 Great Yarmouth Borough Council undertakes ambient monitoring of NO_2 across the borough through the operation of a continuous chemiluminescent monitoring station at Gorleston and passive NO_2 diffusion tubes across 11 sites.

5.3.5 There are four NO_2 diffusion tubes within 500m of the scheme. The results from these diffusion tubes, as reported in the 2016 Air Quality Annual Status Report, are presented in Table 5-2.

[5] Department for Environment, Food and Rural Affairs (Defra) (2015) Air Quality Management Areas [online] http://uk-air.defra.gov.uk/aqma/ as accessed on the 14/03/17.

[6] Defra (2016) MAGIC Geographic Information about the Natural Environment from across Government [online] http://magic.defra.gov.uk/ as accessed on 14/10/16.

Table 5-2: Great Yarmouth Borough Nitrogen Dioxide Diffusion Tube Monitoring

Site ID	Location	OS Grid Reference		Annual Mean NO_2 Concentration (µg/m^3)				
		X	Y	2011	2012	2013	2014	2015
DT7	41 Southgates Rd	652611	306223	24.3	23.8	20.8	22.9	20.9
DT8a	Maltings House (1)	652492	305612	20.3	18.5	18.2	17.8	16.0
DT8b	Maltings House (2)	652492	305612	19.9	18.3	14.3	16.9	16.3
DT8c	Maltings House (3)	652492	305612	19.5	17.8	17.2	15.4	15.7
NO_2 Annual Mean Objective				**40µg/m^3**				

5.3.6 The results demonstrate that there were no exceedances of the national objective for NO_2 since 2011 at the aforementioned NO_2 diffusion tube monitoring sites. This further establishes that levels of NO_2 remained fairly stable over this period. The diffusion tube sites at Maltings House are co-located with the Gorleston continuous monitoring station.

5.3.7 The continuous monitoring station is positioned at Maltings House, Malthouse Lane, Gorleston, Great Yarmouth and is classified as an urban background monitoring location. This location is situated approximately 340m to the south of the options.

5.3.8 Annual mean NO_2 data from 2011 to 2015 taken from the continuous monitoring station location is presented in Table 5-3, and this was sourced from the 2016 Air Quality Annual Status Report[7].

Table 5-3: Great Yarmouth Borough Council Nitrogen Dioxide Continuous Monitoring

Site ID	Location	Type	OS Grid Reference		Annual Mean NO_2 Concentration (µg/m^3)				
			X	Y	2011	2012	2013	2014	2015
CM1	Gorleston	Urban BKG	652492	305612	20.0	18.8	18.2	17.1	16.8
NO_2 Annual Mean Objective					**40 µg/m^3**				

5.3.9 The results presented in Table 5-3 indicate that exceedance of the annual mean NO_2 objective has not been recorded at the continuous monitoring station between 2011 and 2015.

5.3.10 At present, $PM_{2.5}$ particulate monitoring is not undertaken by Great Yarmouth Borough Council. However, the council is considering the following measures to address $PM_{2.5}$:

- Reviewing current air quality monitoring arrangements and assessing feasibility to sample ambient atmospheric concentrations of $PM_{2.5}$ within the borough by the 2017-18 financial year;

[7] Great Yarmouth Borough Council (2016) *2016 Air Quality Annual Status Report for Great Yarmouth Borough Council.*

- Working through the Norfolk Environmental Protection Group's (NEPG) Air Quality Sub-Group to ensure regular two-way engagement with representatives of Public Health England, and the Director of Public Health at Norfolk County Council; and

- Dialogue with Officers of Norfolk County Council Highways, and through the NEPG Air Quality Sub-Group on proposed significant changes to highways and traffic flows in the borough, and also considers potential improvements to $PM_{2.5}$ exposure during this dialogue.

Background Pollutant Concentrations

5.3.11 The background pollutant concentrations for NOx, NO_2, PM_{10} and $PM_{2.5}$ are published on Defra's UK website for every 1km x 1km grid square covering the UK. The background estimates are available throughout the UK for years between 2010 and 2030. The relevant background concentrations which encompasses the scheme location for years 2015 to 2017 are presented in Table 5-4.

Table 5-4: Defra Background Mapped NO2, NOx, PM10 and PM2.5 Concentrations Per Grid Square Covering the Scheme Location – 2015 to 2017

Pollutant	Objective Value (annual average concentration µg/m^3)	X	Y	2015 (µg/m3)	2016 (µg/m3)	2017 (µg/m3)
NO_x	30*	651500	306500	19.0	18.2	17.4
NO_2	40			13.6	13.1	12.6
PM_{10}	40			15.4	15.3	15.1
$PM_{2.5}$	25			10.9	10.8	10.7
NO_x	30*	652500	306500	22.7	21.8	20.8
NO_2	40			15.9	15.3	14.7
PM_{10}	40			15.5	15.3	15.2
$PM_{2.5}$	25			11.2	11.1	10.9
NO_x	30*	653500	306500	16.7	16.1	15.5
NO_2	40			12.1	11.7	11.3
PM_{10}	40			13.9	13.8	13.7
$PM_{2.5}$	25			10.1	10.0	9.9
NO_x	30*	651500	305500	19.1	18.3	17.6
NO_2	40			13.6	13.1	12.6
PM_{10}	40			15.0	14.9	14.7
$PM_{2.5}$	25			10.8	10.7	10.5
NO_x	30*	652500	305500	24.7	23.7	22.6
NO_2	40			17.1	16.4	15.8
PM_{10}	40			16.1	15.8	15.5
$PM_{2.5}$	25			11.6	11.4	11.2
NO_x	30*	653500	305500	16.5	15.9	15.2
NO_2	40			11.9	11.5	11.1
PM_{10}	40			14.0	13.8	13.7
$PM_{2.5}$	25			10.1	10.0	9.9

** All background concentrations were obtained from the latest 2013 based background maps. The values are rounded to 1 decimal place.*

5.3.12 The highest background NO_2 concentration between 2015 and 2017 (17.1µg/m³) covers the area of the A12, the A143 / B1370 Church Road roundabout and several other minor roads in close proximity to Fisherman's Wharf in 2015. All background concentrations of NO_2, PM_{10} and $PM_{2.5}$ recorded in this period are below the relevant annual mean objectives.

Pollution Climate Mapping Links

5.3.13 PCM modelling is undertaken by Defra to produce 1km x 1km background pollutant concentrations, such as those presented in Table 5-4 above, in addition to producing approximately 9,000 representative roadside pollutant concentrations based on a national network of road-link specific emissions.

5.3.14 These modelled data are used to fulfil part of the UK's commitment to the requirements of EU Directive (2008/50/EC)[8] to report on the concentrations of particular pollutants in the atmosphere, which includes NO_x, NO_2, and PM_{10}.

5.3.15 The PCM road links located within 200m of the scheme's location, for which a roadside pollutant concentrations are produced by PCM modelling, were identified. The respective modelled roadside NO_2 concentrations for the years 2013, 2015, 2020, 2025 and 2030 are provided in Table 5-5.

Table 5-5: PCM Links within 200m of each Option

Road Name / Number	Census ID	PCM Roadside NO_2 (µg/m³)				
		2013	*2015	2020	2025	2030
A12	29011	32.0	29.4	23.0	19.0	18.0

**2015 concentrations were obtained by linear interpolation based on the change between year 2013 and year 2020 PCM Roadside NO2 concentrations.*

5.3.16 The PCM modelled roadside NO_2 data for all links identified within 200m of the scheme showed that the 40µg/m³ annual mean objective is not predicted to be exceeded by 2030.

5.4 Local Air Quality Appraisal

5.4.1 Total traffic flows for the AM and PM peak periods and for the Inter Peak (IP) period were provided for the opening year (2023) DM and DS scenarios for each option and associated study area were provided by a traffic specialist. With the traffic data available at this stage a comparison exercise was completed to identify the links experiencing an increase or decrease in flows per option. The results of this analysis for each option are given in Table 5-6.

[8] The European Parliament and the Council of the European Union (2008) *Ambient Air Quality Directive (2008/50/EC)*

Table 5-6: Number of Road Links with an Increase or Decrease in Flow (2023 Do Something versus Do Minimum)

Flow change	Option 32	Option 33	Option 37
	No. links	No. links	No. links
Increase	21	21	19
Decrease	16	16	18
New Road Links	2	2	2
Total Links	39	39	39

5.4.2 WebTAG requires that the number of potentially sensitive receptors within 200m of the ARN are calculated. In the absence of a defined ARN, the number of potentially sensitive receptors within 200m of each option was obtained using OS Address Base Plus data. The results of these analyses for each option are presented in Table 5-7.

Table 5-7: Number of Sensitive Receptors within 200m of Each Option

Distance bands (m)	Number of Properties per Distance Band	
	Options 32 and 33	Option 37
0 to 50	32	27
50 to 100	54	34
100 to 200	166	145
Total	252	206

5.4.3 The address data review indicates that Options 32 and 33 have a greater number of potentially sensitive receptors situated within 200m of their design footprint than Option 37.

5.4.4 The traffic data comparison and review indicates that Options 32 and 33 have the greatest number of key links – Table 5-6 (the scheme and roads immediately surrounding the scheme), for which traffic data has been provided by a traffic specialist, experiencing an increase in traffic flow based upon combined AM, IP and PM flow data.

5.4.5 As the scheme is to build an additional bridge over the River Yare, it is likely that the traffic would reduce on the existing road links around the existing bridge. In view of this and the absence of an AQMA in the vicinity of the scheme, an overall neutral local air quality impact is considered most likely for each option.

5.4.6 Nevertheless, further detailed air quality dispersion modelling using Atmospheric Dispersal Modelling Software (ADMS) ADMS-Roads is required to predict the magnitude of local air quality impact relating to each scheme, which will take account of other key variables such as link speed, HDV percentage, and meteorology.

5.5 Regional Air Quality Appraisal

5.5.1 The review of 2023 DM and DS traffic data for the options is presented in Table 5-6, showing the number of links predicted to experience an increase or decrease traffic

flows (combined AM, PM and IP flows).

5.5.2 As the scheme is to provide an additional passing bridge over the River Yare, it is likely that the total vehicle mileage travelled will be reduced and there regional emissions reduced. However, in the absence of AADT traffic data, a conclusion as to the number of links expected to experience a change in excess of the DMRB AADT criterion could not be made. Based upon the period flow data available, and taking into account the expected improvements in traffic congestion as a result of the scheme an overall beneficial impact in emissions is considered most likely for each option. It should be noted that the scores provided are based on traffic data for the AM, PM and Inter-Peak periods only and not 24hr AADT traffic data, therefore the scores may be subject to change when the quantitative assessment is completed.

6 Townscape

6.1 Introduction

6.1.1 The following sections provide an appraisal of potential townscape effects relating to the proposed third crossing of the River Yare at Great Yarmouth. The appraisal describes and evaluates the townscape resource of the study area, reports on the potential changes as a result of the different options under consideration and makes an informed prediction of the likely effects.

6.2 Appraisal Methodology

6.2.1 A desk study has been undertaken to inform the appraisal of the options developed for the OBC. This desk study has included a review of designated and non-designated sites from the sources identified below:

- OS mapping and a site walk-over to identify the location of visual receptors;
- Information from the Local Planning Authority regarding townscape appraisals, conservation area appraisals and local plan policies relating to townscape; and
- The location and nature of any significant planned development in the area.

6.2.2 The study area for the townscape appraisal has been driven by the geographical scope of the options developed for the OBC. An initial walk-over survey by an appropriately qualified and experienced landscape architect has been undertaken to inform the appraisal and the extent to which the options may influence the perception of townscape within Great Yarmouth and its immediate environs.

6.2.3 The proposed bridge, being an animated structure will enact varying degrees of visibility and accordingly townscape influence. When closed its potential for influence is limited by the river corridor environs and the immediate local urban context surrounding the scheme. When open however, the bridge will be a temporary but much more visible component of townscape; in this regard the study area has considered the wider townscape setting of Great Yarmouth, from Gorleston-on-Sea at the mouth of the Yare and north to the historic townscape frontages of South Quay, the Haven Bridge and as a backdrop to the Broads National Park on the north and west fringes of the town.

6.2.4 The appraisal has followed the process described in TAG Unit A3 Chapters 5 and 7. The methodology for appraising the impact on the townscape follows the five step general approach to appraising ‘environmental capital’:

- Step 1: Scoping and identification of study area (as set out above);
- Step 2: The identification of the key townscape environmental resources and describing their features. In order to accurately assess the character of the key townscape environmental resources, it was necessary to identify and describe the features of the townscape as per the guidance set out in TAG Unit A3 Chapter 7. Therefore the townscape features have been described in terms of their layout, density and mix, scale, appearance, human interaction,

cultural and land use to allow a summary of the townscape character to be developed;

- Step 3: The townscape appraisal has been undertaken against the following set of indicators to establish the significance of each key townscape resource: scale it matters, rarity, importance substitutability, and baseline changes;
- Step 4: An impact assessment has been undertaken of the options under consideration for the OBC on the significance of the townscape. All impacts on the townscape, both adverse (damaging) and beneficial (enhancing) have been identified along with their predicted magnitude. The appraisal process has addressed how the options could impact on and change:
    - The character of key townscape environmental resources, such as effects on the locally distinctive pattern of townscape features;
    - The ambience of an urban area and the way people interact with the key townscape environmental resource; and
    - The tolerance of the key townscape environmental resource to accommodate further change.
- Step 5: The townscape effects on the townscape have been summarised from the Townscape Appraisal Worksheets (see Section 6.5) for inclusion in the ASTs for the options. These are based on the seven point scale for scoring of effects in line with the guidance set out in TAG Unit A3 Chapter 7.

6.2.5 The appraisal has adopted the following design assumptions for each of the alternatives as presented:

- The long term development and regeneration aspirations for the River Yare and its environs in accordance with the Great Yarmouth Waterfront Area Action Plan;
- A bascule bridge form, with opening spans rising to a vertical height of 31.5m above its closed elevation;
- The incorporation of appropriate landscape mitigation and planting provision in relation to new road infrastructure; and
- The narrowing of the river width to accommodate the bridge may allow the scope for environmental enhancement measures, however this has not informed the comparison of the options.

6.3 Existing Environment

6.3.1 Great Yarmouth, situated at the mouth of the River Yare on Norfolk's east coast, has a varied townscape quality arising from its maritime history, its Victorian expansion as a holiday destination and in latter times its continued evolution as a recreational and tourism focus.

6.3.2 The historic and retail core of the town is centred on a broad and linear marketplace, a mixture of intact historic street pattern intervened by larger scale retail development. A fine grain of interconnecting residential street pattern surrounds this core, linking with the more formal Victorian parades and open green spaces along the seafront, for which Great Yarmouth is most familiarly identified. Within the scheme area, there are four Conservation Areas.

6.3.3 The River Yare is an integral aspect of Great Yarmouth's townscape, its course defining the western edge of the promontory on which the main town is situated. It

provides a point of passage and haven for private and commercial craft between the inland waterway network of the Broads and the coastal waters of the North Sea. The river townscape is largely industrial but with areas of recognised high quality and appealing quayside frontage along South Quay near the existing bridge crossings. The river defines a sense of arrival, with open prospects along the river corridor and in particular from the South Quay, Haven Bridge and towards the river mouth at Gorleston–on-Sea.

6.3.4 In the vicinity of the scheme, the river townscape is a fragmented mix of residential and port-related development. Residential terraces define a largely continuous frontage along the western riverside, with the eastern margin flanked by warehouses, storage yards and larger, maritime related infrastructure. The overriding character is of a locally maritime and generally unremarkable townscape quality, with little in the way of townscape definition beyond the immediate confine of the river itself.

6.3.5 Despite the mixed townscape quality there is a sense of movement and passage throughout the river corridor, where larger vessels moor along the urban quaysides and animate the river setting with a sense of dynamic, temporary change of aspect. The existing lift bridges form a part of this animation and of river character. The temporary visibility of lift bridges, set above and against the residential and industrial skyline is an aspect of the town's character.

6.3.6 West of the River Yare, residential and retail development define a generally unremarkable hinterland townscape. Development is low rise and of medium density, interspersed by pockets of open land. Southtown Common Recreation Ground and adjoining allotments provide an established vegetation buffer and a well-used facility between neighbouring residential areas and the A12 road corridor.

6.3.7 The broad expanse of the Norfolk landscape is evident immediately beyond the developed fringes of Great Yarmouth. The Norfolk Broads National Park borders the town to its west and north, an exposed river, estuary and wetland landscape with often far reaching views. The low skyline of Great Yarmouth and its exposed industrial edge forms a backdrop to Breydon Water, with the National Park boundary extending to the confluence of the Rivers Yare and Bure at the very edge of the town.

6.4 Brief Evaluation of Topic Related Constraints

6.4.1 The Broads National Park, bordering Great Yarmouth to its immediate north and west is influenced by the low skyline and industrial fringe of the town. Changes to townscape setting, in particular to the skyline of the town may have the potential to influence the perception of landscape from within the Park. The river is also a point of passage to and from the inland waterway network, and so as a gateway becomes an indirect part of visitor experience.

6.4.2 There are no other designations that relate directly to townscape in the immediate area of the scheme. The river corridor does however contribute to setting and there are open vistas along the river corridor, from existing bridging points and from areas of more established, historic townscape character. The bridge crossing will be a visible structure with the potential to add or detract from both local townscape and that of the wider river context.

6.4.3 Public open green space provision in the vicinity of the scheme is well screened from surrounding development. There is a potential for significant effect on its setting as a

consequence of any loss of established boundary vegetation.

6.4.4 The dynamic form of a bascule bridge means that when open, the structure has the potential to be a much more influential aspect of townscape form, albeit temporarily. This nature of change and its potential influence is considered in the appraisal of options.

6.5 Townscape Appraisal - WebTAG Worksheets

6.5.1 For each of the options assessed, the following reference sources have been utilised:

- Great Yarmouth Core Strategy 2013 - 2030 (Great Yarmouth Borough Council Local Development Framework (LDF))
- Great Yarmouth Waterfront Area Action Plan (LDF)
- Great Yarmouth Borough Landscape Character Assessment (April 2008)

Option 32 - Townscape Worksheet

Option 32 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
Layout	The town layout is heavily influenced by the Rivers Yare and Bure, which define the promontory upon which Great Yarmouth is sited. Between seafront and river, the historic and retail core of the town is centred on a broad and linear marketplace, a mixture of intact historic street pattern intervened by larger scale retail development. A fine grain of interconnecting residential street pattern surrounds this core, linking with the more formal parades and open green spaces of the seafront. Townscape layout is heavily fragmented where residential areas abut with the coarser grained, working quayside environments alongside both sides of the River Yare. Beyond the river to the west, the hinterland of Great Yarmouth is comprised largely of residential streets and estates interspersed with open green space, encompassing the A12 road corridor and extending south to the seaside town of Gorleston-on-Sea at the mouth of the Yare. The expanse of Harfreys Industrial Estate, in the immediate vicinity of scheme at Southtown, is a noticeable interruption of this otherwise residential framework, beyond which the horizontal expanse of the fen landscape frames the town.	The townscape layout in the vicinity of the proposed crossing, both east and west of the River Yare, matters at a local scale.	Conservation Areas (CA) to the north (town centre areas and seafront) would suggest local rarity. The river itself is a formative feature of the town. Local to the scheme location, layout has no rarity value.	The town centre areas defined by the CA and the historic seafront townscape layout is of high importance at a local level. The river corridor setting is of moderate importance at a local level, where established historic frontages face toward the Bure.	The seafront and river context are not readily substitutable. Townscape layout elsewhere is substitutable.	Townscape Layout would not substantially alter.	**Neutral** The local townscape pattern would not substantially alter as a consequence of the change of road layout.
Density and mix	The River Yare corridor is largely industrial in character, though set alongside areas of terraced residential frontage and, to the north of the proposed bridge crossing a more defined historic quayside of greater density. The retail core of the town is of small and medium density development, with recreational facilities focused along the sea front and along several linking routes into the town. Around this core is largely residential land use of a consistent, moderate property density.	Composition and distribution within the townscape matters at a local scale.	The CA would suggest local rarity in respect of the seafront context and buildings fronting the Bure to the south. No perceived rarity elsewhere.	The density and composition of the seafront townscape and that of the River Yare corridor matters at a local level.	Density and mix are substitutable.	Density and mix of townscape would not substantially change or differ.	**Neutral** The density and mix of development will not substantially differ.
Scale	The vertical scale of townscape across Great Yarmouth is broadly low and consistent, the area being of a flat topography with no particular dominance of built development occupying its skyline. The sea front forms a prominent vista, with 3-4 storey buildings flanking the main promenade. The retail core has some massing of larger scale development, but aside of this the residential and retail scale of the town is predominantly low rise. The River Yare is of a broad horizontal scale with key vistas along its course, these being evident from the approaches to the town and across its bridging points. It is a key contextual reference to the town, its bridges being of prominence locally and the river providing a sense of place and scale in positioning the town within the exposed, wider landscape context. Structures associated with the industrial quayside are of a prominent scale locally.	The scale of the local townscape matters at a local level.	The scale of the River Yare through the urban fabric of Lowestoft has a rarity value, although expansive inland waterspace is a feature of the nearby rural Broads landscape.	The scale of the river corridor is of local importance, being a visible and defining feature. The seafront townscape is important at a local level in respect of identity.	The scale of the townscape is substitutable.	The scale of townscape in vicinity of the scheme would significantly change in a without scheme case.	**Neutral** The bascule bridge would be in scale with the river environment. It would however alter townscape scale temporarily at a local level when opened, although not out of context with the setting and in character with other bridges locally.
Appearance	The town has a mix of architectural styles. The seafront has an established and regular townscape appearance where 3 and 4 storey Victorian terraces and civic buildings flank the promenade. Other more recent modifications and recreational developments along the promenade and along main streets into the town are of mixed quality, some of which impact negatively on townscape appearance. The quayside frontages of South Quay alongside the River Yare have a well-defined, intact townscape form. However the majority of the river corridor through the town is industrial by nature and generally of low quality appearance. While the river setting is contained, the larger storage towers and warehouses alongside the river corridor are visible elements of the townscape.	The appearance of the river townscape matters at a local scale.	The appearance of the buildings and structures that surround the River Yare in the vicinity of the scheme are unremarkable. CA elsewhere in the town would suggest a recognised level of rarity.	The appearance of the seafront townscape and its architecture is important at a local level in terms of identity. The river corridor has limited importance in appearance.	The townscape appearance is substitutable. The potential for townscape change in and around the river setting is high.	The likely nature of townscape change and its influence on the setting would not substantially differ.	**Neutral** The introduction of a new road bridge across the river would not significantly alter the appearance of the setting. It would be in keeping with the appearance of the urban river corridor, although would interrupt existing views along the River Yare from vantage points such as The Haven Bridge & South Quay.

Option 32 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
	Residential development is generally unremarkable and townscape value quickly diminishes beyond the town core.						Views along the river corridor and of the bridge in an open position would highlight the location within the townscape temporarily.
Human interaction	Great Yarmouth's seafront promenade and its town core are the main areas of focus for social activity and interaction. Outside of these areas the townscape is predominantly residential, reflecting typical levels of associated social activity and function. In the vicinity of the scheme there is a mix of well used open green space and allotments. Interaction along the River Yare is limited to areas of historic and intact frontage, at South Quay in the town and further south towards Gorleston-on-Sea. Elsewhere along the urban river corridor, the over-riding industrial context offers little in the way of interaction.	The scale of human interaction matters mainly at a local level. The town centre, seafront provide the most interaction, with little interaction in the vicinity of the scheme.	The context of the River Yare and immediate setting in respect of interaction matters at a local scale with no inherent rarity.	The current river townscape in the vicinity of the scheme has a low importance in respect of interaction.	The nature of interaction is substitutable.	No change.	**Slight Beneficial** Improved access for pedestrians/cyclists would improve interaction. There would be some loss of interaction in the immediate community through loss of residential property and allotment space. The provision of the bridge crossing would potentially alleviate pressures on the Haven and Breydon Bridge locations to the north, allowing greater interaction benefits for this area of locally important townscape.
Cultural	Great Yarmouth's history as a fishing town and subsequently its development as a seaside resort is reflected by its townscape and architecture. The Victorian seafront and its recreation focus is a characteristic aspect of the town, which to a large degree creates a cultural identity. Within the town there are specific buildings and architectural frontages that reference the town's maritime heritage, with a sense of cultural time depth and isolated townscape quality. The River Yare is closely linked with the cultural character of the town, integral to its townscape and from its past and ongoing maritime use.	The river and its formative role in the townscape evolution matter at a local scale.	Rarity in the river townscape is limited to those areas of intact historic frontage, north and south of the proposed bridging point.	The association of Yarmouth as a seaside destination, and point of passage to inland waterways are important cultural aspects of the town, its townscape elements derived from this cultural baseline.	The cultural heritage of townscape features is not substitutable. Cultural change by its essence is ongoing and will modify townscape.	Cultural change would not differ in a without-scheme scenario.	**Neutral** The scheme would introduce a new built feature into the river corridor townscape, visible temporarily as a landmark/reference and potentially changing cultural perception of the location.
Land use	The town core and seafront comprises a mix of retail and commercial land use, with the town relying heavily on leisure as a focus. The urban river corridor comprises a mixture of predominantly maritime and industrial activity. Outside of these areas, land use is predominantly residential with linked facilities. Light industry is focused largely within a single industrial estate, to the western fringe of the town.	The associated function of the river in terms of its passage for leisure and commercial craft matters at a local level.	The land use in the immediate vicinity of the river corridor has no rarity value.	Land use and the resulting townscape elements matter at a local level.	Land use is substitutable. However the river as a physical form is not easily substitutable.	The nature of land use change in the vicinity of the river corridor would not substantially alter.	**Neutral** There would be no significant change of land use as a result of the scheme.
Summary of character	The townscape of Great Yarmouth is defined by the historic and contemporary seafront context of the town; the promontory of land on which Great Yarmouth is historically sited and which has a mixed townscape quality (the older, more intact historic townscape in contrast to surrounding residential development); the division and maritime corridor created by the River Yare and its mix of historic frontage and maritime industrial townscape; the developed hinterland of Great Yarmouth, west of the River Yare and surrounding the A12 link road and the town's relative exposure as a settlement within the wider fen landscape. In the vicinity of the scheme, townscape character is a fragmented mix of residential and industrial development. Alongside the river corridor, residential terraces define a largely continuous frontage along the western river edge, whereas the eastern margin is flanked by low warehouses, storage yards and larger, maritime related infrastructure. The overriding character is locally	Scale matters at a predominantly local level, with CA designations emphasising the significance of the relative scale of the seafront townscape.	The CA would suggest local rarity in respect of the seafront context. No perceived rarity of townscape in the vicinity of the scheme.	The appearance of the seafront townscape and its architecture is important at a local level in terms of identity. The existing river character is of no importance in the vicinity of the scheme.	The majority of the townscape surrounding the river corridor is substitutable, although the character of the town centre and seafront not readily so.	The townscape evolution around the River Yare in the area of the scheme would not significantly change in a without-scheme case.	**Neutral** The introduction of the bridge would not significantly alter the townscape character within Great Yarmouth. However the bridge form would serve temporarily as a visual reference and landmark, heightening a sense of townscape animation along the river corridor. The scheme would alleviate vehicular congestion, benefiting more established and valued

Option 32 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
	maritime but of a poor townscape quality, with little in the way of townscape definition beyond the immediate confine of the river itself.						townscape areas of the town.

Option 32 Summary Appraisal (including Assessment Score)

6.5.2 The road infrastructure changes to provide access to the bridge crossing would cause the loss of some existing residential townscape and associated allotment resource. However the area does not have a particularly strong or defined townscape value and the layout of the new roundabout and bridge approaches would not represent any material disruption of the nearby Southtown Common Recreation Ground and its established boundaries. Alleviation of vehicular pressure on the Haven and Breydon bridge crossings to the north may potentially improve human interaction potential in this locally more important area of townscape.

6.5.3 The bascule bridge crossing would be in context with the urban nature of the river corridor, and would not (other than when open) have any major influence on townscape. Existing vistas along the river corridor may be interrupted or fore-shortened by the structure, although the bridge would not appear out of context in terms of how these views are perceived.

6.5.4 The opening of the bridge, estimated at a frequency of 10-20 times daily would temporarily transform the bridge and its visible influence on townscape. When open, the bridge spans would rise to a vertical height of 31.5m above its closed elevation (at 6.9m above the existing quaysides), this would represent a prominent feature in the context of the river corridor and an influence on the wider townscape. The nature of the bridge opening would be similar (though of greater span and height) to other bridges along the river, in that it would represent a dynamic change of townscape but also a potential point of reference, in context with the wider animation of the active urban river space. Overall there would be no direct loss of any perceived rare or important townscape quality, although the bridge may become a skyline feature to views along the river corridor.

6.5.5 The height of the fully open bridge structure would be an evident, but distant feature of the Great Yarmouth skyline from within the Broads National Park. It would be perceived in the context of the town as an existing developed and in part industrial backdrop to the Park setting.

6.5.6 In summary, the majority of impacts are predicted on balance to have a neutral effect on an area of locally unremarkable townscape quality, although it is observed that the introduction of a third bridge crossing would have a beneficial effect on human interaction (non-motorised users) by way of improved townscape linkages. The bridge would interrupt the existing open aspect of the river corridor and appear as an aspect of townscape from quayside locations to the north and south. The bridge in its temporary open position would be an evident feature of Great Yarmouth's contextual townscape as a skyline feature, although this would not fundamentally change the associated character of the river corridor nor how the town is perceived in context with its surrounding landscape.

Summary Assessment Score: **Neutral**

Option 33 – Townscape Worksheet

Option 33 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
Layout	The town layout is heavily influenced by the Rivers Yare and Bure, which define the promontory upon which Great Yarmouth is sited. Between seafront and river, the historic and retail core of the town is centred on a broad and linear marketplace, a mixture of intact historic street pattern intervened by larger scale retail development. A fine grain of interconnecting residential street pattern surrounds this core, linking with the more formal parades and open green spaces of the seafront. Townscape layout is heavily fragmented where residential areas abut with the coarser grained, working quayside environments alongside both sides of the River Yare. Beyond the river to the west, the hinterland of Great Yarmouth is comprised largely of residential streets and estates interspersed with open green space, encompassing the A12 road corridor and extending south to the seaside town of Gorleston-on-Sea at the mouth of the River Yare. The expanse of Harfreys Industrial Estate, in the immediate vicinity of the scheme at Southtown, is a noticeable interruption of this otherwise residential framework, beyond which the horizontal expanse of the Broads landscape frames the town.	The townscape layout in the vicinity of the scheme, both east and west of the River Yare, matters at a local scale.	Conservation Areas to the north (town centre areas and seafront) would suggest local rarity. The river itself is a formative feature of the town. Local to the scheme location, layout has no rarity value.	The town centre areas defined by the CA and the historic seafront townscape layout is of high importance at a local level. The river corridor setting is of moderate importance at a local level, where established historic frontages face toward the Bure.	The seafront and river context are not readily substitutable. Townscape layout elsewhere is substitutable.	Townscape Layout would not substantially alter.	**Neutral** The local townscape pattern would not substantially alter as a consequence of the change of road layout.
Density and mix	The River Yare corridor is largely industrial in character, though set alongside areas of terraced residential frontage and, to the north of the scheme a more defined historic quayside of greater density. The retail core of the town is of small and medium density development, with recreational facilities focused along the sea front and along several linking routes into the town. Around this core is largely residential land use of a consistent, moderate property density.	Composition and distribution within the townscape matters at a local scale.	The CA would suggest local rarity in respect of the seafront context and in buildings fronting the Bure to the south. No perceived rarity elsewhere.	The density and composition of the seafront townscape and that of the River Yare corridor matters at a local level.	Density and mix are substitutable.	Density and mix of townscape would not substantially change or differ.	**Neutral** The density and mix of development will not substantially differ.
Scale	The vertical scale of townscape across Great Yarmouth is broadly low and consistent, the area being of a flat topography with no particular dominance of built development occupying its skyline. The sea front forms a prominent vista, with 3-4 storey buildings flanking the main promenade. The retail core has some massing of larger scale development, but aside of this the residential and retail scale of the town is predominantly low rise. The River Yare is of a broad horizontal scale with key vistas along its course, these being evident from the approaches to the town and across its bridging points. It is a key contextual reference to the town, its bridges being of prominence locally and the river providing a sense of place and scale in positioning the town within the exposed, wider landscape context. Structures associated with the industrial quayside are of a prominent scale locally.	The scale of the local townscape matters at a local level.	The scale of the River Yare through the urban fabric of Lowestoft has a rarity value, although expansive inland waterspace is a feature of the nearby rural Broads landscape. The overall scale of the seafront townscape is relatively scarce within the regional coastal landscape.	The scale of the river corridor is of local importance, being a visible and defining feature. The seafront townscape is important at a local level in respect of identity.	The scale of the townscape is substitutable.	The scale of townscape in the vicinity of the scheme would significantly change in a without scheme case.	**Neutral** The bascule bridge would be in scale with the river environment. It would however alter townscape scale temporarily at a local level when opened, although not out of context with the setting and in character with other bridges locally.
Appearance	The town has a mix of architectural styles. The seafront has an established and regular townscape appearance where 3 and 4 storey Victorian terraces and civic buildings flank the promenade. Other more recent modifications and recreational developments along the promenade and along main streets into the town are of mixed quality, some of which impact negatively on townscape appearance. The quayside frontages of South Quay alongside the River Yare have a well-defined, intact townscape form. However the majority of the river corridor through the town is industrial by nature and generally of low quality	The appearance of the river townscape matters at a local scale.	The appearance of the buildings and structures that surround the River Yare in the vicinity of the scheme are unremarkable. CA elsewhere in the	The appearance of the seafront townscape and its architecture is important at a local level in terms of identity. The river corridor has limited importance in appearance.	The townscape appearance is substitutable. The potential for townscape change in and around the river setting is high.	The likely nature of townscape change and its influence on the setting would not substantially differ.	**Neutral** The introduction of a new road bridge across the river, including overhead signage gantries would not significantly alter the appearance of the setting. It would be in keeping with the appearance of the

Option 33 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
	appearance. While the river setting is contained, the larger storage towers and warehouses alongside the river corridor are visible elements of the townscape. Residential development is generally unremarkable and townscape value quickly diminishes beyond the town core.		town would suggest a recognised level of rarity.				urban river corridor, although would interrupt existing views along the River Yare from vantage points such as The Haven Bridge & South Quay. Views along the river corridor and of the bridge in an open position would highlight the location within the townscape temporarily.
Human interaction	Great Yarmouth's seafront promenade and its town core are the main areas of focus for social activity and interaction. Outside of these areas the townscape is predominantly residential, reflecting typical levels of associated social activity and function. In the vicinity of the scheme there is a mix of well used open green space and allotments. Interaction along the River Yare is limited to areas of historic and intact frontage, at South Quay in the town and further south towards Gorleston-on-Sea. Elsewhere along the urban river corridor, the over-riding industrial context offers little in the way of interaction.	The scale of human interaction matters mainly at a local level. The town centre, seafront provide the most interaction, with little interaction in the vicinity of the scheme.	The context of the River Yare and immediate setting in respect of interaction matters at a local scale with no inherent rarity.	The current river townscape in the vicinity of the scheme has a low importance in respect of interaction.	The nature of interaction is substitutable.	No change.	**Slight Beneficial** Improved access for pedestrians/cyclists would improve scope for interaction either side of the river. There would be some loss of interaction in the immediate community through loss of residential property and allotment space. The provision of the bridge crossing would potentially alleviate pressures on the Haven and Breydon Bridge locations to the north, allowing greater interaction benefits for this area of locally important townscape.
Cultural	Great Yarmouth's history as a fishing town and subsequently its development as a seaside resort is reflected by its townscape and architecture. The Victorian seafront and its recreation focus is a characteristic aspect of the town, which to a large degree creates a cultural identity. Within the town there are specific buildings and architectural frontages that reference the town's maritime heritage, with a sense of cultural time depth and isolated townscape quality. The River Yare is closely linked with the cultural character of the town, integral to its townscape and from its past and ongoing maritime use.	The river and its formative role in the townscape evolution matter at a local scale.	Rarity in the river townscape is limited to those areas of intact historic frontage, north and south of the proposed bridging point.	The association of Yarmouth as a seaside destination, and point of passage to inland waterways are important cultural aspects of the town, its townscape elements derived from this cultural baseline.	The cultural heritage of townscape features is not substitutable. Cultural change by its essence is ongoing and will modify townscape.	Cultural change would not differ in a without-scheme scenario.	**Neutral** The scheme would introduce a new built feature into the river corridor townscape, visible temporarily as a landmark/reference and potentially changing cultural perception of the location.
Land use	The town core and seafront comprises a mix of retail and commercial land use, with the town relying heavily on leisure as a focus. The urban river corridor comprises a mixture of predominantly maritime and industrial activity. Outside of these areas, land use is predominantly residential with linked facilities. Light industry is focused largely within a single industrial estate, to the western fringe of the town.	The associated function of the river in terms of its passage for leisure and commercial craft matters at a local level.	The land use in the immediate vicinity of the river corridor has no rarity value.	Land use and the resulting townscape elements matter at a local level.	Land use is substitutable. However the river as a physical form is not easily substitutable.	The nature of land use change in the vicinity of the river corridor would not substantially alter.	**Neutral** There would be no significant change of land use as a result of the scheme.
Summary of character	The townscape of Great Yarmouth is defined by the historic and contemporary seafront context of the town; the promontory of land on which Great Yarmouth is historically sited and which has a mixed townscape quality (the older, more intact historic townscape in contrast to surrounding residential development); the division and maritime corridor created by the	Scale matters at a predominantly local level, with CA designations emphasising the	The CA would suggest local rarity in respect of the seafront context. No perceived rarity	The appearance of the seafront townscape and its architecture is important at a local level in terms of identity.	The majority of the townscape surrounding the river corridor is substitutable,	The townscape evolution around the River Yare in the area of the scheme would not significantly change in a without-	**Neutral** The introduction of the bridge would not significantly alter the townscape character within

Option 33 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
	River Yare and its mix of historic frontage and maritime industrial townscape; the developed hinterland of Great Yarmouth, west of the River Yare and surrounding the A12 link road and the town's relative exposure as a settlement within the wider fen landscape. In the vicinity of the scheme, townscape character is a fragmented mix of residential and industrial development. Alongside the river corridor, residential terraces define a largely continuous frontage along the western river edge, whereas the eastern margin is flanked by low warehouses, storage yards and larger, maritime related infrastructure. The overriding character is locally maritime but of a poor townscape quality, with little in the way of townscape definition beyond the immediate confine of the river itself.	significance of the relative scale of the seafront townscape.	of townscape in the vicinity of the scheme.	The existing river character is of no importance in the vicinity of the scheme.	although the character of the town centre and seafront not readily so.	scheme case.	Great Yarmouth. However the bridge form would serve temporarily as a visual reference and landmark, heightening a sense of townscape animation along the river corridor. The scheme would alleviate vehicular congestion, benefiting more established and valued townscape areas of the town.

Option 33 Summary Appraisal (including Assessment Score)

6.5.7 The Option 33 layout corresponds closely with Option 32. The townscape appraisal comments for the road network modifications and for the bridge appearance are broadly similar.

6.5.8 Option 33 differs in that the bridge itself would be narrower in cross section, which would represent slightly less of an influence on townscape when the bridge is in its opened, temporary position. The presence of permanent gantry mounted signals approaching and across the bridge would have a slightly greater impact on townscape at a local level, although these variations would have little effect on townscape at a wider scale.

6.5.9 In summary, the majority of impacts are predicted on balance to have a neutral effect on an area of locally unremarkable townscape quality, although it is observed that the introduction of a third bridge crossing would have a beneficial effect on human interaction (non-motorised users) by way of improved townscape linkages. The bridge would interrupt the existing open aspect of the river corridor and appear as an aspect of townscape from quayside locations to the north and south. The bridge in its temporary open position would be an evident feature of Great Yarmouth's contextual townscape as a skyline feature, although this would not fundamentally change the associated character of the river corridor nor how the town is perceived in context with its surrounding landscape.

Summary Assessment Score: **Neutral**

Option 37 – Townscape Worksheet

Option 37 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
Layout	The town layout is heavily influenced by the Rivers Yare and Bure, which define the promontory upon which Great Yarmouth is sited. Between seafront and river, the historic and retail core of the town is centred on a broad and linear marketplace, a mixture of intact historic street pattern intervened by larger scale retail development. A fine grain of interconnecting residential street pattern surrounds this core, linking with the more formal parades and open green spaces of the seafront. Townscape layout is heavily fragmented where residential areas abut with the coarser grained, working quayside environments alongside both sides of the River Yare. Beyond the river to the west, the hinterland of Great Yarmouth is comprised largely of residential streets and estates interspersed with open green space, encompassing the A12 road corridor and extending south to the seaside town of Gorleston-on-Sea at the mouth of the River Yare. The expanse of Harfreys Industrial Estate, in the immediate vicinity of the scheme at Southtown, is a noticeable interruption of this otherwise residential framework, beyond which the horizontal expanse of the fen landscape frames the town.	The townscape layout in the vicinity of the scheme, both east and west of the River Yare, matters at a local scale.	Conservation Areas to the north (town centre areas and seafront) would suggest local rarity. The river itself is a formative feature of the town. Local to the scheme location, layout has no rarity value.	The town centre areas defined by the CA and the historic seafront townscape layout is of high importance at a local level. The river corridor setting is of moderate importance at a local level, where established historic frontages face toward the Bure.	The seafront and river context are not readily substitutable. Townscape layout elsewhere is substitutable.	Townscape Layout would not substantially alter.	**Neutral** The local townscape pattern would not substantially alter as a consequence of the change of road layout, although there would be some fragmentation of road pattern.
Density and mix	The Yare river corridor is largely industrial in character, though set alongside areas of terraced residential frontage and, to the north of the scheme a more defined historic quayside of greater density. The retail core of the town is of small and medium density development, with recreational facilities focused along the sea front and along several linking routes into the town. Around this core is largely residential land use of a consistent, moderate property density.	Composition and distribution within the townscape matters at a local scale.	The CA would suggest local rarity in respect of the seafront context and in buildings fronting the Bure to the south. No perceived rarity elsewhere.	The density and composition of the seafront townscape and that of the River Yare corridor matters at a local level.	Density and mix are substitutable.	Density and mix of townscape would not substantially change or differ.	**Neutral** The density and mix of development will not substantially differ.
Scale	The vertical scale of townscape across Great Yarmouth is broadly low and consistent, the area being of a flat topography with no particular dominance of built development occupying its skyline. The sea front forms a prominent vista, with 3-4 storey buildings flanking the main promenade. The retail core has some massing of larger scale development, but aside of this the residential and retail scale of the town is predominantly low rise. The River Yare is of a broad horizontal scale with key vistas along its course, these being evident from the approaches to the town and across its bridging points. It is a key contextual reference to the town, its bridges being of prominence locally and the river providing a sense of place and scale in positioning the town within the exposed, wider landscape context. Structures associated with the industrial quayside are of a prominent scale locally.	The scale of the local townscape matters at a local level.	The scale of the River Yare through the urban fabric of Lowestoft has a rarity value, although expansive inland waterspace is a feature of the nearby rural Broads landscape. The overall scale of the seafront townscape is relatively scarce within the regional coastal landscape.	The scale of the river corridor is of local importance, being a visible and defining feature. The seafront townscape is important at a local level in respect of identity.	The scale of the townscape is substitutable.	The scale of townscape in vicinity of the scheme would significantly change in a without scheme case.	**Neutral** The bascule bridge would be in scale with the river environment. It would however alter townscape scale temporarily at a local level when opened, although not out of context with the setting and in character with other bridges locally.
Appearance	The town has a mix of architectural styles. The seafront has an established and regular townscape appearance where 3 and 4 storey Victorian terraces and civic buildings flank the promenade. Other more recent modifications and recreational developments along the promenade and along main streets into the town are of mixed quality, some of which impact negatively on townscape appearance. The quayside frontages of South Quay alongside the River Yare have a well-defined, intact townscape form. However the majority of the river corridor through the town is industrial by nature and generally of low quality	The appearance of the river townscape matters at a local scale.	The appearance of the buildings and structures that surround the River Yare in the vicinity of the scheme are unremarkable. CA elsewhere in the town would suggest	The appearance of the seafront townscape and its architecture is important at a local level in terms of identity. The river corridor has limited importance in appearance.	The townscape appearance is substitutable. The potential for townscape change in and around the river setting is high.	The likely nature of townscape change and its influence on the setting would not substantially differ.	**Neutral** The introduction of a new road bridge across the river would not significantly alter the appearance of the setting, although there would be some fragmentation of residential townscape.

Option 37 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
	appearance. While the river setting is contained, the larger storage towers and warehouses alongside the river corridor are visible elements of the townscape. Residential development is generally unremarkable and townscape value quickly diminishes beyond the town core.		a recognised level of rarity.				The bridge would be in keeping with the appearance of the urban river corridor, although would interrupt existing views along the River Yare from vantage points such as The Haven Bridge & South Quay. Views along the river corridor and of the bridge in an open position would highlight the location within the townscape temporarily.
Human interaction	Great Yarmouth's seafront promenade and its town core are the main areas of focus for social activity and interaction. Outside of these areas the townscape is predominantly residential, reflecting typical levels of associated social activity and function. In the vicinity of the scheme there is a mix of well used open green space and allotments. Interaction along the River Yare is limited to areas of historic and intact frontage, at South Quay in the town and further south towards Gorleston-on-Sea. Elsewhere along the urban river corridor, the over-riding industrial context offers little in the way of interaction.	The scale of human interaction matters mainly at a local level. The town centre, seafront provide the most interaction, with little interaction in the vicinity of the proposed bridge.	The context of the Yare and immediate setting in respect of interaction matters at a local scale with no inherent rarity.	The current river townscape in the vicinity of the proposed bridge has a low importance in respect of interaction.	Density and mix are substitutable.	No change.	**Slight Beneficial** Improved access for pedestrians/cyclists would improve scope for interaction either side of the river. The provision of the bridge crossing would potentially alleviate pressures on the Haven and Breydon Bridge locations to the north, allowing greater interaction benefits for this area of locally important townscape.
Cultural	Great Yarmouth's history as a fishing town and subsequently its development as a seaside resort is reflected by its townscape and architecture. The Victorian seafront and its recreation focus is a characteristic aspect of the town, which to a large degree creates a cultural identity. Within the town there are specific buildings and architectural frontages that reference the town's maritime heritage, with a sense of cultural time depth and isolated townscape quality. The River Yare is closely linked with the cultural character of the town, integral to its townscape and from its past and ongoing maritime use.	The river and its formative role in the townscape evolution matter at a local scale.	Rarity in the river townscape is limited to those areas of intact historic frontage, north and south of the proposed bridging point.	The association of Yarmouth as a seaside destination, and point of passage to inland waterways are important cultural aspects of the town, its townscape elements derived from this cultural baseline.	The cultural heritage of townscape features is not substitutable. Cultural change by its essence is ongoing and will modify townscape.	Cultural change would not differ in a without-scheme scenario.	**Neutral** The scheme would introduce a new built feature into the river corridor townscape, visible temporarily as a landmark/reference and potentially changing cultural perception of the location.
Land use	The town core and seafront comprises a mix of retail and commercial land use, with the town relying heavily on leisure as a focus. The urban river corridor comprises a mixture of predominantly maritime and industrial activity. Outside of these areas, land use is predominantly residential with linked facilities. Light industry is focused largely within a single industrial estate, to the western fringe of the town.	The associated function of the river in terms of its passage for leisure and commercial craft matters at a local level.	The land use in the immediate vicinity of the river corridor has no rarity value.	Land use and the resulting townscape elements matter at a local level.	Land use is substitutable. However the river as a physical form is not easily substitutable.	The nature of land use change in the vicinity of the river corridor would not substantially alter.	**Neutral** There would be no significant change of land use as a result of the scheme.
Summary of character	The townscape of Great Yarmouth is defined by the historic and contemporary seafront context of the town; the promontory of land on which Great Yarmouth is historically sited and which has a mixed townscape quality (the older, more intact historic townscape in contrast to surrounding residential development); the division and maritime corridor created by the River Yare and its mix of historic frontage and maritime industrial townscape; the developed hinterland of Great Yarmouth, west of the River Yare and surrounding the A12 link road and the town's relative exposure as a	Scale matters at a predominantly local level, with CA designations emphasising the significance of the relative scale of the seafront townscape.	The CA would suggest local rarity in respect of the seafront context. No perceived rarity of townscape in the vicinity of the scheme.	The appearance of the seafront townscape and its architecture is important at a local level in terms of identity. The existing river character is of no importance in the vicinity	The majority of the townscape surrounding the river corridor is substitutable, although the character of the town centre and	The townscape evolution around the River Yare in the area of the scheme would not significantly change in a without-scheme case.	**Neutral** The introduction of the bridge would not significantly alter the townscape character within Great Yarmouth. However the bridge form would serve temporarily as

Option 37 Townscape Worksheet							
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-Scheme case**	**Impact**
	settlement within the wider fen landscape. In the vicinity of the scheme, townscape character is a fragmented mix of residential and industrial development. Alongside the river corridor, residential terraces define a largely continuous frontage along the western river edge, whereas the eastern margin is flanked by low warehouses, storage yards and larger, maritime related infrastructure. The overriding character is locally maritime but of a poor townscape quality, with little in the way of townscape definition beyond the immediate confine of the river itself.			of the scheme	seafront not readily so.		a visual reference and landmark, heightening a sense of townscape animation along the river corridor. The scheme would alleviate vehicular congestion, benefiting more established and valued townscape areas of the town.

Option 37 Summary Appraisal (including Assessment Score)

6.5.10 The road changes to provide access to the bridge crossing would have a slightly greater impact on layout than Options 32 and 33, as a result of the loss of more existing residential frontage along the river edge and in the stopping up of roads. However the area does not have a particularly strong or defined townscape value, also the layout of the new junction and bridge approaches would not represent any material disruption of the nearby Southtown Common Recreation Ground and its established boundaries. As with the other options, alleviation of vehicular pressure on the Haven and Breydon bridge crossings may potentially improve the human interaction potential in this locally more important area of townscape to the north.

6.5.11 The bridge would be approximately 2.4m lower in elevation than Options 32 and 33 across its centre span, which would reduce the physical and perceived scale of the structure within the local townscape. Consequently the vertical elevation of the raised bridge (at 31.5m above its closed elevation) would be 2.5m lower than Options 32 and 33, with slightly less visibility of the bridge structure within the townscape and from surrounding areas as a result. As a single carriageway crossing, the bridge would have slightly less of an influence on townscape when the bridge is in its opened position.

6.5.12 In summary, the majority of impacts are predicted on balance to have a neutral effect on an area of locally unremarkable townscape quality, although it is observed that the introduction of a third bridge crossing would have a beneficial effect on human interaction (non-motorised users) by way of improved townscape linkages. The bridge and embanked road junction would interrupt the existing open aspect of the river corridor and appear as an aspect of townscape from quayside locations to the north and south. The bridge in its temporary open position would be an evident feature of Great Yarmouth's contextual townscape as a skyline feature, although this would not fundamentally change the associated character of the river corridor nor how the town is perceived in context with its surrounding landscape.

Summary Assessment Score: **Neutral**

7 Biodiversity

7.1 Introduction

7.1.1 This chapter summarises the findings of the ecological assessment undertaken for the options being considered. It considers the potential ecological effects on nature conservation and biodiversity. The ecological assessment has been informed by detailed desk studies identifying designated wildlife sites, non-designated habitats, and field surveys to identify potential for encountering protected species within the study area.

7.1.2 Field surveys focussed on land within the scheme's footprint, but also examined adjacent habitats where appropriate (e.g. ponds and water courses located off-site but within the scheme's zone of influence.

7.2 Appraisal Methodology

7.2.1 A study area, extending up to 2km from the site of the scheme location was surveyed in order to determine impacts and likely constraints to the scheme. The study set out to:

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

7.2.2 The Norfolk Biodiversity Information Service was consulted to gather information on records of species and nature conservation designations from within the study area.

7.2.3 A review of the MAGIC[9] online resource was also undertaken to gather information on statutory nature conservation designations within the study area.

7.2.4 A walkover survey, undertaken broadly in accordance with Phase 1 habitat survey methodology[10], 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.

7.3 Existing Environment

Statutory Designated Sites

7.3.1 The Outer Thames Estuary Special Protection Area is within 2km of the proposed bridge crossing point. This site is designated because it supports 38% of the Great

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

[10] Joint Nature Conservancy Council (JNCC) (2007). Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit. Peterborough, UK

British population of red-throated diver *Gavia stellate*, which is listed on Annex 1 of the EU Birds Directive.

Non-Statutory Designated Sites

7.3.2 There are no non-statutory designated sites within 2km of the scheme location.

Species

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

Amphibians

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

7.3.5 There are three records of common toad *Bufo bufo*, the most recent dating from March 1999. These records are for Southtown Common, approximately 800m west of the scheme location.

7.3.6 There are areas of terrestrial habitat within 250m of the scheme 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 turning to the north-west. As the ditches are linked underneath the two roads, they are considered here as one water body.

7.3.7 There is a small pond at TG523058. This is located roughly in the centre of the survey area, adjacent to William Adams Way and Queen Anne's Road. This and the surrounding habitat of grassland, scrub and woodland is suitable for use by amphibians.

7.3.8 Both waterbodies were subject to a Great Crested Newt Habitat Suitability Index (HSI) assessment. The outcome of this is detailed in Table 8-1.

Table 8-1: HSI Assessment Result

Pond	Location	Pond Area	Pond Permanence	Water Quality	Pond Shading	Waterfowl	Fish Count	Pond Count	Terrestrial Habitat	Macrophyte Cover	HSI Assessment
Ditch	1	0.8	0.9	0.01	1	1	0.33	0.65	0.67	0.8	0.49
Pond	1	0.05	0.5	0.67	0.2	1	1	0.65	1	0.7	0.52

7.3.9 The scores of 0.49 which correlates as Poor and 0.52 which correlates as Below Average indicate that great crested newts are unlikely to use these ponds and further surveys are therefore unlikely to be required.

Reptiles

7.3.10 There are four records of common lizard *Zootoca vivipara*, the most recent being

from Southtown Common in June 2008.

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

7.3.12 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.

Water Vole

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

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

Otter

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

7.3.16 The main channel of the River Yare is canalised and provides no suitable holt habitat in which otters may build holts.

Bats

7.3.17 There are multiple records of bat species within the 2km study area, many of which are from within the footprint of the scheme. The most recent of these are described in Table 8-2.

Table 8-2: Bat Species Records within 2km of Study Area

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

7.3.18 There are several structures within 100m of the proposed bridge crossing point that may be suitable for use by roosting bats. These include two uninhabited and poorly

maintained houses at TG524058 as well as old brick buildings at TG524057 on the west side of the River Yare.

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

Badger

7.3.20 There is one record of badger *Meles meles* within 2km of the scheme, dating from September 2014.

7.3.21 No evidence of badgers was found during the surveys.

Other Mammals

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

7.3.23 No evidence of hedgehog was found during the survey but the scheme is located within areas of habitats suitable to support this species.

7.3.24 No evidence of brown hare was found during the survey. The scheme area of the does not contain suitable habitat for this species.

Birds

7.3.25 A large number of bird species have been recorded within 2km of the scheme. 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.

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

7.3.27 The mosaic of urban areas with scattered ruderal vegetation with areas of grassland and scrub is suitable habitat for use by black redstart *Phoenicurus ochruros*.

7.3.28 Trees and areas of scrub within and adjacent to the scheme location 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.

7.4 Brief Evaluation of Topic Related Constraints

Statutory Designated and Non-Statutory Protected Sites

7.4.1 The Outer Thames Estuary SPA is within 2km of the scheme. It is a requirement that a Screening study for Habitats Regulations Assessment is undertaken.

Habitats

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

not a constraint to the scheme.

Amphibians and Reptiles

7.4.3 Although small areas of habitat that is suitable to provide foraging, shelter and hibernation areas for these groups exist, the site is located within a predominantly urban environment and is not connected to areas of suitable offsite habitat. No further work in respect of amphibians and reptiles is recommended. The loss of these areas of habitat would not be significant on reptiles as extensive suitable habitat are present elsewhere on adjacent and nearby land.

7.4.4 During construction it is possible, though unlikely, that individual animals may be present in these isolated areas of suitable habitat. Precautionary measures are recommended as follows to ensure that individual animals are not affected during the works.

Water Vole

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

Bats

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

Hedgehog

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

Birds

7.4.8 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 in the scheme area.

7.4.9 Area 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 the nest until the young have fledged.

7.5 Biodiversity Appraisal - WebTAG Worksheets

Option 32 - Biodiversity Worksheet

Option 32 Biodiversity Worksheet							
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Outer Thames Estuary SPA	This is an area along the east coast of England within the Southern North Sea and extends northwards from the Thames Estuary to the sea area off Great Yarmouth on the East Norfolk Coast, providing an important foraging ground during the breeding season.	National	The site is designated as it supports 38% of the Great British population of red-throated diver *Gavia stellate*, which is listed on Annex 1 of the EU Birds Directive. [11]		High	Neutral	Neutral
Standing water habitat	These would include natural systems such as lakes, pools, man-made systems such as ponds, canals and gravel pits.	Local	They have the potential to support protected species. The biodiversity value of the ponds and ditches individually could be greater depending on presence of significant populations of protected species.	Agricultural intensification has traditionally resulted in the loss of standing water habitat. The decline in dependant species, such as great crested newts, can be attributable to this process.	Lower	Unknown	Unknown
River Yare	River Yare is one of five major rivers within the Broadland Rivers catchment; a tidally dominated area of inland waterways.	Local	Riparian habitat provides an important corridor for the movement of animals between habitats and the formation of meta-populations. Both the aquatic and riparian habitats have the potential to support legally protected and ecologically significant species.	Across the UK in the past 100 years, river engineering has significantly impacted riparian ecosystems, particularly in urban areas.	Lower	Neutral	Neutral
Bat species	Protected Species	Local	All bat species receive legal protection under Schedule II of the Conservation (Natural Habitats, &c.) Regulations 1994 through which they are given the status of European Protected Species (EPS). They also receive protection nationally through inclusion in Schedule 5 of the Wildlife and Countryside Act 1981. There are records of the following bat species within the 10km grid square: parti-coloured bat, daubenton, serotine and noctule, pipistrelle, nathusius's pipistrelle, soprano pipistrelle, brown long-eared	The common bat species, including common pipistrelle and daubenton's, have generally shown a decline in population and distribution both nationally and in Europe. The trends in rarer bat species is not entirely known due to recording difficulties, but generally appear to have declined.	Low	Unknown	Unknown
Water Vole	Protected Species	Borough	Water voles receive full legal protection through inclusion in Schedule 5 of the Wildlife and Countryside Act 1981, following an amendment in April 2008. There are records of water vole within the 10km grid square.	Water voles are listed as moderately common in the UK, but declined substantially in the 1990s due to habitat loss, degradation, population fragmentation and predation by feral American Mink. The decline is thought to have stabilised, and the species is not currently listed as threatened.	Medium	Unknown	Unknown
Breeding birds	Protected Species	Local	Breeding birds receive legal protection at the national level through their inclusion in the Wildlife and Countryside Act 1981. The legislative protection is not	Some bird species are listed as Schedule 1 species, which are identified as ecologically significant	Low	Minor negative	Slight adverse

[11] http://jncc.defra.gov.uk/page-7249 [Accessed 15/03/17]

Option 32 Biodiversity Worksheet							
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
			related to conservation status or vulnerability, and covers all birds regardless of how common they are. Swift and song thrush are listed on the Norfolk BAP Priority list.	or sensitive. Many common bird species are not listed as threatened.			
Black redstart	Protected Species	Local	Black redstarts receive full legal protection through inclusion in Schedule 1 of the Wildlife and Countryside Act 1981, as amended. There are records of black redstart within the 10km grid square.	Black redstart population size and range have declined in since the 1980s with the species being red listed as a result of these declines.	Medium	Unknown	Unknown
Hedgehog	Priority Species	Local	Hedgehog are listed in the UK BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of hedgehog within the 10km grid square.	Hedgehog populations and distributions have seen considerable declines since the 1950's due to habitat loss, degradation and fragmentation.	Low	Unknown	Unknown
Common toad	Priority Species	Local	Common toad are listed in the UK BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of common toad within the 10km grid square.	Widespread but in decline countrywide. 50% of rural populations have declined between 1985 and 2000, including extinction in some areas.	Low	Unknown	Unknown
Song thrush	Priority Species	Local	Song thrush is listed in both the UK and Norfolk BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of song thrush within the 10km grid square.	Widespread but has suffered a steep decline since the mid-1970s.	Low	Unknown	Unknown
Swift	Priority Species	Local	Swift is listed in the Norfolk BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of swift within the 10km grid square.	Widespread but has suffered declines across the UK since 1994.	Low	Unknown	Unknown

Option 32 Summary Appraisal (including Assessment Score)

7.5.1 As the Option passes through several areas of habitat that are suitable for breeding birds, these protected species may potentially be affected. There are also several buildings which may have suitable bat roost within them that could be impacted. It is anticipated that once assessment of these populations have been made and potential mitigating activities completed, the overall result should not exceed a slight adverse effect.

Summary assessment score: **Slight Adverse**

Option 33 – Biodiversity Worksheet

Option 33 Biodiversity Worksheet							
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Outer Thames Estuary SPA	This is an area along the east coast of England within the Southern North Sea and extends northwards from the Thames Estuary to the sea area off Great Yarmouth on the East Norfolk Coast, providing an important foraging ground during the breeding season.	National	The site is designated as it supports 38% of the Great British population of red-throated diver *Gavia stellate*, which is listed on Annex 1 of the EU Birds Directive. [12]		High	Neutral	Neutral
Standing water habitat	These would include natural systems such as lakes, pools, man-made systems such as ponds, canals and gravel pits.	Local	Standing water habitats, including ponds and ditches, is listed as a BAP broad habitat. They have the potential to support protected species. The biodiversity value of the ponds and ditches individually could be greater depending on presence of significant populations of protected species.	Agricultural intensification has traditionally resulted in the loss of standing water habitat. The decline in dependant species, such as great crested newts, can be attributable to this process.	Lower	Unknown	Unknown
River Yare	River Yare is one of five major rivers within the Broadland Rivers catchment; a tidally dominated area of inland waterways.	Local	Riparian habitat provides an important corridor for the movement of animals between habitats and the formation of meta-populations. Both the aquatic and riparian habitats have the potential to support legally protected and ecologically significant species.	Across the UK in the past 100 years, river engineering has significantly impacted riparian ecosystems, particularly in urban areas.	Lower	Neutral	Neutral
Bat species	Protected Species	Local	All bat species receive legal protection under Schedule II of the Conservation (Natural Habitats, &c.) Regulations 1994 through which they are given the status of an EPS. They also receive protection nationally through inclusion in Schedule 5 of the Wildlife and Countryside Act 1981. There are records of the following bat species within the 10km grid square: parti-coloured bat, daubenton, serotine and noctule, pipistrelle, nathusius's pipistrelle, soprano pipistrelle, brown long-eared	The common bat species, including common pipistrelle and daubenton's, have generally shown a decline in population and distribution both nationally and in Europe. The trends in rarer bat species is not entirely known due to recording difficulties, but generally appear to have declined.	Low	Unknown	Unknown
Water Vole	Protected Species	Borough	Water voles receive full legal protection through inclusion in Schedule 5 of the Wildlife and Countryside Act 1981, following an amendment in April 2008. There are records of water vole within the 10km grid square.	Water voles are listed as moderately common in the UK, but declined substantially in the 1990s due to habitat loss, degradation, population fragmentation and predation by feral American Mink. The decline is thought to have stabilised, and the species is not currently listed as threatened.	Medium	Unknown	Unknown

[12] http://jncc.defra.gov.uk/page-7249 [Accessed 15/03/17]

Option 33 Biodiversity Worksheet							
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Breeding birds	Protected Species	Local	Breeding birds receive legal protection at the national level through their inclusion in the Wildlife and Countryside Act 1981. The legislative protection is not related to conservation status or vulnerability, and covers all birds regardless of how common they are. Swift and song thrush are listed on the Norfolk BAP Priority list.	Some bird species are listed as Schedule 1 species, which are identified as ecologically significant or sensitive. Many common bird species are not listed as threatened.	Low	Minor negative	Slight adverse
Black redstart	Protected Species	Local	Black redstarts receive full legal protection through inclusion in Schedule 1 of the Wildlife and Countryside Act 1981, as amended. There are records of black redstart within the 10km grid square.	Black redstart population size and range have declined in since the 1980s with the species being red listed as a result of these declines.	Medium	Unknown	Unknown
Hedgehog	Priority Species	Local	Hedgehog are listed in the UK BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of hedgehog within the 10km grid square.	Hedgehog populations and distributions have seen considerable declines since the 1950's due to habitat loss, degradation and fragmentation.	Low	Unknown	Unknown
Common toad	Priority Species	Local	Common toad are listed in the UK BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of common toad within the 10km grid square.	Widespread but in decline countrywide. 50% of rural populations have declined between 1985 and 2000, including extinction in some areas.	Low	Unknown	Unknown
Song thrush	Priority Species	Local	Song thrush is listed in both the UK and Norfolk BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of song thrush within the 10km grid square.	Widespread but has suffered a steep decline since the mid-1970s.	Low	Unknown	Unknown
Swift	Priority Species	Local	Swift is listed in the Norfolk BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of swift within the 10km grid square.	Widespread but has suffered declines across the UK since 1994.	Low	Unknown	Unknown

Option 33 Summary Appraisal (including Assessment Score)

7.5.2 As the Option passes through several areas of habitat that are suitable for breeding birds, these protected species may potentially be affected. There are also several buildings which may have suitable bat roost within them that could be impacted. It is anticipated that once assessment of these populations have been made and potential mitigating activities completed, the overall result should not exceed a slight adverse effect.

Summary assessment score: **Slight Adverse**

Option 37 – Biodiversity Worksheet

Option 37 Biodiversity Worksheet							
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Outer Thames Estuary SPA	This is an area along the east coast of England within the Southern North Sea and extends northwards from the Thames Estuary to the sea area off Great Yarmouth on the East Norfolk Coast, providing an important foraging ground during the breeding season.	National	The site is designated as it supports 38% of the Great British population of red-throated diver *Gavia stellate*, which is listed on Annex 1 of the EU Birds Directive. [13]		High	Neutral	Neutral
Standing water habitat	These would include natural systems such as lakes, pools, man-made systems such as ponds, canals and gravel pits.	Local	Standing water habitats, including ponds and ditches, is listed as a BAP broad habitat. They have the potential to support protected species. The biodiversity value of the ponds and ditches individually could be greater depending on presence of significant populations of protected species.	Agricultural intensification has traditionally resulted in the loss of standing water habitat. The decline in dependant species, such as great crested newts, can be attributable to this process.	Lower	Unknown	Unknown
River Yare	River Yare is one of five major rivers within the Broadland Rivers catchment; a tidally dominated area of inland waterways.	Local	Riparian habitat provides an important corridor for the movement of animals between habitats and the formation of meta-populations. Both the aquatic and riparian habitats have the potential to support legally protected and ecologically significant species.	Across the UK in the past 100 years, river engineering has significantly impacted riparian ecosystems, particularly in urban areas.	Lower	Neutral	Neutral
Bat species	Protected Species	Local	All bat species receive legal protection under Schedule II of the Conservation (Natural Habitats, &c.) Regulations 1994 through which they are given the status of an EPS. They also receive protection nationally through inclusion in Schedule 5 of the Wildlife and Countryside Act 1981. There are records of the following bat species within the 10km grid square: parti-coloured bat, daubenton, serotine and noctule, pipistrelle, nathusius's pipistrelle, soprano pipistrelle, brown long-eared	The common bat species, including common pipistrelle and daubenton's, have generally shown a decline in population and distribution both nationally and in Europe. The trends in rarer bat species is not entirely known due to recording difficulties, but generally appear to have declined.	Low	Unknown	Unknown
Water Vole	Protected Species	Borough	Water voles receive full legal protection through inclusion in Schedule 5 of the Wildlife and Countryside Act 1981, following an amendment in April 2008. There are records of water vole within the 10km grid square.	Water voles are listed as moderately common in the UK, but declined substantially in the 1990s due to habitat loss, degradation, population fragmentation and predation by feral American Mink.	Medium	Unknown	Unknown

[13] http://jncc.defra.gov.uk/page-7249 [Accessed 15/03/17]

Option 37 Biodiversity Worksheet							
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
				The decline is thought to have stabilised, and the species is not currently listed as threatened.			
Breeding birds	Protected Species	Local	Breeding birds receive legal protection at the national level through their inclusion in the Wildlife and Countryside Act 1981. The legislative protection is not related to conservation status or vulnerability, and covers all birds regardless of how common they are. Swift and song thrush are listed on the Norfolk BAP Priority list.	Some bird species are listed as Schedule 1 species, which are identified as ecologically significant or sensitive. Many common bird species are not listed as threatened.	Low	Minor negative	Slight adverse
Black redstart	Protected Species	Local	Black redstarts receive full legal protection through inclusion in Schedule 1 of the Wildlife and Countryside Act 1981, as amended. There are records of black redstart within the 10km grid square.	Black redstart population size and range have declined in since the 1980s with the species being red listed as a result of these declines.	Medium	Unknown	Unknown
Hedgehog	Priority Species	Local	Hedgehog are listed in the UK BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of hedgehog within the 10km grid square.	Hedgehog populations and distributions have seen considerable declines since the 1950's due to habitat loss, degradation and fragmentation.	Low	Unknown	Unknown
Common toad	Priority Species	Local	Common toad are listed in the UK BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of common toad within the 10km grid square.	Widespread but in decline countrywide. 50% of rural populations have declined between 1985 and 2000, including extinction in some areas.	Low	Unknown	Unknown
Song thrush	Priority Species	Local	Song thrush is listed in both the UK and Norfolk BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of song thrush within the 10km grid square.	Widespread but has suffered a steep decline since the mid -1970s.	Low	Unknown	Unknown
Swift	Priority Species	Local	Swift is listed in the Norfolk BAP Priority list. Although the species does not receive legal protection, this identifies the species as being of ecological significance. There are records of swift within the 10km grid square.	Widespread but has suffered declines across the UK since 1994.	Low	Unknown	Unknown

Option 37 Summary Appraisal (including Assessment Score)

7.5.3 As the Option passes through several areas of habitat that are suitable for breeding birds, these protected species may potentially be affected. There are also several buildings which may have suitable bat roost within them that could be impacted. It is anticipated that once assessment of these populations have been made and potential mitigating activities completed, the overall result should not exceed a slight adverse effect.

Summary assessment score: **Slight Adverse**

8 Historic Environment

8.1 Introduction

8.1.1 This chapter identifies and assesses the potential impacts upon cultural heritage resources as a result of the options being considered for the scheme. The heritage resource consists of archaeological remains, historic buildings and the historic landscape and covers both designated and non-designated assets.

8.2 Appraisal Methodology

8.2.1 The study area which has been adopted for the assessment of cultural heritage features extends to 500m around the combined options for undesignated cultural heritage assets, and 1km around the combined options for designated assets. Areas impacted by traffic noise have also been taken into account.

8.2.2 There is scope for the study area to be reduced for further stages of assessment, however a larger study area allows any cultural heritage assets to be considered within their wider context. For this study area, the following was undertaken:

- Data was gathered on designated heritage assets from the National Heritage List for England and Historic England Archive;
- Conservation Area data was obtained from the relevant local authority websites;
- Details of un-designated heritage assets was gathered from the Norfolk Historic Environment Record (NHER);
- A preliminary historic landscape assessment was made based on modern mapping, readily available aerial photography and Historic Landscape Characterisation data obtained from NHER; and
- A preliminary assessment of the archaeological potential of the study area.

8.2.3 Initial value assessments have been made for each cultural heritage asset following the guidance set out in DMRB Volume 11, Section 3, Part 2 (HA208/07*).*

8.2.4 The appraisal has followed the assessment methodology as required by TAG Unit A3 Chapters 5 and 8*.* This follows the five step approach to appraising 'environmental capital':

- Step 1: Scoping and identification of study area (as detailed above);
- Step 2: the key environmental resources have been identified and their features described as per the requirements of TAG Unit A3 Chapter 8, in terms of their form, survival, condition, complexity, context and period;

- Step 3: The appraisal has been undertaken against the following set of indicators to establish the significance of each key historic environmental resource in question; the scale at which it matters, significance (value) and rarity;

- Step 4: An impact assessment has been undertaken of the options on the historic environmental resources in terms of seriousness and scale. Incremental, secondary and cumulative impacts have also been considered. The extent to which resource is adversely affected or enhanced will be described; and

- Step 5: An assessment of the significance of all impacts on the receptors has been undertaken to determine the overall appraisal score using the definitions for overall impact outlined in TAG Unit A3 Table 8. The significant impacts on the historic environment have been summarised on the Historic Environment Worksheets (see section 9.4) for inclusion in the ASTs.

8.3 Existing Environment

8.3.1 There are no World Heritage Sites, Scheduled Monuments, Registered Parks and Gardens, Registered Battlefields or Protected Wreck sites within 1km of the options.

8.3.2 There are four Conservation Areas and 45 Listed Buildings within 1km of the options. The listed buildings consist of one Grade I, four Grade II* and 40 Grade II. The majority of the listed buildings will be screened from the options by topography, vegetation and existing structures. The listed buildings represent a mixture of domestic, religious, industrial and leisure uses and mainly date to the post-medieval period.

8.3.3 There are 90 undesignated heritage assets recorded on the Norfolk Historic Environment Record (NHER) in the study area. The vast majority of these sites represent World War II structures, camps and bomb crater sites, with the remaining sites comprising finds and structures which reflect the important Naval and shipping history of the town. The majority of the known recorded sites date to the post medieval period. Within the wider study area, there is evidence of remains dating to the medieval period, as well as a single findspot of a Neolithic scraper. A full list of identified heritage assets is presented in **Appendix C**: Gazetteer of Heritage Assets.

8.3.4 A deposit model for Great Yarmouth has been created by the Great Yarmouth Archaeological Map project using data from 142 boreholes which were drilled by the Norfolk County Laboratory. The model shows that, the area where Great Yarmouth now stands started out as the mouth of a great estuary. Since the last Ice Age, a south bound current has laid a spit of sand across the north of the estuary, from the north end to the south. The sand spit blocked off the estuary, leading to the formation of the peat which was cut to make the Broads. The sand spit was breached by the sea, and left as either a low tidal island or a shoal until about 1300 years ago, when it gradually took shape. When it was first occupied, probably sometime in the tenth century, it was a low lying sand spit, most of it about 1m above sea level. Throughout the first centuries of habitation, large drifts of windblown sand buried dwellings and shifted sand dunes, and by the time the walls were built around the medieval town in

the 13th and 14th centuries the ground level was over 1m high.

8.3.5 The boreholes, and evidence from archaeological excavations in the area suggest the presence of buried medieval shorelines (evidence of this has been found just outside the 500m study area at the site of the Power Station during its construction).

8.3.6 The medieval walled town lies to the north of the scheme location, just outside the 500m study area for undesignated sites, but within this area the remains of boats have been found on an earlier buried shoreline at around 3m below the current ground level. An old landing place was also recorded below the Town Hall site in 1887.

8.3.7 All of the above suggests that buried medieval deposits may survive deep below the current ground level on either side of the River Yare within the study area.

8.3.8 As mentioned above, the vast majority of features within the study area date to the modern period, and specifically the period of the Second World War. Unfortunately, most, if not all, of these features recorded on the NHER have since been demolished and modern development has wiped out all trace of these features. The town was first bombed during World War I in 1915 and this event represents the first aerial bombardment in the UK, however the majority of wartime features date to World War II. During this time the town suffered extensive bombing by the Luftwaffe as it was the last significant place the German bombers could drop bombs before returning home. However, despite this, two-thirds of the medieval town wall survived. At least 43 air raid shelters are recorded on the NHER within the 500m study area, along with Anti-Aircraft batteries, pill boxes, gun emplacements, barbed wire obstructions, blast walls, beach defences, anti-tank defences and military camps. There are also at least 12 recorded bomb craters.

8.3.9 The majority of the built heritage remains within the study area are listed buildings. The area has undergone substantial industrial redevelopment in the 20th century. Earlier buildings are now isolated, although still maintain links to the wharfs and river. The listed buildings consist of a mixture of uses, but a number of these are related to the Naval Hospital which dates from 1806 and was built to treat the sick and wounded from the North Sea Fleet which was engaged in war with France. Great Yarmouth was an important naval base throughout the Napoleonic Wars, and Admiral Lord Horatio Nelson is known to have landed at Great Yarmouth on three occasions. Following Nelson's death, funds were raised to erect a monument in the town, 30 years before a monument was erected in Trafalgar Square. The monument is also a listed building, and lies within the study area. It is 144 feet high.

8.4 Brief Evaluation of Topic Related Constraints

Constraints Common to All Options

8.4.1 The options lie close to one another and the underlying historic environment characteristics of the area is relevant to all options. The study area contains a total of 135 recorded heritage assets, but as outlined above, many of these records relate to demolished Second World War defences. Deposit Modelling has indicated the presence of buried medieval deposits on both shores of the River Yare, and the earliest recorded evidence from recent archaeological investigations dates to the

early medieval and medieval periods. It is unlikely that local conditions before this date would have been suitable for prehistoric settlers, however, the possibility of prehistoric finds or features surviving within the study area cannot be ruled out.

Options 32 and 33

8.4.2 These options are almost identical, and as a result constraints affecting these options are the same. These constraints include:

- WWII defensive structures (barbed wire obstruction, military building and roadblock) for which no remains survive above ground;
- A 19th century railway line;
- A levelled bomb crater;
- Setting of the Camperdown and Gorleston Conservation Areas;
- Setting of the Grade II Listed Gas Works; and
- Setting of the Grade II Listed Dolphin Public House (immediately adjacent to the scheme options).

Option 37

8.4.3 The constraints affecting this option are:

- WWII defensive structures (barbed wire obstruction, military building & roadblock) for which no remains survive above ground;
- A 19th century railway line;
- Setting of the Camperdown and Gorleston Conservation Areas;
- Setting of the Grade II Listed Gas Works; and
- Setting of the Grade II Listed Dolphin Public House (c.37m from the scheme option).

8.5 Historic Environment Assessment - WebTAG Worksheets

8.5.1 The options are listed and described in the following order:

- Options 32 and 33; and
- Option 37.

8.5.2 Options 32 and 33 are considered together as the impacts associated with both options are identical.

Options 32 and 33 – Historic Environment Worksheet

Options 32 and 33 Historic Environment Worksheet					
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	Within the study area there are no World Heritage Sites, Scheduled Monuments, Registered Parks and Gardens, Registered Battlefields or Protected Wreck Sites within 1km of Options 32 and 33. There are 45 listed buildings (1 Grade I, 4 Grade II* and 40 Grade II) and 4 Conservation Areas within 1km of these options. The part of the study area in proximity to these options has an industrial, commercial, transportation, and slight residential character. It is located about 2km to the south of the medieval, post medieval and modern core of Great Yarmouth. Two Grade II listed buildings are in close proximity to the scheme location and would be visually impacted by Options 32 and 33. Four non-designated heritage assets also lie within close proximity to Options 32 and 33, and will be directly impacted by these options. These assets date from the 19th century to the modern period, and mainly relate to WWII defences for which no above ground remains survive today. Deposit modelling also suggests the presence of buried medieval deposits on either side of the River Yare which may be impacted by these options.	The protection and enhancement of heritage assets is of national concern as set out in the National Planning Policy Framework (NPPF), which sets out to conserved heritage assets in a manner appropriate to their significance.	The Grade I and Grade II* listed buildings are of national significance. The Grade II listed buildings are of Regional Significance. The survival of later prehistoric palaeoenvironmental and archaeological remains, and medieval archaeological remains would be of regional or local significance. Other identified archaeological remains are of regional or local significance	The known heritage resource at this part of the study area is not rare within a national or regional context. However, the current level of archaeological work means that potential sub-surface remains are rare locally.	The proposed bridge would cross the River Yare interrupting views up and down the river and would result in a **slight adverse** impact on the character of the historic landscape. These Options would have **moderate adverse** impact on the listed buildings. There is a moderate potential for unknown archaeological remains of a medieval or later date to be located.
Survival	The area was extensively developed during the early 20th century and the construction of buildings and infrastructure will have adversely impacted sub-surface remains of earlier periods. Little archaeological investigation has occurred and the survival of archaeological remains is indeterminate.	The protection and enhancement of heritage assets is of national concern as set out in the NPPF, which sets out to conserve heritage assets in a manner appropriate to their significance. The survival of heritage assets is a contributing factor to its significance.	The significance of sub-surface heritage assets is indeterminate	The survival of the heritage resource is not rare.	There would be a **neutral** impact on the survival of the listed buildings. Options 32 and 33 may have an adverse effect on unknown buried remains, but this is not quantifiable at this stage.
Condition	The listed buildings are in good condition. The condition of unknown sub-surface archaeological remains is indeterminate.	The protection and enhancement of heritage assets is of national concern as set out in the NPPF, which sets out to conserve heritage assets in a manner appropriate to their significance. The condition of heritage assets contributes to their significance and sensitivity to impacts.	The condition of designated heritage assets is important as, in good condition, they can inform our understanding of the history of the region and contribute to the economic wellbeing of the local areas. The significance of the condition of undesignated assets will vary with the individual asset and cannot be quantified at this stage.	The condition of the known heritage assets is common locally.	There would be **neutral** impact on the condition of the listed building. The scheme may have adverse impacts upon non-designated assets, but this cannot be quantified at this point.
Complexity	The complexity of the heritage resource is average for the type and periods.	The protection and enhancement of heritage assets is of national concern as set out in the NPPF, which sets out to conserve heritage assets in a manner appropriate to their significance. The complexity of assets, including individually complex assets or groups of assets contribute to their significance.	The listed buildings are not complex, but represent a variety of forms and purposes in the medieval, post medieval and modern periods that is significant to the local area in particular and to the region in general. The complexity of the undesignated assets is unknown at this stage.	The level of complexity of the designated assets is common nationally. Complexity of non-designated assets is unknown.	The scheme would not have an effect on the complexity of designated or undesignated assets.
Context	The options cross industrial, transport and commercial areas located either side of the River Yare.	The context and setting of most cultural heritage assets is a material	The context of related groups of listed buildings is locally significant. The	The context of the designated assets is	Most designated assets are screened from the scheme by

Options 32 and 33 Historic Environment Worksheet					
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
		consideration at the local, regional and national policy level.	context of many designated and non-designated assets is dependent on as-yet unassessed non-designated assets. The significance is therefore unknown.	common in this region. The setting of the non-designated assets is common nationally	topography and the existing built environment. However, two Grade II listed buildings will be affected.
Period	The dominant historic character is 19th and 20th century industrial, transportation and commercial. Within the study area there few examples of assets of a medieval date as the main medieval core is situated c.2km to the north.	Period does not necessarily determine the importance of the historic resource although it can affect it. Policies within the Local and Regional Plans make reference to the safeguarding and enhancement of cultural heritage assets. The protection of listed buildings regardless of their period is of national concern as set out in the NPPF	The range and periods of the designated and non-designated assets is relatively narrow, but important in terms of understanding the development of the region.	The heritage assets of all periods are not uncommon in the region.	The scheme would not have an effect on the periods of designated or undesignated assets.

Options 32 and 33 Summary Appraisal (including Assessment Score)

8.5.3 Options 32 and 33 would have a moderate adverse impact upon the setting of two listed building due to their proximity to the options. The construction of either of these options would have a major adverse impact upon any unknown sub-surface archaeological remains, which deposit modelling suggests could include buried medieval layers.

Summary Assessment Score: **Moderate Adverse**

Option 37 – Historic Environment Worksheet

Option 37 Historic Environment Worksheet					
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	Within the study area there are no World Heritage Sites, Scheduled Monuments, Registered Parks and Gardens, Registered Battlefields or Protected Wreck Sites within 1km of option 37. There are 45 listed buildings (1 Grade I, 4 Grade II* and 40 Grade II) and 4 Conservation Areas within 1km of this option. The part of the study area in proximity to this option has an industrial, commercial, transportation, and slight residential character. It is located c.2km to the south of the medieval, post medieval and modern core of Great Yarmouth. Two Grade II listed buildings are in close proximity to the scheme and would be visually impacted by Option 37. Three non-designated heritage assets also lie within close proximity to Option 37, and will be directly impacted by this option. These assets date from the 19th century to the modern period, and mainly relate to WWII defences for which no above ground remains survive today. Deposit modelling also suggests the presence of buried medieval deposits on either side of the River Yare which may be impacted by this option.	The protection and enhancement of heritage assets is of national concern as set out in the NPPF, which sets out to conserved heritage assets in a manner appropriate to their significance.	The Grade I and Grade II* listed buildings are of national significance. The Grade II listed buildings are of Regional Significance. The survival of later prehistoric palaeoenvironmental and archaeological remains, and medieval archaeological remains would be of regional or local significance. Other identified archaeological remains are of regional or local significance	The known heritage resource at this part of the study area is not rare within a national or regional context. However, the current level of archaeological work means that potential sub-surface remains are rare locally.	The proposed bridge would cross the River Yare interrupting views up and down the river and would result in a **slight adverse** impact on the character of the historic landscape. The alignment would have **moderate adverse** impact on the listed buildings. There is a moderate potential for unknown archaeological remains of a medieval or later date to be located.
Survival	The area was extensively developed during the early 20th century and the construction of buildings and infrastructure will have adversely impacted sub-surface remains of earlier periods. Little archaeological investigation has occurred and the survival of archaeological remains is indeterminate.	The protection and enhancement of heritage assets is of national concern as set out in the NPPF, which sets out to conserve heritage assets in a manner appropriate to their significance. The survival of heritage assets is a contributing factor to its significance.	The significance of sub-surface heritage assets is indeterminate	The survival of the heritage resource is not rare.	There would be a **neutral** impact on the survival of the listed buildings. Option 37 may have an adverse effect on unknown buried remains, but this is not quantifiable at this stage.
Condition	The listed buildings are in good condition. The condition of unknown sub-surface archaeological remains is indeterminate.	The protection and enhancement of heritage assets is of national concern as set out in the NPPF, which sets out to conserve heritage assets in a manner appropriate to their significance. The condition of heritage assets contributes to their significance and sensitivity to impacts.	The condition of designated heritage assets is important as, in good condition, they can inform our understanding of the history of the region and contribute to the economic wellbeing of the local areas. The significance of the condition of undesignated assets will vary with the individual asset and cannot be quantified at this stage.	The condition of the known heritage assets is common locally.	There would be **neutral** impact on the condition of the listed building. The scheme may have adverse impacts upon non-designated assets, but this cannot be quantified at this point.
Complexity	The complexity of the heritage resource is average for the type and periods.	The protection and enhancement of heritage assets is of national concern as set out in the NPPF, which sets out to conserve heritage assets in a manner appropriate to their significance. The complexity of assets, including individually complex assets or groups of assets contribute to their significance.	The listed buildings are not complex, but represent a variety of forms and purposes in the medieval, post medieval and modern periods that is significant to the local area in particular and to the region in general. The complexity of the undesignated assets is unknown at this stage.	The level of complexity of the designated assets is common nationally. Complexity of non-designated assets is unknown.	The scheme would not have an effect on the complexity of designated or undesignated assets.

Option 37 Historic Environment Worksheet					
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Context	This option crosses industrial, transport and commercial areas located either side of the River Yare.	The context and setting of most cultural heritage assets is a material consideration at the local, regional and national policy level.	The context of related groups of listed buildings is locally significant. The context of many designated and non-designated assets is dependent on as-yet unassessed non-designated assets. The significance is therefore unknown.	The context of the designated assets is common in this region. The setting of the non-designated assets is common nationally	Most designated assets are screened from the scheme by topography and the existing built environment. However the setting of two Grade II listed buildings will be affected.
Period	The dominant historic character is 19th and 20th century industrial, transportation and commercial. Within the study area there few examples of assets of a medieval date as the main medieval core is situated approximately 2km to the north.	Period does not necessarily determine the importance of the historic resource although it can affect it. Policies within the Local and Regional Plans make reference to the safeguarding and enhancement of cultural heritage assets. The protection of listed buildings regardless of their period is of national concern as set out in the National Planning Policy Framework.	The range and periods of the designated and non-designated assets is relatively narrow, but important in terms of understanding the development of the region.	The heritage assets of all periods are not uncommon in the region.	The scheme would not have an effect on the periods of designated or undesignated assets.

Option 37 Summary Appraisal (including Assessment Score)

8.5.4 This option would have a moderate adverse impact upon the settings of two listed building due to its proximity to the buildings. The construction of the scheme would have a major adverse impact upon any unknown sub-surface archaeological remains, which deposit modelling suggests could include buried medieval layers.

Summary Assessment Score: **Moderate Adverse**

9 Water Environment

9.1 Introduction

9.1.1 This chapter assesses the potential impacts on the water environment and takes into account; surface hydrology and quality; groundwater quality and hydrogeology; and fluvial geomorphology. A desk study of the hydrological and hydrogeological features associated with the options has been undertaken. As at the time of preparing this report, no site walk-over has been undertaken to supplement the desk study.

9.2 Appraisal Methodology

9.2.1 A desk study has been undertaken to inform the appraisal of the options for the OBC. The desk study has identified any changes to known water environment resources previously identified by other studies, primarily the Simple Environmental Assessment (Mott MacDonald 2009) and has also considered any new features including designated and non-designated sites. The following sources of information have been interrogated as part of the desk based exercise:

- Mott MacDonald report 'Great Yarmouth Third River Crossing – Simple Environmental Assessment' (August 2009);
- Environment Agency (EA) 'What's in My Backyard' (WIMBY) Online Mapper;
- Environment Agency Catchment Data Explorer;
- Environment Agency Long Term Flood Risk Information Mapper;
- British Geological Survey's Onshore GeoIndex Online Mapper;
- Ordnance Survey Opendata; and
- Defra's online GIS portal - http://www. magic.defra.gov.uk/

9.2.2 The study area has been defined as the physical area of the scheme under consideration and a buffer of 1km either side of the scheme and any surface or groundwater bodies or water dependent conservation sites located up to 1km downstream of any potential future outfalls that will discharge highway drainage. The water environment receptors detailed within this Chapter are shown on Figure 1 in **Appendix A**: Environmental Constraints Plan.

9.2.3 Potential water abstractions from both surface and groundwater sources have been considered. The EA list abstractions within the WIMBY interactive mapper, however this is considered to be a non-exhaustive list with the potential for smaller abstractions, falling outside of the EA's licensing criteria, to occur.

9.2.4 Water Framework Directive (WFD) data[14] for surface, groundwater, transitional and coastal waters is provided within the EA Catchment Data Explorer.

9.2.5 The appraisal will follow the methodology as required by TAG Unit A3 Chapters 5 and 10. This follows the five step approach to appraising 'environmental capital':

- Step 1: Scoping and identification of study area (as detailed above);
- Step 2: key environmental resources have been identified and their features described. The resources have been described in terms of features or services that the resources provide;
- Step 3: The indicators that have been used to make a judgement on the importance of a feature under consideration are quality, scale, rarity and substitutability. Having gathered information against each of the four indicators, a summary of the value of each feature has been established based upon the criteria in TAG Unit A3 Chapter 10, Table 14;
- Step 4: An impact assessment of the scheme on identified water features has then been undertaken. Incremental, secondary and cumulative impacts have been considered and the extent to which resources are adversely affected or enhanced has been described; and
- Step 5: This step combines the appraisal of the importance of the water environment features, with the appraisal of the magnitude of the impacts, to determine the consequence of those impacts. A two-step process is required. The first step has assessed the significance of a potential impact on each affected feature (refer to Table 16 of TAG Unit A3, Chapter 10) based on the likely impact magnitude and the importance of the feature. The second step has combined the assessment of each feature into an assessment score for each key water environmental resource (based on the definitions given in Table 17 of TAG Unit A3, Chapter 10). The significant impacts on the water environment have been summarised on the Water Environment Worksheets (see Section 11.5) for inclusion in the AST.

9.3 Existing Environment

Surface Watercourses

9.3.1 The scheme crosses the River Yare once at TG524058, between Southtown Road to the west and Southgates Road to the east. The River Yare flows north to south throughout the study area, and is tidally influenced. The tidal extent of the River Yare reaches 15km upstream with a spring tidal range of approximately 2.2m[15]. The source of the River Yare is located near Shipham (TF937063, approximately 52km upstream of the scheme), where it flows east, skirting around the city of Norwich. It then flows south-east, then north-east towards the Norfolk Broads where it enters its

[14] Environment Agency, (2015). Anglian River Basin District. Retrieved 6th October 2016 from: http://environment.data.gov.uk/catchment-planning/RiverBasinDistrict/5

[15] Mott MacDonald (2009) Great Yarmouth Third River Crossing Simple Environmental Assessment.

estuary at Breydon Water at TG 469051. The Rivers Bure and Waveney also flow into the estuary from the north and south respectively. Downstream of Breydon Water, the Yare then flows south through the study area at Great Yarmouth and flows into the North Sea at TG534037.

9.3.2 Breydon Water is located 2.3km north-west and upstream of the scheme, and comprises of a large stretch of sheltered estuary which is 5km in length and up to 1.5km in width. It features extensive mudflats and is a designated SSSI (ID 1002542), Special Protection Area (ID UK9009181), Royal Society for the Protection of Birds Nature Reserve, Local Nature Reserve (ID 1008804) and Ramsar Site (UK11008) (Defra, 2016)[16].

9.3.3 Under the Water Framework Directive, the study area falls within the Anglian TraC (Transitional and Coastal) management catchment, within the Anglian River Basin District[17]. The Norfolk East TraC, is an operational catchment which is a subset of the Anglian TraC. The Norfolk East coastal waterbody and the Bure, Waveney, Yare & Lothing transitional waterbody are subsets of the Norfolk East TraC.

9.3.4 The River Yare in the vicinity of the study area is classified as part of the Bure, Waveney, Yare & Lothing transitional waterbody (ID GB510503410700). This waterbody extends north and upstream of the study area, up the River Chet to Chedgrave (TM 366 991) to the west, up the River Bure to Thurne (TG376 029) north-west of the site, and along the entire River Waveney to Lake Lothing at Lowestoft. This waterbody has an overall status of Poor, a Good chemical status and a Poor ecological status (due to poor biological quality elements such as Angiosperms). It is protected under the Conservation of Wild Birds Directive, Habitats Directive, Nitrates Directive and Urban Waste Water Treatment Directive. It is also classified as Heavily Modified[18]. It also features the marine designated SPA named Outer Thames Estuary Extension (Site Code UK9020309) with the status as a potential Special Area of Protection (pSPA).

9.3.5 Downstream of the scheme, the River Yare flows into North Sea, which is classified as the Norfolk East coastal water (ID GB650503520003). It has an overall water body status of Moderate, an ecological status of Moderate (due to Moderate levels of dissolved Inorganic Nitrogen) and a chemical status of Good. It is protected under the Bathing Water Directive, Conservation of Birds Directive and Habitats Directive. It also has a Heavily Modified hydromorphological designation. The North Sea at Great Yarmouth is also a designated marine SPA 'Outer Thames Estuary (Site Code UK9010309) and a possible SAC (Inshore) 'Southern North Sea) (no site code available)[16].

9.3.6 As part of site investigation work carried out in 2007 by Mott MacDonald, water samples from the River Yare were taken to collate information on water quality. Results indicated there were a number of parameters which exceeded Environmental

[16] Defra (2016) Magic Map Application. Retrieved 12th October 2016 from http://magic.defra.gov.uk/MagicMap.aspx

[17] Environment Agency (2016) Catchment Data Explorer. Retrieved 12th October 2016 from http://environment.data.gov.uk/catchment-planning/RiverBasinDistrict/5

[18] Environment Agency (2016) Catchment Data Explorer. Retrieved 12th October 2016 from http://environment.data.gov.uk/catchment-planning

Quality Standards. These parameters include copper, Biological Oxygen Demand and Total Suspended Solids[21].

Groundwater

9.3.7 The study area is underlain by the Broadland Rivers Chalk and Crag groundwater body (Waterbody ID GB40501G400300) which has an overall status of Poor, and both a quantitative and chemical status of Poor. This is as a result of a Poor status for a quantitative Groundwater Dependent Terrestrial Ecosystems (GWDTEs) test, as well as poor Chemical results within a Drinking Water Protected Area. The scheme is within a Nitrate Vulnerable Zone (NVZ - Zone ID 79). There are no Source Protection Zones (SPZs) within the study area.

9.3.8 The study area is underlain by Breydon Formation Clays and Silts along the River Yare, and north towards the Breydon Water. There are superficial peat deposits located west of the scheme location towards the A12, and North Denes Formation sand and gravel deposits located east of the scheme. The study area is underlain by sand and gravels of the Crag Group Bedrock[19].

9.3.9 The superficial deposits are designated as a Secondary A aquifer, comprising permeable layers capable of supporting water supplies at a local scale. The bedrock aquifer within the study area is designated as a principal aquifer, meaning that they typically provide a high level of water storage, and may support water supply/river base flow on a strategic level[20]. The study area is also entirely classified as having a groundwater vulnerability of Major Aquifer – High.

9.3.10 Ground Investigation works carried out in 2007 reported groundwater levels between 0.77 and 2.83 metres below ground level (mbgl), with groundwater flow direction unclear due to the tidal influence. The groundwater is also likely to be connected to the river level[21]. Groundwater quality monitoring was also carried out, with a number of contaminants exceeding the drinking water standards. These included dissolved arsenic, boron, nickel, selenium, nitrate, sulphate, benzo(a)pyrene and total cyanide. Dissolved nickel and selenium levels exceeded the drinking water standards in shallow water samples at one site, BH104. High dissolved boron concentrations were observed at all monitoring sites[21].

Abstractions

9.3.11 There are two tidal water sources of abstraction along the River Yare, a medium sized abstraction located approximately 1km upstream of the scheme and a large abstraction located 1km downstream[20].

9.3.12 The information provided by the EA (2007) detailed in the previous Environmental Assessment reported five abstractions from the River Yare for industrial uses

[19] British Geological Survey (BGS) (2016) Geology of Britain Viewer 1:50,000 scale. Retrieved 12th October 2016 http://mapapps.bgs.ac.uk/geologyofbritain/home.html.

[20] Environment Agency (2016) 'What's in your backyard' online mapper. Retrieved 12th October 2016 from http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

[21] Mott MacDonald (2007) Great Yarmouth Third River Crossing – Simple Environmental Assessment.

(approximately 500m downstream of the scheme), and two groundwater abstractions from the glacial sand and gravel deposits[15].

9.3.13 No information on domestic private water supplies were available as part of this assessment. This data will be sought from NCC as part of any detailed design work and assessment.

Pollution

9.3.14 Within the study area, one major pollution incident (featuring oil and fuel spill) and two significant pollution incidents (featuring oils, fuel and other waste material) relating to the water environment have been reported. There are six discharge consents along the River Yare, three relating to waste processes and three relating to discharges from fuel and power sources[20].

Flooding

9.3.15 Based on long term flood risk information provided by the EA, the study area features an extensive area along the River Yare which has a high flood risk (1% or 1 in 100 chance or greater of flooding each year). This is under the footprint of the scheme location from the roundabout on the western extent to the eastern side of the River Yare, and extensively in the Southtown area. Also along the River Yare downstream as far as the North Sea but less extensively. The River Yare watercourse itself is designated as a high flood risk. Upstream, there is a high risk of flooding (3.3% or 1 in 30 year chance) across the Breydon Water and adjacent marshland[22].

9.3.16 There are existing flood defences located upstream of the study area at Vauxhall Bridge at TG251081 and the existing A1243 crossing north of the scheme. Upgrades and repairs to the flood defences are due to be complete in 2017[23].

9.3.17 Surface water flooding data indicates that there are areas of medium and high risk surface water flooding between the A12 roundabout and the River Yare, and along the eastern banks of the River Yare between the river and the A1243 road, all of this area is built up ground[22].

Value of Receptors

9.3.18 The value (importance) of water environment features is summarised below in Table 9-1.

[22] Environment Agency (2016) Long term flood risk information. Retrieved 12th October fromhttps://flood-warning-information.service.gov.uk/long-term-flood-risk/

[23] Environment Agency (2015) Press release - £18m scheme under way to construct flood defences in Gt Yarmouth. Available from https://www.gov.uk/government/news/18m-scheme-under-way-to-construct-flood-defences-in-gt-yarmouth

Table 9-1: Criteria Used to Estimate the Value of Receptors

Value	Criteria
Very High	**Surface Water Quality and Biodiversity** Large or medium watercourses with pristine / near pristine water quality 'High' WFD Overall Status surface water body Sites protected under EU wildlife legislation (Special Area of conservation, Special Protection Areas and Ramsar) Watercourses supporting a wide range of significant species and habitats sensitive to changes in suspended sediment concentrations and turbidity such as salmon or freshwater pearl mussels Water dependent ecosystems of international/national biodiversity value **Hydromorphology** A watercourse exhibiting a range of natural morphological features such as pools and riffles, active gravel bars and varied river bank types, such morphological variability is a primary determinant of ecological diversity. Minimal modification **Hydrology and Flood Risk** Watercourses or floodplains, with direct flood risk to adjacent populated areas and/or presence of critical infrastructure such as schools and hospitals etc, which are highly sensitive to increased flood risk by the possible increase in water levels **Groundwater** Aquifer Productivity - Principal Groundwater vulnerability – Major Aquifer High Designated GWDTEs and GWDTEs located within designated areas **Water Supplies** Watercourse supporting major/critical public water supplies Public water supply or large private water supply serving >10 properties
High	**Surface Water Quality and Biodiversity** Medium or small watercourses with minor degradation of water quality as a result of anthropogenic factors 'Good' WFD Overall Status surface water body Sites protected under UK wildlife legislation (Sites of Special Scientific Interest and National Nature Reserves) Water dependent ecosystems of regional/county biodiversity value Watercourses supporting some species and habitats sensitive to changes in suspended sediment concentrations and turbidity **Hydromorphology** A watercourse exhibiting a range of morphological features with very little modification **Hydrology and Flood Risk** Watercourses or floodplains, with a possibility of direct flood risk to less populated areas without critical infrastructure, which are sensitive to increased flood risk by the possible increase in water levels **Groundwater**

Value	Criteria
	WFD Good overall status groundwater body Aquifer Productivity – Secondary A Groundwater vulnerability – Major Aquifer Intermediate/Low Non designated GWDTEs with highly groundwater dependent NVC communities **Water Supplies** Watercourses supporting minor/non-critical public drinking water supplies Private water supply serving 2-10 properties
Medium	**Surface Water Quality and Biodiversity** Small watercourses with degradation of water quality as a result of anthropogenic factors 'Moderate' WFD Overall Status surface water body Water dependent ecosystems of county/district biodiversity value Watercourses supporting limited species and habitats sensitive to changes in suspended sediment concentrations and turbidity **Hydromorphology** A watercourse exhibiting some signs of modifications and recovering to a natural equilibrium. Limited morphological features and a limited range of fluvial processes **Hydrology and Flood Risk** Watercourses or floodplains, with a possibility of direct flood risk to high value agricultural areas, which are moderately sensitive to increased flood risk by the possible increase in water levels **Groundwater** Aquifer Productivity – Secondary B Groundwater vulnerability – Minor Aquifer High/Intermediate Non designated GWDTEs with moderately groundwater dependent NVC communities **Water Supplies** Watercourses supporting private drinking water supplies or for agricultural/industrial use Private water supply serving a single property
Low	**Surface Water Quality and Biodiversity** Small, heavily modified watercourses or drains with poor water quality as a result of anthropogenic factors 'Poor'/'Bad' WFD Overall Status surface water body Water dependent ecosystems of local/less than local biodiversity value Watercourses which do not support any significant species and habitats sensitive to changes in suspended sediment concentrations and turbidity **Hydromorphology** A watercourse exhibiting no morphological diversity; flow is uniform, gravel bars absent and bank type's uniform and stable, with no evidence of active fluvial processes. Such watercourses may have been subject to past modification such as straightening, bank protection and culverting, or other anthropogenic pressures. **Hydrology and Flood Risk** Watercourses or floodplains passing through low value agricultural areas, which are less sensitive to increased flood risk by the possible increase in water levels

Value	Criteria
	Groundwater WFD Poor overall status groundwater body Aquifer Productivity – Secondary (undifferentiated) Groundwater vulnerability – Minor aquifer Low **Water Supplies** Watercourses not supporting water abstractions

9.3.19 The value/importance of surface watercourses (River Yare) is considered to be **Very High**, due to the connectivity of the River Yare with designated sites upstream and downstream.

9.3.20 The value of groundwater is considered to be **Low**, due to the Poor WFD status criteria for the Broadland Rivers Chalk and Crag groundwater body.

9.3.21 The value of surface and groundwater receptors in the area is considered to be **High**, based on the confirmation of agricultural/industrial water supplies in the study area, and uncertainty about any private domestic supplies.

9.3.22 The value/importance of river floodplain receptors is considered to be **High** due to the presence of High risk areas of flooding within the study area.

9.4 Brief Evaluation of Topic Related Constraints

9.4.1 The potential impacts of the three proposed bridge options have been considered in this appraisal. Options 32 and 33 are similar in terms of design, construction, operation and maintenance, the only difference being in the finer design details and road layout. The impacts of the proposed bridge options on the water environment have been adjudged to be similar. Therefore, this chapter presents the constraints of Options 32 and 33 together and the Option 37 separately.

9.4.2 Summarily, there are a number of potential environmental constraints highlighted within Section 9.3 which have been considered and these include:

- Surface Watercourses – potential for impact as a result of pollution from construction works, accidental spillage and routine run-off to the River Yare and local drainage networks. There may be geomorphological changes to watercourses as a result of new structures such as bridges and culverts;
- Groundwater – The construction of road cuttings and deep excavations associated with structural foundations have the potential to impact on groundwater levels and flows, with subsequent impacts on groundwater dependant receptors such as private water supplies and GWDTEs. If there are any groundwater discharges there is potential for pollution to groundwater from construction, routine run-off and accidental spillage;
- Flooding – there is potential for an increase in river and surface water flood risk, due to potential increase in impermeable areas created by the scheme.

In relation to flooding from sewers, it has not been possible to draw any conclusions on this risk due to the lack of available data; and

- Abstractions – tidal abstractions along the River Yare and groundwater abstractions within the study area may be impacted, due to changes in water flow and quality during construction and operation of the scheme.

9.4.3 The three options currently being considered are located entirely within floodplain cited as Flood Zone 3 (land assessed as having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding in any year). With flood defences, there is low risk of flooding to the eastern and western areas of the option, however the central part of the option which crosses over the River Yare remain at high risk.

9.4.4 All three options do not fall within the Environment Groundwater SPZ. However, they are located entirely within the British Geological Society (BGS) Bedrock Principal aquifer designation and partially within the BGS Superficial Deposits Secondary A aquifer designation.

9.4.5 All three options are not within the maximum extent of flooding from reservoirs. There are no major sources of artificial flooding affecting the scheme area.

Option 32

9.4.6 Option 32 consists of a dual carriageway with new four arm roundabout Suffolk Road tie-in to the west (four lane high level bridge across the River Yare, roundabout as west tie in and traffic signals to the east at South Denes Road). At the location of the bridge crossing, the water body is approximately 85m wide and is characterised as a heavily modified water body, with artificial, developed banks and a tidal flow regime.

9.4.7 There are small areas of low, medium and high risk of flooding from surface water. The notable area of risk is located to the south-east of the existing Hafrey's roundabout, in the location of the proposed new roundabout.

Option 33

9.4.8 Option 33 consists of a three lane carriageway, new four arm roundabout Suffolk Road tie-in to the west (three lane high level bridge across the River Yare, roundabout as west tie in and traffic signals to the east at South Denes Road). This option would operate as a tidal flow arrangement depending on the traffic flow conditions. The tidal flow arrangement would be controlled by overhead lane signals mounted on cantilever / portal gantries. At the location of the bridge crossing, the water body is approximately 85m wide and is characterised as a heavily modified water body, with artificial, developed banks and a tidal flow regime.

9.4.9 There are small areas of low, medium and high risk of flooding from surface water. The notable area of risk is located to the south-east of the existing Hafrey's roundabout, in the location of the proposed new roundabout.

Option 37

9.4.10 Option 37 consists of a single carriageway with at grade junction Southtown Road tie in to the west (single carriageway two lane low level bridge with traffic signal junctions to the west and the east at South Denes Road). At the location of the bridge crossing, the water body is approximately 85m wide and is characterised as a heavily modified water body, with artificial, developed banks and a tidal flow regime.

9.4.11 Option 37 is entirely located within floodplain cited as Flood Zone 3 (land assessed as having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding in any year). With flood defences, there is low risk of flooding to the eastern and western areas of the option, however the central part of the option which crosses over the River Yare remain at high risk.

9.4.12 There are small areas of low, medium and high risk of flooding from surface water. The notable area of risk is located to the south-east of the existing Hafrey's roundabout, at a section along the alignment of the new road which links the existing roundabout to the proposed river crossing.

9.5 Water Environment Appraisal - WebTAG Worksheets

1.1.1 The options are listed and described in the following order:

- Options 32 and 33; and
- Option 37.

Options 32 and 33 - Water Environment Worksheet

Options 32 and 33 Water Environment Worksheet									
Description of study area/ summary of potential impacts	**Key environmental resource**	**Features**	**Quality**	**Scale**	**Rarity**	**Substitutability**	**Importance**	**Magnitude**	**Significance**
Surface Water									
Potential floodplain loss and increased flood risk	Sea and Estuaries-River Yare	Conveyance of flood levels and overland flows, flood risk	Option falls within Flood Zone 3. Existing flood risk – fluvial and tidal.	Entire scheme within floodplain.	Feature of all watercourses and estuaries	Floodplain is heavily developed with urban environments and artificial surfaces on floodplain where scheme crosses land. Major compensation or mitigation of floodplain loss likely to be required through potential structural or sustainable flood management measures. Suitable location for attenuation Sustainable Drainage Systems (SuDS) to be sought outside of the floodplain	High	Large Adverse	Significant
Pollution to surface waters from construction	Sea and Estuaries-River Yare	Water quality	WFD Chemical - Good WFD Overall - Poor Ecological Status – Poor (due to poor biological quality elements such as Angiosperms). Classified as a Heavily Modified Water Body.	Regional	Medium	Limited	Medium	Slight adverse	Insignificant
Pollution to surface waters from routine runoff	Sea and Estuaries-River Yare	Water quality	WFD Chemical - Good WFD Overall - Poor Ecological Status – Poor (due to poor biological quality elements such as Angiosperms). Classified as a Heavily Modified Water Body.	Regional	Medium	Limited	Medium	Slight adverse	Insignificant
Pollution to surface waters from accidental spillage	Sea and Estuaries-River Yare	Water quality	WFD Chemical - Good WFD Overall - Poor Ecological Status – Poor (due to poor biological quality elements such as Angiosperms). Classified as a Heavily Modified Water Body.	Regional	Medium	Limited	Medium	Negligible	Insignificant
Alteration to surface flow characteristics that may affect channel, erosive or deposition processes	Sea and Estuaries-River Yare	Channel geomorphology	WFD - Heavily Modified Water Body Urbanised environment.	Local	Low	Limited	Low	Negligible	Insignificant
Alteration to availability of surface water abstractions	Sea and Estuaries-River Yare	Water supply	Tidal watercourse, with high saline content reducing resource demand	Local	Low	High	Low	Slight adverse	Insignificant
Chemical impacts of River Yare through diffuse pollution and highways	Seas and Estuaries-River Yare	Chemical Water Quality	Currently good chemical status	Measured on catchment	Common, region-wide	Substitute to ground water discharge	Medium	Minor Adverse	Insignificant

Options 32 and 33 Water Environment Worksheet									
Description of study area/ summary of potential impacts	**Key environmental resource**	**Features**	**Quality**	**Scale**	**Rarity**	**Substitutability**	**Importance**	**Magnitude**	**Significance**
discharge				wide basis.					
Pollution or flow alterations, including structures	Sea and Estuaries- River Yare	Chemical Water Quality- Transport and dilution of waste products	Tidal watercourse with potential for transport and dilution from consented discharges. Currently Good chemical status	Local	Medium	Not feasible	Low	Negligible	Insignificant
Groundwater									
Impact upon groundwater supply and abstractions	Water Supply- Broadland Rivers Chalk and Crag groundwater body	Principal Aquifer. Within a Nitrate Vulnerable Zone (NVZ)	Water has high mineral content.	Regional feature and important for supply.	Principal bedrock aquifer.	Widespread aquifer, surface water over abstraction. Unlikely to be substituted.	Very High	Negligible	Low significance
Impact and introduction of groundwater discharges and diffuse pollution to groundwater sources.	Groundwater Quality- Broadland Rivers Chalk and Crag groundwater body	Groundwater Vulnerability WFD status	Ground water vulnerability of Major Aquifer – High. WFD chemical status of Poor.	Regional.	Important principal aquifer. Regional importance for industrial supply.	Unlikely to substitute. Promotion of surface water abstraction unlikely due to pressures on supply and abundance.	Low	Negligible	Insignificant
Restriction or disruption of infiltration and groundwater flow	Groundwater Flow - Broadland Rivers Chalk and Crag groundwater body	Urbanised area.	Heavily urbanised area with numerous impermeable surfaces and reduced permeable areas.	Small increase in permeable area in regional or local context	Common in urban area.	Potential to offset with introduction of green space and permeable areas.	Low	Negligible	Insignificant

Options 32 and 33 Summary Appraisal (including Assessment Score)

9.5.1 The options are deemed to be of significant adverse impact to the water environment as a result of impacts to the floodplain. Groundwater flows and hydrological linkages between the options and potential groundwater abstractions would need to be established. It is unlikely that increased impermeable surfaces would impact upon the permeability of surrounding land and aquifer recharge, given the urbanised land use. It is anticipated that any embankments or bridge structures would not obstruct or alter flood flows any more than existing residential and/or commercial structures.

Summary Assessment Score: **Moderate Adverse**

Option 37 – Water Environment Worksheet

Option 37 Water Environment Worksheet									
Description of study area/ summary of potential impacts	**Key environmental resource**	**Features**	**Quality**	**Scale**	**Rarity**	**Substitutability**	**Importance**	**Magnitude**	**Significance**
Surface Water									
Potential floodplain loss and increased flood risk	Sea and Estuaries-River Yare	Conveyance of flood levels and overland flows, flood risk	Option falls within Flood Zone 3. Existing flood risk – fluvial and tidal.	Entire scheme within floodplain.	Feature of all watercourses and estuaries	Floodplain is heavily developed with urban environments and artificial surfaces on floodplain where scheme crosses land. Major compensation or mitigation of floodplain loss likely to be required through potential structural or sustainable flood management measures. Suitable location for attenuation SuDS to be sought outside of the floodplain	High	Large Adverse	Significant
Pollution to surface waters from construction	Sea and Estuaries-River Yare	Water quality	WFD Chemical - Good WFD Overall - Poor Ecological Status – Poor (due to poor biological quality elements such as Angiosperms). Classified as a Heavily Modified Water Body.	Regional	Medium	Limited	Medium	Slight adverse	Insignificant
Pollution to surface waters from routine runoff	Sea and Estuaries-River Yare	Water quality	WFD Chemical - Good WFD Overall - Poor Ecological Status – Poor (due to poor biological quality elements such as Angiosperms). Classified as a Heavily Modified Water Body.	Regional	Medium	Low level bridge which may potentially impede runoff from the full length of the bridge to be conveyed to the ends of the bridge and into stormwater treatment provision.	Medium	Minor adverse	Low significance
Pollution to surface waters from accidental spillage	Sea and Estuaries-River Yare	Water quality	WFD Chemical - Good WFD Overall - Poor Ecological Status – Poor (due to poor biological quality elements such as Angiosperms). Classified as a Heavily Modified Water Body.	Regional	Medium	Low level bridge which may potentially provide pathway for pollutants released through accidental spillage onto surface water receptors.	Medium	Minor adverse	Low significance
Alteration to surface flow characteristics that may affect channel, erosive or deposition processes	Sea and Estuaries-River Yare	Channel geomorphology	WFD - Heavily Modified Water Body Urbanised environment.	Local	Low	Limited	Low	Negligible	Insignificant

Option 37 Water Environment Worksheet									
Description of study area/ summary of potential impacts	**Key environmental resource**	**Features**	**Quality**	**Scale**	**Rarity**	**Substitutability**	**Importance**	**Magnitude**	**Significance**
Alteration to availability of surface water abstractions	Sea and Estuaries-River Yare	Water supply	Tidal watercourse, with high saline content reducing resource demand	Local	Low	Limited	Low	Negligible	Insignificant
Chemical impacts of River Yare through diffuse pollution and highways discharge	Seas and Estuaries-River Yare	Chemical Water Quality	Currently good chemical status	Measured on catchment wide basis.	Common, region-wide	Substitute to ground water discharge	Medium	Minor Adverse	Low significance
Pollution or flow alterations, including structures	Sea and Estuaries-River Yare	Chemical Water Quality-Transport and dilution of waste products	Tidal watercourse with potential for transport and dilution from consented discharges. Currently Good chemical status	Local	Medium	Not feasible	Low	Negligible	Insignificant
Groundwater									
Impact upon groundwater supply and abstractions	Water Supply-Broadland Rivers Chalk and Crag groundwater body	Principal Aquifer. Within a Nitrate Vulnerable Zone (NVZ)	Water has high mineral content.	Regional feature and important for supply.	Principal bedrock aquifer.	Widespread aquifer, surface water over abstraction. Unlikely to be substituted.	Very High	Negligible	Low significance
Impact and introduction of groundwater discharges and diffuse pollution to groundwater sources.	Groundwater Quality-Broadland Rivers Chalk and Crag groundwater body	Groundwater Vulnerability WFD status	Ground water vulnerability of Major Aquifer – High. WFD chemical status of Poor.	Regional.	Important principal aquifer. Regional importance for industrial supply.	Unlikely to substitute. Promotion of surface water abstraction unlikely due to pressures on supply and abundance.	Low	Negligible	Insignificant
Restriction or disruption of infiltration and groundwater flow	Groundwater Flow - Broadland Rivers Chalk and Crag groundwater body	Urbanised area.	Heavily urbanised area with numerous impermeable surfaces and reduced permeable areas.	Small increase in permeable area in regional or local context	Common in urban area.	Potential to offset with introduction of green space and permeable areas.	Low	Negligible	Insignificant

Option 37 Summary Appraisal (including Assessment Score)

9.5.2 The option is deemed to be of a significant adverse impact to the water environment as a result of impacts to floodplain. There are also a number of low significant impacts of the option on the water environment in relation to pollution to surface water and groundwater bodies. Groundwater flows and hydrological linkages between the option and potential groundwater abstractions would need to be established. It is unlikely that increased impermeable surfaces would impact upon the permeability of surrounding land and aquifer recharge, given the urbanised land use. It is anticipated that any embankments or bridge structures would not obstruct or alter flood flows any more than existing residential and/or commercial structures.

Summary Assessment Score: **Moderate Adverse.**

10 Appraisal Summary Tables – Environment

10.1 Introduction

10.1.1 The AST displays the degree to which the five Central Government objectives for transport (environment, safety, economy, accessibility and integration) would be achieved. It is from this AST that a judgement should be made about the overall value-for-money of the options in achieving the Government's objectives.

10.1.2 The information provided in the AST enable a consistent view to be taken about the value of the options developed for the scheme.

10.1.3 Sections 10.3 to 10.5 present summary extracts from the environmental assessments focusing on the environmental sub-objectives of the ASTs for the options.

10.2 Distributional Impact

10.2.1 A WebTAG distributional impact assessment has not been undertaken at this stage of the appraisal process for Noise and Air Quality as the options are at the same crossing point, making the outcome of a distributional impact immaterial to the optioneering process. This will be required at the detailed assessment stage.

10.3 Option 32 Appraisal Summary Table

Impacts		Summary of key impacts	Assessment			
			Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Environmental	Noise	There are 663 sensitive receptor buildings and no Defra Noise Important Areas within the 300m study area. This option is likely to cause some increases in noise level at the dwellings and other noise sensitive receptors in the immediate vicinity of the both the new and improved sections of carriageway due to increases in road traffic generated noise. Preliminary traffic data indicates that there are road links in the immediate area of the scheme which will experience significant changes in traffic flow and hence noise level as a result of the introduction of this option.	A combined property count of all sensitive receptors has identified 663 buildings in the study area.	N/A	Not Calculated	Not Calculated
	Air Quality	There are no designated AQMAs within 200m of this Option. There are also no ecologically designated sites considered sensitive to air pollution situated within 200m of this Option. An overall neutral local air quality impacts is likely given the traffic data provided (AM, IP & PM flows). A beneficial impact on regional emissions can be expected given the likelihood of the new bridge to reduce the distance travelled to cross the River Yare.	There are 252 potentially sensitive receptors within 200m of this option. Background mapped air pollutant concentrations are well below national objective values. Max roadside PCM concentrations 2015: 29.4µg/m^3 2020: 23µg/m^3	N/A	Not Calculated	Not Calculated
	Greenhouse gases	Scoped Out	Change in non-traded carbon over 60y (CO2e): N/A Change in traded carbon over 60y (CO2e): N/A	N/A	N/A	N/A
	Landscape	Scoped Out	N/A	N/A	N/A	N/A
	Townscape	This option would result in the loss of some existing residential townscape although not of particularly strong or defined townscape value. Existing vistas along the river corridor may be interrupted or fore-shortened by the structure, although the bridge would not appear out of context in respect of existing townscape.	N/A	Neutral	N/A	N/A

		The bridge when open would become a skyline feature to views along the river corridor and a distant feature of the Great Yarmouth skyline from within the Broads National Park. It would be perceived in the context of the town's existing townscape and in part industrial backdrop to the Park setting. The introduction of a third bridge crossing would have a beneficial effect on human interaction (non-motorised users) by way of improved townscape linkages.				
	Historic Environment	The setting of at least 2 Grade II Listed Buildings and two conservation areas may be indirectly impacted upon by this Option. Four non-designated heritage assets, including a railway line, a bomb crater and WWII defensive features may be directly impacted by this Option. There is potential for this Option to impact upon currently unknown below ground heritage assets.	N/A	Moderate Adverse	N/A	N/A
	Biodiversity	No adverse effects expected to any international or national designated nature conservation sites. Potential to impact bat roosts, breeding bird, water voles, black redstarts and hedgehogs due to the loss of suitable habitat for these species associated with land take for this option.	N/A	Slight adverse	N/A	N/A
	Water Environment	Water environment impacts include increased discharge into water bodies (surface and groundwater), which may cause a slight decrease in water quality. Increased potential for accidental spillage contaminating surface water or groundwater. Potential adverse impact to local aquifers during construction. Increase in flood risk along the watercourse due to increased run-off and reduction of floodplain.	N/A	Moderate Adverse	N/A	N/A

10.4 Option 33 Appraisal Summary Table

Impacts		Summary of key impacts	Assessment			
			Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Environmental	Noise	There are 663 sensitive receptor buildings and no Defra Noise Important Areas within the 300m study area. This option is likely to cause some increases in noise level at the dwellings and other noise sensitive receptors in the immediate vicinity of the both the new and improved sections of carriageway due to increases in road traffic generated noise. Preliminary traffic data indicates that there are road links in the immediate area of the scheme which will experience significant changes in traffic flow and hence noise level as a result of the introduction of this option.	A combined property count of all sensitive receptors has identified 663 buildings in the study area.	N/A	Not Calculated	Not Calculated
	Air Quality	There are no designated AQMAs and no ecologically designated sites that are considered sensitive to air pollution situated within 200m of the option. An overall neutral local air quality impacts is likely given the traffic data provided (AM, IP and PM flows). A beneficial impact on regional emissions can be expected given the likelihood of the new bridge to reduce the distance travelled to cross the River Yare.	There are 252 potentially sensitive receptors within 200m of the option. Background mapped air pollutant concentrations are well below national objective values. Max roadside PCM concentrations 2015: 29.4µg/m^3 2020: 23µg/m^3	N/A	Not Calculated	Not Calculated
	Greenhouse gases	Scoped Out	Change in non-traded carbon over 60y (CO2e): N/A Change in traded carbon over 60y (CO2e): N/A	N/A	N/A	N/A
	Landscape	Scoped Out	N/A	N/A	N/A	N/A
	Townscape	This option would result in the loss of some existing residential townscape although not of particularly strong or defined townscape value. Existing vistas along the river corridor may be interrupted or fore-shortened by the	N/A	Neutral	N/A	N/A

		structure, although the bridge would not appear out of context in respect of existing townscape. The bridge when open would become a skyline feature to views along the river corridor and a distant feature of the Great Yarmouth skyline from within the Broads National Park. It would be perceived in the context of the town's existing townscape and in part industrial backdrop to the Park setting. The introduction of a third bridge crossing would have a beneficial effect on human interaction (non-motorised users) by way of improved townscape linkages.				
	Historic Environment	The setting of at least 2 Grade II listed buildings and two conservation areas may be indirectly impacted upon by this Option. Four non-designated heritage assets, including a railway line, a bomb crater and WWII defensive features may be directly impacted by this scheme Option. There is potential for this Option to impact upon currently unknown below ground heritage assets.	N/A	Moderate Adverse	N/A	N/A
	Biodiversity	No adverse effects expected to any international or national designated nature conservation sites. Potential to impact bat roosts, breeding bird, water voles, black redstarts and hedgehogs due to the loss of suitable habitat for these species associated with land take for this option.	N/A	Slight adverse	N/A	N/A
	Water Environment	Water environment impacts include increased discharge into water bodies (surface and groundwater), which may cause a slight decrease in water quality. Increased potential for accidental spillage contaminating surface water or groundwater. Increase in flood risk along the watercourse due to increased run-off and reduction of floodplain.	N/A	Moderate Adverse	N/A	N/A

10.5 Option 37 Appraisal Summary Table

Impacts		Summary of key impacts	Assessment			
			Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Environmental	Noise	There are 663 sensitive receptor buildings and no Defra Noise Important Areas within the 300m study area. This option is likely to cause some increases in noise level at the dwellings and other noise sensitive receptors in the immediate vicinity of the both the new and improved sections of carriageway due to increases in road traffic generated noise. Preliminary traffic data indicates that there are road links in the immediate area of the scheme which will experience significant changes in traffic flow and hence noise level as a result of the introduction of this option.	A combined property count of all sensitive receptors has identified 571 buildings in the study area.	N/A	Not Calculated	Not Calculated
	Air Quality	There are no designated AQMAs and no ecologically designated sites that are considered sensitive to air pollution situated within 200m of this Option. An overall neutral local air quality impacts is likely given the traffic data provided (AM, IP & PM flows). A beneficial impact on regional emissions can be expected given the likelihood of the new bridge to reduce the distance travelled to cross the River Yare.	There are 206 potentially sensitive receptors within 200m of this Option. Background mapped air pollutant concentrations are well below national objective values. Max roadside PCM concentrations 2015: 29.4 µg/m^3 2020: 23 µg/m^3	N/A	Not Calculated	Not Calculated
	Greenhouse gases	N/A	Change in non-traded carbon over 60y (CO2e): N/A Change in traded carbon over 60y (CO2e): N/A	N/A	N/A	N/A
	Landscape	Scoped Out	N/A	N/A	N/A	N/A
	Townscape	This option would result in the loss of some existing residential townscape although not of particularly strong or defined townscape value. Existing vistas along the river corridor may be	N/A	Neutral	N/A	N/A

		interrupted or fore-shortened by the structure, although the bridge would not appear out of context in respect of existing townscape. The bridge when open would become a skyline feature to views along the river corridor and a distant feature of the Great Yarmouth skyline from within the Broads National Park. It would be perceived in the context of the town's existing townscape and in part industrial backdrop to the Park setting. The introduction of a third bridge crossing would have a beneficial effect on human interaction (non-motorised users) by way of improved townscape linkages.				
	Historic Environment	The setting of at least two Grade II listed buildings and two conservation areas may be indirectly impacted upon by this scheme Option. Three non-designated heritage assets, including a railway line, a bomb crater and WWII defensive features may be directly impacted by this scheme Option. There is potential for this scheme Option to impact upon currently unknown below ground heritage assets.	N/A	Moderate Adverse	N/A	N/A
	Biodiversity	No adverse effects expected to any international or national designated nature conservation sites. Potential to impact bat roosts, breeding bird, water voles, black redstarts and hedgehogs due to the loss of suitable habitat for these species associated with land take for this option.	N/A	Slight adverse	N/A	N/A
	Water Environment	Water environment impacts include increased discharge into water bodies (surface and groundwater), which may cause a slight decrease in water quality. Increased potential for accidental spillage contaminating surface water or groundwater. Increase in flood risk along the watercourse due to increased run-off and reduction of floodplain.	N/A	Moderate Adverse	N/A	N/A

Appendices

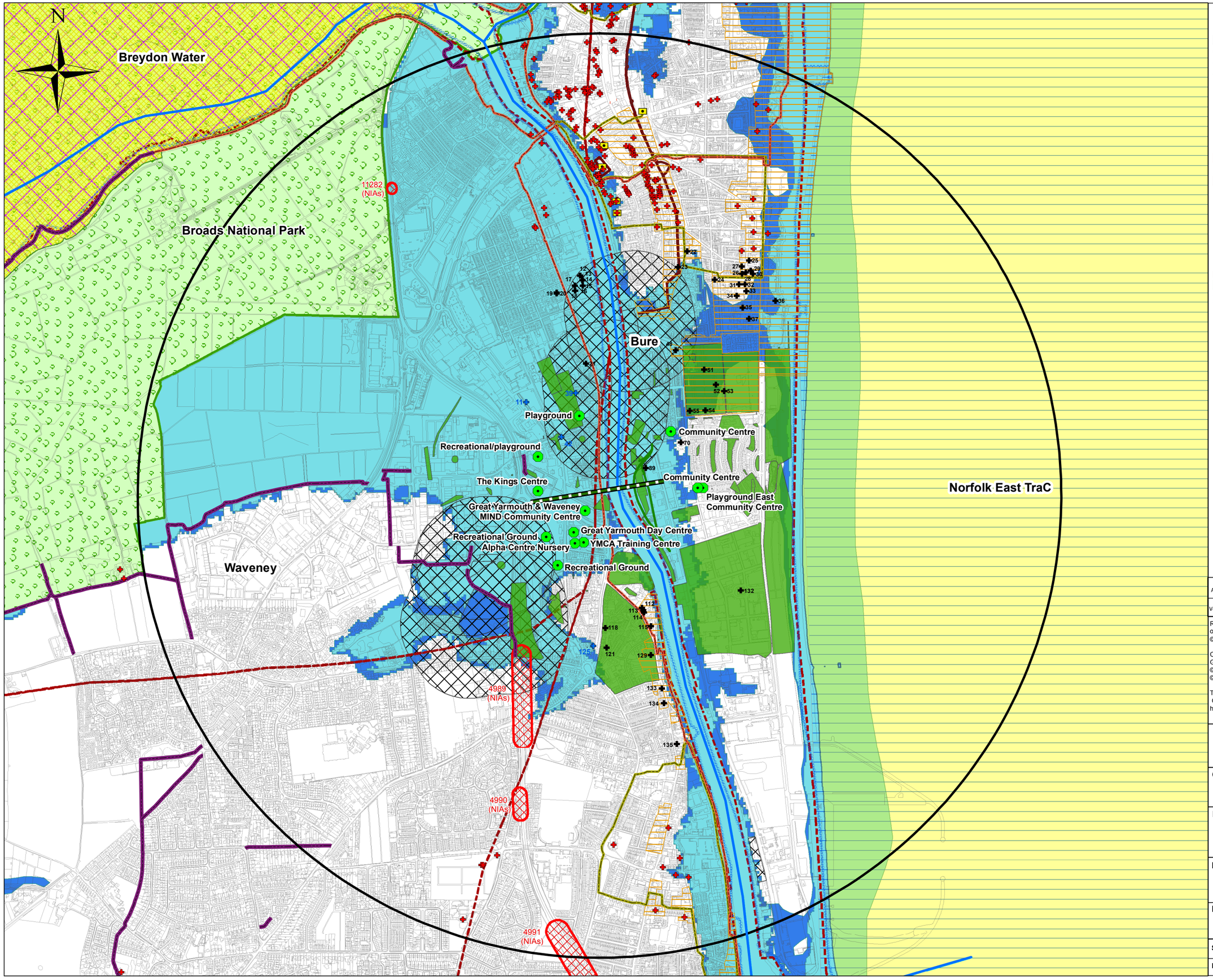
Appendix A: Plans

Environmental Constraints Plan

Option 32

Option 33

Option 37



KEY

- Immediate Zone of Influence (2KM buffer)
- Proposed Bridge Location
- Watercourse
- Undesignated Sites (Line) - Great Yarmouth
- Undesignated Sites (Region) - Great Yarmouth
- Undesignated sites - Great Yarmouth
- Listed Buildings - Great Yarmouth
- Listed Building
- Other (non-dwelling) Noise Sensitive Receptors
- Conservation Areas (Great Yarmouth)
- Noise Important Areas
- Scheduled Monument (Point)
- Scheduled Monument (Areas)
- Ramsar
- Special Protection Areas
- Sites of Special Scientific Interest (SSSI)
- Public Rights of Way
- Main Trails
- Circulars Trails
- Minerals and Waste Sites
- National Character Areas
- Broads National Park
- WFD Surface Water Operational Catchments Cycle 2
- Flood Zone 3
- Flood Zone 2

DRAFT

Ver	Amendments	IW 23/03/2017 Originated by and date	OE 23/03/2017 Checked by and date	RA 23/03/2017 Approved by and date
A				

mouchel
building great relationships

Client
Norfolk County Council

Project
Great Yarmouth Thrid River Corssing

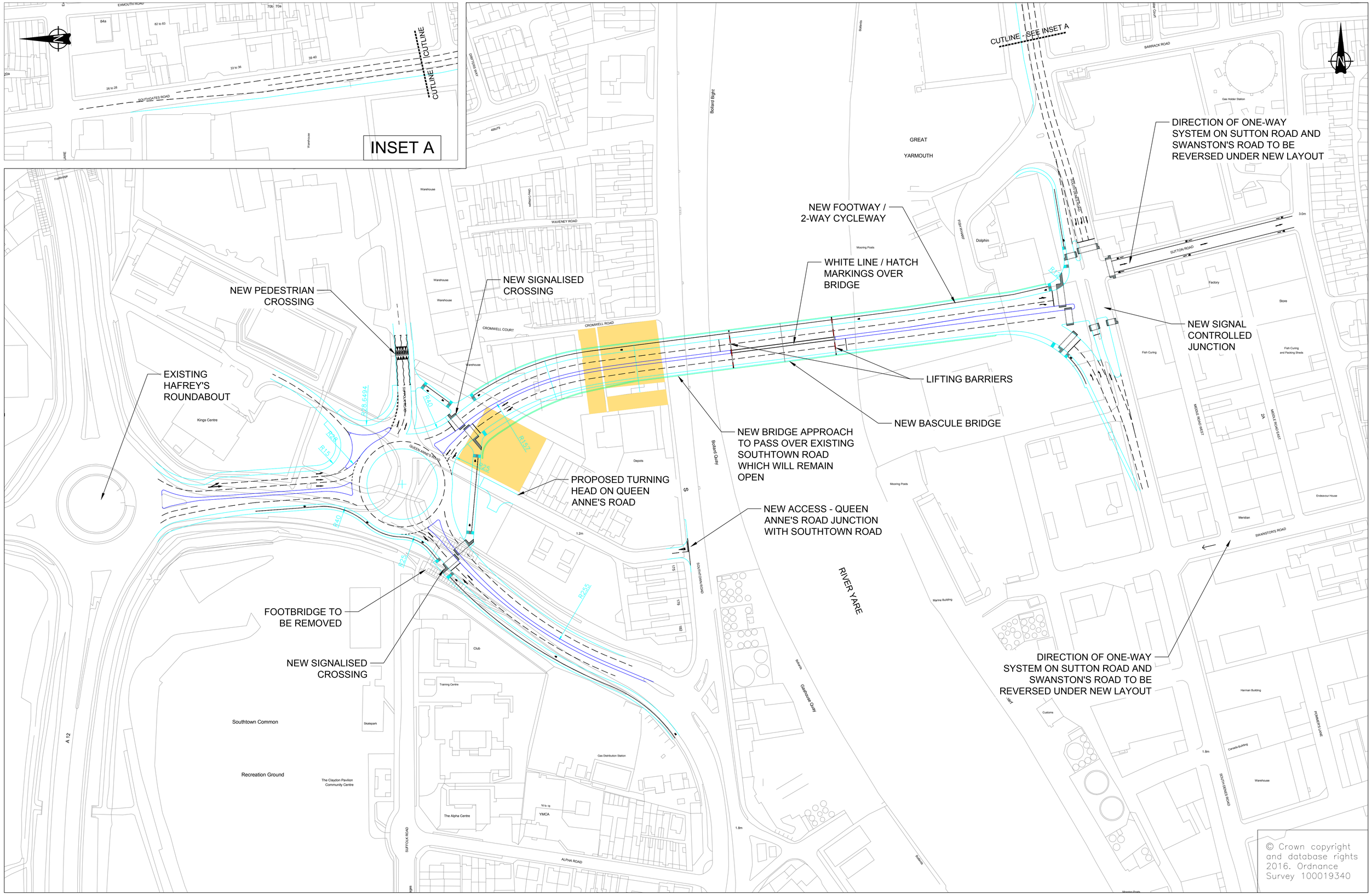
Drawing Title
Environmental Constraints Plan

Drawing No.
FIGURE 1

Scale @ A3 : 1:15,000

Purpose : Information

Path: W:\ENVADMIN\Hydradmin\GIS_Projects_External\GreatYarmouth_3rdRiverCrossing\MXD_GIS\Figure 1 environmental constraints plan.mxd



Norfolk County Council

Tom McCabe
Executive Director of
Community and Environmental Services
Norfolk County Council
County Hall, Martineau Lane
Norwich NR1 2SG

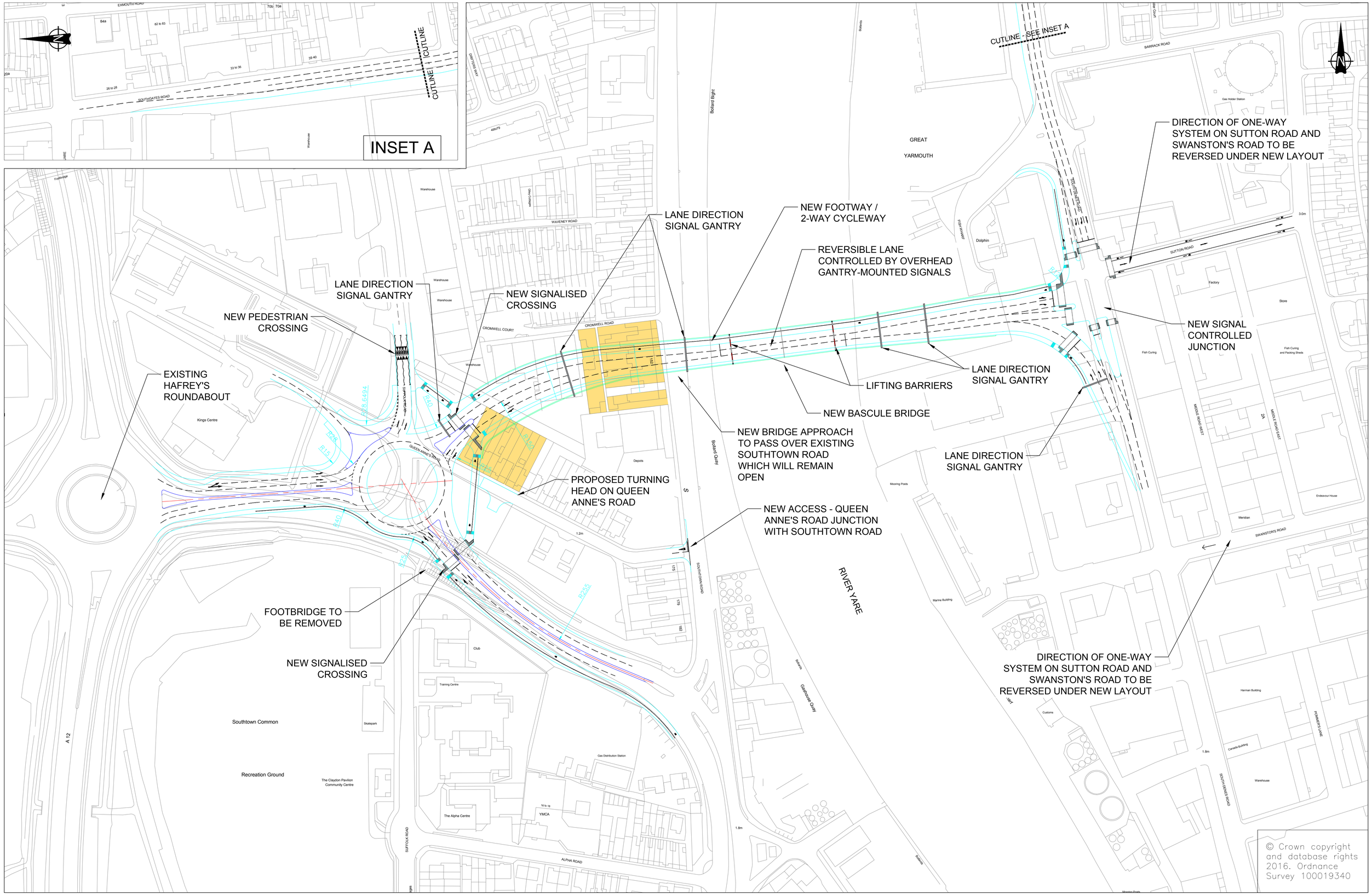
DRAWING TITLE

GREAT YARMOUTH THIRD RIVER CROSSING
OPTION 32 - NORTHERN ALTERNATIVE ROUTE
PLAN

REV.	DESCRIPTION	DRAWN BY	CHECKED	DATE
A	FIRST ISSUE	LP	MM	FEB17

	INITIALS	DATE	DRAWING No. 1076653-MOU-HGN-OPT32-DR-D-0001(P1,S2)	
DESIGNED BY	LP	FEB 17	PROJECT TITLE	
DRAWN BY	LP	FEB 17	GREAT YARMOUTH THIRD RIVER CROSSING	
CHECKED BY	MM	FEB 17		
APPROVED BY	RB	FEB 17	SCALE 1:1000 @ A1	FILE No. 0001

IG 12/10/16



Norfolk County Council

Tom McCabe
Executive Director of
Community and Environmental Services
Norfolk County Council
County Hall, Martineau Lane
Norwich NR1 2SG

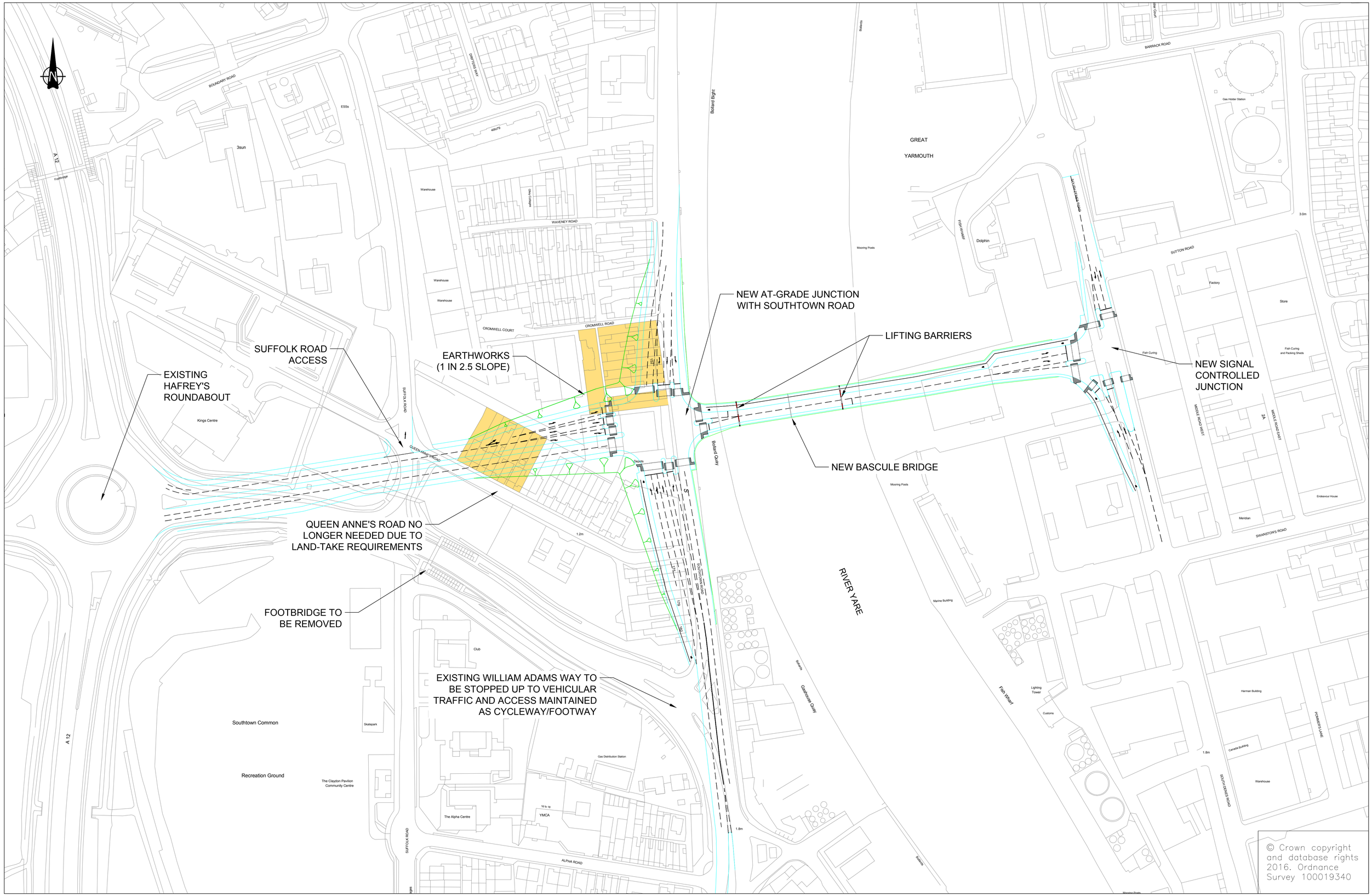
DRAWING TITLE

GREAT YARMOUTH THIRD RIVER CROSSING
OPTION 33 - NORTHERN ALTERNATIVE ROUTE
PLAN

REV.	DESCRIPTION	DRAWN BY	CHECKED	DATE
A	FIRST ISSUE	AP	MM	FEB17

	INITIALS	DATE	
DESIGNED BY	AP	FEB 17	DRAWING No. 1076653-MOU-HGN-OPT33-DR-D-0003(P1,S2)
DRAWN BY	AP	FEB 17	PROJECT TITLE: GREAT YARMOUTH THIRD RIVER CROSSING
CHECKED BY	MM	FEB 17	
APPROVED BY	RB	FEB 17	SCALE 1:1000 @ A1 / FILE No. 0003

IG-13/10/16



Norfolk County Council

Tom McCabe
Executive Director of
Community and Environmental Services
Norfolk County Council
County Hall, Martineau Lane
Norwich NR1 2SG

DRAWING TITLE

GREAT YARMOUTH THIRD RIVER CROSSING
OPTION 37 - LOW COST ALTERNATIVE
PLAN

REV.	DESCRIPTION	DRAWN BY	CHECKED	DATE
A	FIRST ISSUE	AP	MM	FEB17

	INITIALS	DATE	DRAWING No. 1076653-MOU-HGN-OPT37-DR-D-0005(P1,S2)	
DESIGNED BY	AP	FEB 17	PROJECT TITLE	
DRAWN BY	AP	FEB 17	GREAT YARMOUTH THIRD RIVER CROSSING	
CHECKED BY	MM	FEB 17		
APPROVED BY	RB	FEB 17	SCALE 1:1000 @ A1	FILE No. 0005

IO 12/10/16

Appendix B: Preliminary Ecological Report

GREAT YARMOUTH THIRD RIVER CROSSING

Preliminary Ecological Appraisal

October 2016

Produced for

Norfolk County Council

Prepared by

mouchel
building great relationships

Unit 2180
1st Floor
Thorpe Park
Century Way
Leeds
LS15 8ZB
UK

Document Control Sheet

Project Title	Great Yarmouth Third River Crossing
Report Title	Preliminary Ecological Appraisal
Report ref no.	
Revision	1
Status	Final
Control Date	October 2016

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
1	Final	D. Lovett	20/10/16	R. Bailey	21/10/16	A. Bascombe	24/10/16

Distribution

Date	Organisation	Contact	Format	Copies

This report is presented to Norfolk County Council in respect of the Great Yarmouth Third River Crossing and may not be used or relied on by any other person. It may not be used by Norfolk County Council in relation to any other matters not covered specifically by the agreed scope of this report.

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

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

Contents

1 Introduction

1.1 Background

Mouchel was commissioned by Norfolk County Council to undertake a Preliminary Ecological Appraisal (PEA) of land at the proposed site of the Great Yarmouth Third River Crossing. The site has been identified by Norfolk County Council 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 1km from the site and makes recommendations for further survey work and/or avoidance or mitigation measures as appropriate.

1.2 Site Location

The scheme proposals would change 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 ties in to 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

A study area, extending up to 1km from the site of the proposed scheme was surveyed in order to determine impacts and likely constraints to the proposed scheme. The study set out to:

- Consult records of statutory protected sites within 1km of the proposed scheme;
- Identify habitats and species present or likely to be present that are ecologically important and/or have legal protection;
- 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 study 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 study 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 study area 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 during October, which is outside of the optimal season for carrying out botanical surveys (April to September inclusive). Nevertheless, it is considered that the survey work undertaken was sufficient to be able to map the habitats and ecological features present.

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

[2] *Joint Nature Conservancy Council (JNCC) (2007). 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 proposed scheme. This site is designated because it supports 38% of the Great British population of red-throated 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 proposed scheme.

3.1.3 Species

The information returned from the desk study contained a record of one moth, 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 proposed scheme.

3.1.5 Reptiles

There are four records for common lizard *Zootoca vivipara*, the most recent being 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 proposed scheme, the most recent being from December 2012.

There are three records of otter *Lutra lutra* within 2km of the proposed scheme, 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 study area, many of which are from within the footprint of the proposed scheme. 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 also been recorded within 2km of the proposed scheme, in August 2013.

There is one record of badger *Meles meles* within 2km of the proposed scheme, dating from September 2014.

3.1.7 *Birds*

A large number of bird species have been recorded within 2km of the proposed scheme. 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 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 of the proposed scheme 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 proposed scheme 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 study area 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 proposed scheme 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 proposed scheme 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 redstarts.

4 Evaluation & Recommendations

4.1 Statutory Designated and Non-Statutory Protected Sites

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

4.2 Habitats

The study area 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 study area 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 (Table 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 scheme.

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*

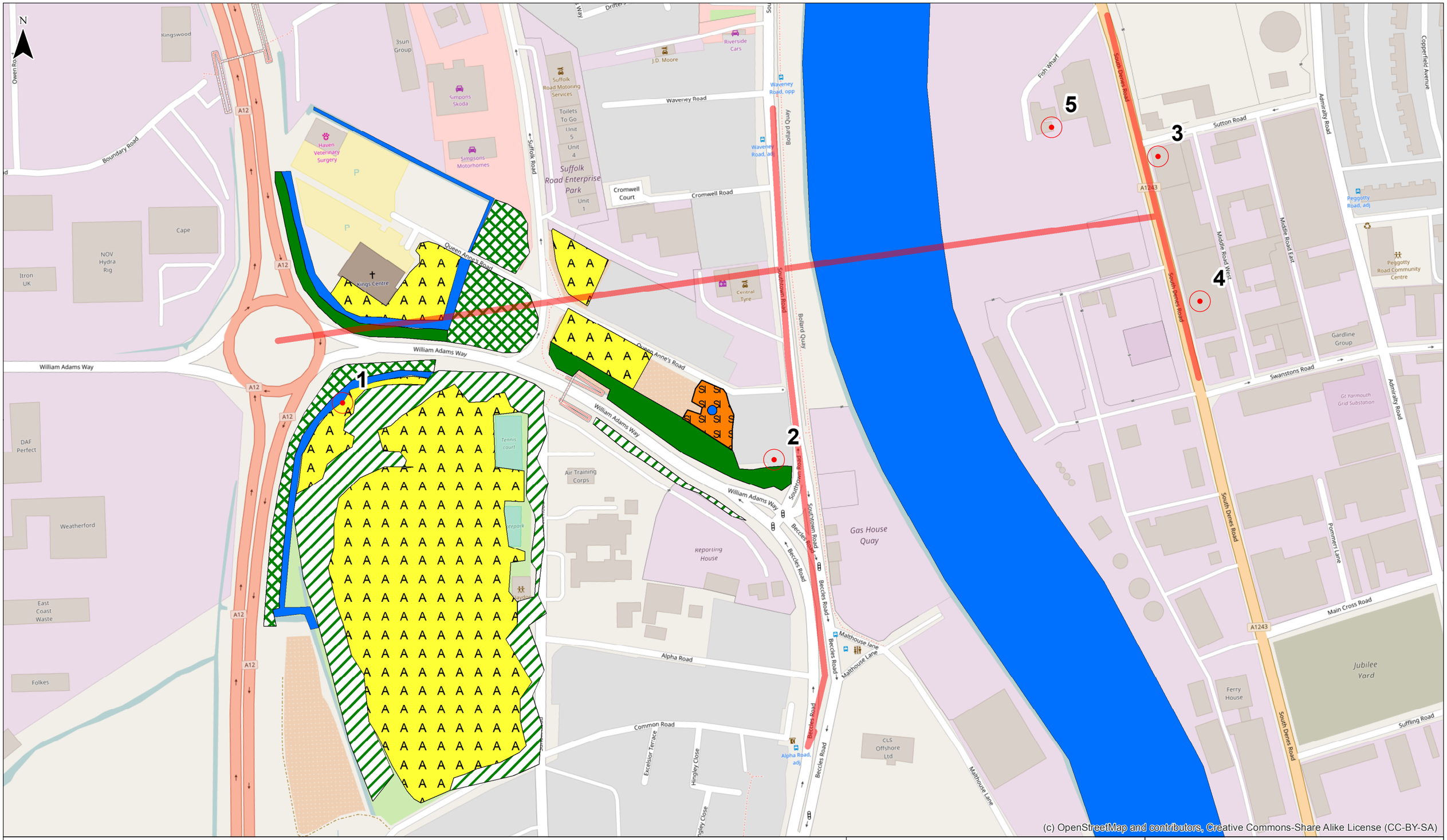
The buildings within the site are either to be purchased for demolition or will be subject to disturbance during the construction of the proposed scheme. It is recommended that further surveys are undertaken to confirm the presence or absence of bats within these buildings.

The wider area supports water voles 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. It is recommended that a watching brief is maintained during the works to protect individual hedgehogs that may be present.

5 Figures

Figure 1 – Habitat Map



Legend

- Target Notes
- Great Yarmouth River Crossing
- Amenity Grasslands
- Water
- Neutral Grassland: Semi-improved
- Scrub: Dense/Continuous
- Woodland:Broad-leave Plantation
- Woodland: Semi-natural

Version	Amendment	Drawing Date	Review Date	Approved Date
A	First Issue	06/12/2016	09/12/2016	09/12/2016

Client: Norfolk County Council

Project: The Great Yarmouth Third River Crossing (GYTRC)

Drawing Title: GYTRC Phase 1 Habitat Survey

mouchel
building great relationships

Office: Puddle Dock

Tel: 020 7822 2497

Scale (at A3 size): 1:2,407

Purpose of Issue: Information

Drawing Number: Page 1 of 1

Appendix C: Gazetteer of Heritage Assets

Appendix C – Archaeology and Built Heritage Baseline Gazetteer

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
1	MNF49675 (NHER)	TG 5170 0621	Bomb Crater	A line of ten WWII bomb craters visible as earthworks on 1940s aerial photographs. Recent aerial photographs and OS mapping suggest the sites is now partially under Harfreys Industrial Estate and waste ground, and the craters have presumably been levelled.	HER	Modern (WWII)	Low
2	MNF49172 (NHER)	TG 5164 0606	Ditch, Bank	A disused drain which probably dates to the post medieval period visible on 1940s aerial photographs. It was probably associated with the drainage of Southtown marches in the post medieval period, but has now been built over.	HER	Post medieval	Low
3	MNF49672 (NHER)	TG 5175 0607	Bomb Crater	A WWII bomb crater visible as an earthwork on 1940s aerial photographs. The site has now been built over.	HER	Modern (WWII)	Low
4	MNF49610 (NHER)	TG 5174 0589	Bomb Crater	A WWII bomb crater visible as an earthwork on 1940s aerial photographs. The site has now been built over.	HER	Modern (WWII)	Low
5	MNF49606 (NHER)	TG 5190 0593	Bomb Crater	A WWII bomb crater visible as an earthwork on 1940s aerial photographs. The site has now been built over.	HER	Modern (WWII)	Low
6	MNF49603 (NHER)	TG 5199 0587	Bomb Crater	A WWII bomb crater visible as an earthwork on 1940s aerial photographs. The site has now been built over.	HER	Modern (WWII)	Low
7	MNF48761 (NHER)	TG 5200 0600	Pillbox	A possible WWII pillbox is visible as an extant structure on 1940s aerial photographs. It if was a pillbox, it would have formed part of a chain of anti-invasion defences sites along the landward side of Great Yarmouth to protect the town and	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				transport links. The structure was removed in 1945. An industrial park now occupies the site.			
8	MNF49697 (NHER)	TG 5209 0601	Air Raid Shelter	Three WWII air raid shelters visible on 1940s aerial photographs. They appear to have been within some sort of industrial site and are likely to have been industrial shelters for the site workers. The shelters have since been levelled and built over.	HER	Modern (WWII)	Low
9	MNF49681 (NHER)	TG 5212 0645	Bomb Crater, Spigot Mortar Emplacement	A pit dating to WWII which is possibly a bomb crater or a spigot mortar emplacement is visible as an earthwork on 1940s aerial photographs. If it was a mortar emplacement it may have been associated with the possible military training area 40m to the SE. The site has been levelled and built over.	HER	Modern (WWII)	Low
10	MNF49738 (NHER)	TG 5216 0644	Ropery, Ropewalk	A ropewalk is marked at this location on the OS 1st edition map. It is one of several which once existed at Great Yarmouth. The site has since been levelled and mostly built over.	HER	Post medieval	Low
11	MNF32661 (NHER)	TG 5206 0632	Pillbox	A WWII type 24 pillbox survives on land at which is now Yarmouth Business Park in Southtown. It was visited on the ground in 1995. It was part of a line of anti-invasion defences cited to protect the landward side of Great Yarmouth.	HER	Modern (WWII)	Low
12	NHLE ref 1245813	TG 52303 06872	Building	Workshop range north of Number 244A. Range of outbuildings constructed for Admiralty barrack use in 1855. It was in commercial use from 1891 and converted to light engineering works in 1971. Built of red brick under Welsh slate roofs.	Listed (Grade II)	Post medieval	Medium
13	NHLE ref 1245811	TG 52303 06872	Barracks	Militia Barracks, built in 1853-5. Converted to light engineering works in 1971.	Listed (Grade II)	Post medieval	Medium

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
14	NHLE ref 1393268	TG 52313 06850	Offices	Utility block immediately east of No 244A Southtown Road. Smithy and Carpenters shop dating to 1806-1810 to designs of James Wyatt for the Ordnance Board. Converted to light engineering works in 1971.	Listed (Grade II)	Post medieval	Medium
15	NHLE ref 1245812	TG 52313 06850	Offices	Utility block immediately east of No 244A Southtown Road. Ancillary building to the naval arsenal by James Wyatt in 1806. Now light engineering works.	Listed (Grade II)	Post medieval	Medium
16	NHLE ref 1245814	TG 52314 06828	Arsenal	244B Southtown Road. Naval arsenal, built 1806 by James Wyatt. Now used as light engineering works. This building was the actual armoury and had until 1829 a fireproof stone roof.	Listed (Grade II)	Post medieval	Medium
17	NHLE ref 1245815	TG 52280 06827	Lodge	245 Southtown Road was the North Lodge to the former naval arsenal, shown as 'Clerk of the Cheques' House' in 1810. Built of 1806-10 by James Wyatt for the Ordnance Board. Altered probably in 1891 when the site was relinquished by the Admiralty for commercial use.	Listed (Grade II)	Post medieval	Medium
18	NHLE ref 1245810	TG 52281 06806	House	244 Southtown Road was a storekeeper's house to the naval arsenal. It was built in 1806 by James Wyatt and formed the south lodge to the complex. It is now commercial offices.	Listed (Grade II)	Post medieval	Medium
19	NHLE ref 1245807	TG 52201 06797	Wall	Boundary wall to south of number 66, built early 19th century of tarred red brick	Listed (Grade II)	Post medieval	Medium
20	NHLE ref 1245808	TG 52201 06794	Wall	Boundary wall to south of number 67, built early 19th century of brick.	Listed (Grade II)	Post medieval	Medium
21	NHLE ref 1245809 MNF48074 (NHER)	TG 52328 06490	House	83 & 84 Southtown Road. A pair of late 18th century houses with 19th century alterations. The houses are separated by an arched passageway with cast iron gates.	Listed (Grade II) & HER	Post medieval	Medium

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
22	NHLE ref 1096791	TG 52766 06976	Fish curing works	Tower fish curing works, built in 1880 in red brick with some stone to the south and east ranges. It is a triangular site with 3 ranges of buildings around a yard. The manager's house and office occupies the west end of the north range. Inside the complex, the brine tanks are still intact.	Listed (Grade II)	Post medieval	Medium
23	NHLE ref 1245561	TG 52727 06909	Fish curing works, pottery production site.	Fish Curing works, then converted to the Great Yarmouth potteries. Built early 19th century against the town walls of 1285-95 to the east. Built of brick and flint with timber interior partitioning.	Listed (Grade II*)	Post medieval	High
24	NHLE ref 1246059	TG 52885 06854	Terrace	41-46 Nelson Road South. Terrace of 6 houses built in the mid-19th century, all were converted into a hotels in the 20th century. Built of gault brick with stuccoed and rusticated ground floors with slate and concrete tile roofs.	Listed (Grade II)	Post medieval	Medium
25	NHLE ref 1246584	TG 53034 06937	Hotel	The Royal Hotel opened in 1840. The façade and large rear extensions were added in 1877 by JB Pearce. It is of stuccoed red brick with a slate roof. Charles Dickens apparently stayed here in 1848-9 while writing David Copperfield.	Listed (Grade II)	Post medieval	Medium
26	NHLE ref 1096805	TG 53004 06878	Terrace, Hotel	Donna Doone Hotel (Nos 1, 1A & 2), Neptune Hotel (Nos 9-11) and Sienna Lodge Hotel (Nos 17-18). Terrace of houses, now including 3 hotels, which were built in 1844-47 of gault brick and partly stuccoed and colourwashed.	Listed (Grade II)	Post medieval	Medium
27	NHLE ref 1245564	TG 53002 06910	Terrace	11-16 Wellington Road. Terrace of houses built in the early 1840s of gault brick.	Listed (Grade II)	Post medieval	Medium
28	NHLE ref 1245566	TG 53020 06885	Arch	Wellington Arch is an archway forming the north entrance to the Victoria estate and was built in 1846 by John Brown. It was restored in 1980. It is built of gault brick with rendered details.	Listed (Grade II)	Post medieval	Medium

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
29	NHLE ref 1245563	TG 53041 06894	Terrace	3, 4 and 5 Waterloo Road. Terrace of 3 houses built in the mid-19th century of gault brick.	Listed (Grade II)	Post medieval	Medium
30	NHLE ref 1246583	TG 53051 06878	Hotel	Cavendish Hotel, formerly known as Brandon Mansions Hotel. Originated as a terrace of houses built in 1844 by Farrants & Turrel. Built of stuccoed brick with slate and concrete tile roof.	Listed (Grade II)	Post medieval	Medium
31	NHLE ref 1096806	TG 52991 06832	Terrace	The Embassy Hotel (Nos 38-41). Terrace of houses, part now a hotel, built in 1844-7 of gault brick.	Listed (Grade II)	Post medieval	Medium
32	NHLE ref 1271805	TG 53016 06832	Arch	Wellington Mews Arch is a monumental arch forming the entrance to the mews behind Kimberley Terrace. It was built in 1847 of gault brick.	Listed (Grade II)	Post medieval	Medium
33	NHLE ref 1271269	TG 53022 06805	Terrace	Carlton Hotel (Nos 1-5). Terrace of houses, part now a hotel. It was laid out from 1841 as the first part of the Victoria Building Company's estate under the overall direction of Thomas Marsh Nelson. Built of stuccoed brick with slate roofs.	Listed (Grade II)	Post medieval	Medium
34	NHLE ref 1096787	TG 52980 06784	Terrace	Mayflower Hotel (No 5), St Georges Hotel (Nos 7-8). Terrace of 8 houses, now 2 hotels. Built in 1844 of stuccoed brick with concrete and tile roofs.	Listed (Grade II)	Post medieval	Medium
35	NHLE ref 1271606	TG 53006 06732	Assembly Rooms	Masonic Royal Assembly Rooms built 1863 by HH Collins. It partly burnt out in 1870 and became the masonic lodge under patronage of HRH Prince of Wales. It is built of gault brick with slate roofs.	Listed (Grade II)	Post medieval	Medium
36	NHLE ref 1271608	TG 53148 06762	Winter Gardens	The Winter Gardens were designed and constructed in Torquay by John Watson and William Harvey between 1878 and 1881 at a cost of £12783. It was relocated to Great Yarmouth in 1904.	Listed (Grade II*)	Post medieval	High

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
37	NHLE ref 1271607	TG 53034 06684	House	Shadingfield Lodge, formerly a house, now a hotel. Built 1862-5 by AW Morant and altered internally in 1953 by AW Ecclestone. Built of gault brick under slate roofs.	Listed (Grade II)	Post medieval	Medium
38	MNF48764 (NHER)	TG 5223 0633	Air Raid Shelter, Bomb Crate, Defence work, gun emplacement, military training site, practice trench.	A WWII military site, comprising various features and defences including air raid shelters, slit trenches, bomb craters and possibly a searchlight emplacement. The precise function of the site is unclear, although the variety of installations and the disorganised layout would suggest a military training site. Much of the site has been built over and no features are no longer visible on the ground or on modern aerial photographs.	HER	Modern (WWII)	Low
39	MNF49703 (NHER)	TG 5228 0636	Air Raid Shelter	A possible air raid shelter dating to WWII visible as an earthwork mound (presumably covering a structure) on 1940s aerial photographs. Its size and shape suggest a private shelter, possibly an Anderson shelter. No trace of the structure survives above ground today.	HER	Modern (WWII)	Low
40	MNF49678 (NHER)	TG 5214 0617	Bomb Crater	Two WWII bomb craters are visible as earthworks on 1940s aerial photographs. The site has now been levelled and built over.	HER	Modern (WWII)	Low
41	MNF48763 (NHER)	TG 5219 0615	Roadblock, anti-tank block	A group of WWI anti invasion defences, comprising two road blocks and a possible pillbox, are visible on aerial photographs taken in 1944. They were situated on the western edge of the inhabited part of Southtown. They were removed in 1945 and no trace of them exists today.	HER	Modern (WWII)	Low
42	MNF12936 (NHER)	TG 5222 0617	Findspot	In 1977 a Neolithic scraper was found during building work. It was found at a depth of 4.2m.	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
43	MNF49679 (NHER)	TG 5231 0616	Bomb Crater	A probable WWII bomb crater visible on 1940s aerial photographs. The site has since been levelled and built over.	HER	Modern (WWII)	Low
44	MNF48762 (NHER)	TG 5231 0610	Spigot Mortar Emplacement	A WWII spigot mortar emplacement is visible as an extant structure and earthwork on 1940s aerial photographs. It appears to have been associated with two roadblocks and other defences. It appears that site has been levelled.	HER	Modern (WWII)	Low
45	MNF48800 (NHER)	TG 5259 0655	Hut, Civil Defence Building	A hut or temporary building, probably related to civil defence or shelter during WWII was visible as an extant structure on 1940s aerial photographs. It was removed soon after the end of the war.	HER	Modern (WWII)	Low
46	MNF49709 (NHER)	TG 5262 0642	Air Raid Shelter	Six probable air raid shelters dating to WWII visible as structures and earthworks on 1940s aerial photographs. These were most likely private shelters and may have been Anderson shelters. There is no evidence of these structures above ground today.	HER	Modern (WWII)	Low
47	MNF46372 (NHER)	TG 5267 0646	Air Raid Shelter	A WWII air raid shelter is visible as an extant earth covered structure on 1940s aerial photographs. It size and location within a light industrial yard would suggest it was placed to protect the local workforce. The site has been levelled and built over.	HER	Modern (WWII)	Low
48	NHLE ref 1245981	TG 52716 06548	Church	Parish church of St James. The nave and chancel date to 1870-78 by JP Seddon. The aisles date to 1902-8 by Bottle & Olley. Built of cut and knapped flint with red brick dressings.	Listed (Grade II)	Post medieval	Medium
49	MNF4340 (NHER)	TG 5283 0642	Barracks, Hospital, Royal Naval Hospital	St Nicholas's Hotel, also known as the Royal Naval Hospital, was built between 1809 and 1811. It was used as a military barracks between 1818 and 1854, but subsequently reverted	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				to its original use as a Naval hospital. The buildings surround a courtyard in which a greenhouse built around 1890, used to stand. In 1815 seven sailors and seventeen Waterloo soldiers were apparently buried in the courtyard. The burials were reported to have been excavated in 1979. During WWII the hospital was used as a Naval information centre and administrative quarters, named HMS Watchful. The surviving hospital buildings have been restored and converted into flats and houses.			
50	MNF46399 (NHER)	TG 5278 0651	Air Raid Shelter	A large WWII air raid shelter is visible as an extant earth covered structure on 1940s aerial photographs. It lay within the grounds of the former St James School, directly adjacent to the main school building as was presumably intended for use by the pupils and teachers of the school.	HER	Modern (WWII)	Low
51	NHLE ref 1245984	TG 52840 06464	Hospital	St Nicholas Hospital Main Entrance Range. These buildings consisted of guard rooms, archway and service rooms to the naval hospital, now general storage and kitchens to St Nicholas' Hospital. Of yellow stock brick with Portland stone dressings and slate roof.	Listed (Grade II*)	Post medieval	High
52	NHLE ref 1245983	TG 52890 06400	Naval hospital	St Nicholas Hospital, formerly Naval Hospital. Built in 1809-11 by William Pilkington under supervision of Edward Holl, Architect to the Navy Board. It became naval barracks in 1818 and subsequently a general hospital. It is of yellow brick laid in Flemish bond with dressings of Portland stone. It is on a quadrangle plan with single depth wards, with a west chapel. Each of the four wings is linked by a single storey quadrant	Listed (Grade II*)	Post medieval	High

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				passageway.			
53	NHLE ref 1245986	TG 52926 06371	Wall, Railings	St Nicholas Hospital Walls and Railings dating to 1811 with mid-20th century insertions and repairs. By Edward Holl and William Pilkington, architects at the Navy Board. They are of brick and cast-iron. The walls run around the west, south and east sides of the site.	Listed (Grade II)	Post medieval	Medium
54	NHLE ref 1245985	TG 52845 06289	Hospital	St Nicholas Hospital South Block. This was an Isolation wing to the Naval Hospital, now St Nicolas' Hospital. It was built c.1809-11 by William Pilkington, supervised by Edward Holl, Architect to the Navy Board. It is of yellow stock brick under slate roofs. It is of one storey.	Listed (Grade II)	Post medieval	Medium
55	NHLE ref 1245982	TG 52778 06286	Mortuary, Chapel	St Nicholas Hospital CSSD store. Formerly a mortuary and chapel dating to c.1810, now dis-used. It is of various shades of red brick with a hipped slate roof. It is rectangular and single depth in plan.	Listed (Grade II)	Post medieval	Medium
56	MNF57307 (NHER)	TG 52550 06356	Naval storehouse	The surviving section of a sail loft and storehouse which was constructed in 1798 for the Royal Navy.	HER	Modern (WWII)	Low
57	MNF49707 (NHER)	TG 5269 0636	Air Raid Shelter	Three probable air raid shelters dating to WWII are visible as earthworks with structural elements on 1940s aerial photographs. These were probably private shelters. The site has since been redeveloped as housing and shelters have presumably been levelled.	HER	Modern (WWII)	Low
58	MNF48794 (NHER)	TG 5299 0641	Air Raid Shelter, Barrage Balloon Site, Hut	WWII military activity and installations are visible as extant buildings, structures and earthworks on aerial photographs from the 1940s. They were located immediately east of the	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				Royal Naval Hospital and may also have been under Naval control during the war. There is no evidence on the ground that these features still exist.			
59	MNF46973 (NHER)	TG 5316 0636	Barbed Wire Obstruction, Trench, Pillbox	A group of WWII anti invasion defences is visible as extant structures, buildings and earthworks on 1940s aerial photographs. The defences, which are visible on Great Yarmouth seafront stretching from Wellington Pier to the Pleasure Beach, formed part of a longer line of defences which extended all the way along the seafront. There is no evidence that any trace of the defences survives today.	HER	Modern (WWII)	Low
60	MNF46981 (NHER)	TG 5306 0627	Roadblock	A WWII road block is visible as a structure on 1940s aerial photographs. It appears to have been removed some time before the end of the war.	HER	Modern (WWII)	Low
61	MNF46982 (NHER)	TG 5306 0622	Roadblock	A WWII road block is visible as a structure on 1940s aerial photographs. A small structure to its west, which appears to be surrounded by a blast wall, may have been an associated defensive building. The road block seems to have been removed some time before the end of the war.	HER	Modern (WWII)	Low
62	MNF47003 (NHER)	TG 5304 0616	Air Raid Shelter	Nine small WWII air raid shelters, at least some of which were probably Anderson shelters, visible as earthworks and structures on 1940s aerial photographs. There is no evidence to suggest that any remains survive above ground.	HER	Modern (WWII)	Low
63	MNF46989 (NHER)	TG 5306 0611	Roadblock	A WWII road block is visible as a structure on 1940s aerial photographs. As with other examples, they appear to have been removed before the end of the year.	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
64	MNF47007 (NHER)	TG 5306 0606	Air Raid Shelter	A large WWII air raid shelter is visible as an arrangement of structures and earthworks on 1940s aerial photographs. It was levelled after the end of the war.	HER	Modern (WWII)	Low
65	MNF41610 (NHER)	TG 53137 06006	Fairground Ride	The 'scenic railway' was built in 1932, and is one of only a few examples in the world of an early wooden roller coaster, and may be the oldest outside of the USA.	HER	Modern	Low
66	MNF47061 (NHER)	TG 5278 0620	Air Raid Shelter	Two small WWII air raid shelters which could have been Anderson shelters or a similar design, are visible on 1940s aerial photographs. There is no evidence that any remains of the shelters survive above ground.	HER	Modern (WWII)	Low
67	MNF47065 (NHER)	TG 5279 0625	Air Raid Shelter	A group of earthwork mounds with structural elements, probably WWII air raid shelters, visible on 1940s aerial photographs. There is no evidence that any remains of these survive above ground today.	HER	Modern (WWII)	Low
68	MNF47063 (NHER)	TG 5285 0625	Air Raid Shelter	A group of earthwork mounds with structural elements, probably WWII air raid shelters, visible on 1940s aerial photographs. There is no evidence that any remains of these survive above ground today.	HER	Modern (WWII)	Low
69	MNF47000 (NHER)	TG 5295 0623	Air Raid Shelter	Four WWII air raid shelters visible as earth covered structures on 1940s aerial photographs. They all lay within the grounds of what is now Greenacre First and Middle Schools and were probably constructed for the use of its staff and pupils. These were levelled since the end of the war.	HER	Modern (WWII)	Low
70	NHLE ref 1096789 MNF32731	TG 52739 06149	Gas Works	Excellent example of a gasometer with ornate finials to the uprights of the frame which is braced with a lattice pattern. The gasometer was built at another site, but collapsed and was	Listed (Grade II) & HER	Post medieval	Medium

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
	(NHER)			rebuilt here in 1885. An old map shows this was the site of a steam engine before the gasometer was built.			
71	MNF47033 (NHER)	TG 5281 0611	Air Raid Shelter	Five small WWII air raid shelters, at least some of which were Anderson shelters, visible as earthworks and structures on 1940s aerial photographs. There is no evidence to suggest any remains survive above ground today.	HER	Modern (WWII)	Low
72	MNF47029 (NHER)	TG 5287 0609	Air Raid Shelter	Eleven small WWII air raid shelters, at least some of which were probably Anderson shelters, visible as earthworks and structures on 1940s aerial photographs. There is no evidence that any remains survive above ground today.	HER	Modern (WWII)	Low
73	MNF47024 (NHER)	TG 5295 0609	Air Raid Shelter	Fifteen small WWII air raid shelters, at least some of which were probably Anderson shelters, visible as earthworks and structures on 1940s aerial photographs. There is no evidence that any remains survive above ground today.	HER	Modern (WWII)	Low
74	MNF47008 (NHER)	TG 5301 0602	Air Raid Shelter	Two small WWII air raid shelters, at least one of which was probably an Anderson shelter, visible as earthworks and structures on 1940s aerial photographs. There is no evidence that any remains survive above ground today.	HER	Modern (WWII)	Low
75	MNF46991 (NHER)	TG 5306 0600	Roadblock	WWII road block visible as a structure on 1940s aerial photographs. As with other examples, this one appears to have been removed some time before the end of the war.	HER	Modern (WWII)	Low
76	MNF46960 (NHER)	TG 5316 0564	Weapons Pit, Gun Emplacement	A group of WWII anti invasion defences is visible as extant structures, buildings and earthworks on 1940s aerial photographs. These defences were visible on Great Yarmouth seafront stretching from the Pleasure Beach to the open ground now used as a caravan park and were part of a longer	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				line of defences which extended all the way along the seafront. There is no evidence that any trace of the defences survive as upstanding features.			
77	MNF4328 (NHER)	TG 530 059	Battery	The South Star Battery was built in 1782. A magazine for storing gunpowder was added in 1793. The battery was restored and reconstructed several times and was still in use in 1914 when it was being used as a barracks. The site is now under Harbord Crescent east of battery road.	HER	Modern (WWII)	Low
78	MNF47009 (NHER)	TG 5305 0594	Air Raid Shelter	Five small WWII air raid shelters, at least some of which were probably Anderson shelters, are visible as earthworks and structures on 1940s aerial photographs. There is no evidence that anything of these remains above ground today.	HER	Modern (WWII)	Low
79	MNF47048 (NHER)	TG 5297 0595	Air Raid Shelter	Five small WWII air raid shelters, at least some of which were Anderson shelters are visible as earthworks on 1940s aerial photographs. There is no evidence that anything of these remains above ground today.	HER	Modern (WWII)	Low
80	MNF46992 (NHER)	TG 5305 0589	Roadblock	A WWII road block is visible as a structure on 1940s aerial photographs. This was removed some time before the end of the war.	HER	Modern (WWII)	Low
81	MNF47012 (NHER)	TG 5303 0586	Air Raid Shelter	A small WWII air shelter, possibly an Anderson shelter, is visible as an earthwork on aerial photographs taken in 1945. There is no evidence that any remains of these survive above ground today.	HER	Modern (WWII)	Low
82	MNF46932 (NHER)	TG 5302 0584	Air Raid Shelter	Three WWII air raid shelters visible as earthworks and structures on 1940s aerial photographs. The site has been built over and the shelters probably levelled.	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
83	MNF47081 (NHER)	TG 5254 0619	Military building	A group of probable WWII buildings visible as extant structures on wartime aerial photographs. All or some of the buildings might be military in origin and relate to the defence of Great Yarmouth or the naval base that was established at the town. Alternatively, they might relate to industrial activity at the quayside during the war years. The buildings have been since levelled and redeveloped in the post war period.	HER	Modern (WWII)	Low
84	MNF47068 (NHER)	TG 5259 0618	Bomb Crater	Two WWII bomb craters are visible as earthworks on 1940s aerial photographs. The intended target was probably the gas works 50m to the southeast. The site has since been levelled since the end of the war.	HER	Modern (WWII)	Low
85	MNF47071 (NHER)	TG 5263 0617	Gas Holder	A WWII air raid shelter and a former gas holder, the latter possibly used as an emergency water supply tank, and visible as extant earthworks and structures on 1940s aerial photographs. The site has since been levelled.	HER	Modern (WWII)	Low
86	MNF62069 (NHER)	TG 5253 0609	Salt Store, Ice House	Icehouse and salt stores visible on the 1st edition ordnance survey map. The buildings have all since been demolished.	HER	Post medieval	Low
87	MNF47036 (NHER)	TG 5257 0582	Barbed wire obstruction, Military building	WWI defences, comprising a circuit of fencing and barbed wire as well as several small buildings, visible on 1940s aerial photographs. These were laid out along the quayside and around the former fish wharf buildings. They were removed after the end of the war.	HER	Modern (WWII)	Low
88	MNF13576 (NHER)	TG 52364 07247	Railway	During the mid and late 19th century a series of railway lines were constructed within Great Yarmouth town. One section linked Vauxhall station to Beach Station, North Quay and the fishmarket, whilst the second linked Ballast Quay and North	HER	Post medieval	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				Pier. At first the trains were horse drawn, but after 1883 engines were used. The railways were closed at various times from 1927 onwards and many of the routes are now covered by modern development, although some features do survive in places.			
89	NHLE ref 1096829 MNF38779 (NHER)	TG 52587 06039	Public House	The Dolphin Public House was built between 1900 and 1904. It was designed by J.W. Cockrill and features his distinctive use of red brick over concrete and decorative tiles. The decorative tiles feature marine subjects.	Listed (Grade II), & HER	Modern	Medium
90	MNF48439 (NHER)	TG 5229 0597	Roadblock	A group of WWII anti invasion defences comprising anti-tank blocks, a type 24 pillbox and a spigot mortar emplacement, are visible as extant buildings, structures and earthworks on 1940s aerial photographs. In the post war period the site was levelled and built over, and there is no evidence that any part of the defences still survives.	HER	Modern (WWII)	Low
91	MNF48445 (NHER)	TG 5239 0588	Roadblock	A group of WWII anti invasion defences, comprising a substantial road block and tank trap protected by two or three pillboxes are visible on 1940s aerial photographs. The defences were removed before August 1945.	HER	Modern (WWII)	Low
92	MNF47054 (NHER)	TG 5287 0594	Air Raid Shelter	A small WWII air raid shelter, possibly an Anderson shelter, visible as an earthwork on 1940s aerial photographs. It lay in the back garden of a house and was probably a private shelter. There is no evidence to suggest that any remains above ground today.	HER	Modern (WWII)	Low
93	MNF61853 (NHER)	TG 5275 0584	Coal Fired Power Station	Great Yarmouth Electricity Works was Great Yarmouth's first power station using steam engines and steam turbines to	HER	Post medieval	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				provide power to industry, transport, public lighting and domestic use. It was decommissioned in 1958 and part of the building (although not original parts) still remain.			
94	MNF47044 (NHER)	TG 5280 0585	Military Building	A WWII structure, possibly a military building such as a guardhouse or sentry box, visible as an extant building on 1940s aerial photographs. It was demolished by 1951.	HER	Modern (WWII)	Low
95	MNF13576 (NHER)	TG 52364 07247	Railway	Railway lines constructed in the mid to late 19th century, no longer extant.	HER	Post medieval	Low
96	MNF49602 (NHER)	TG 5234 0576	Bomb Crater	A probable WWI bomb crater visible as a partially backfilled earthwork on 1940s aerial photographs. The site has since been levelled and resurfaced.	HER	Modern (WWII)	Low
97	MNF49685 (NHER)	TG 5237 0573)	Air Raid Shelter	A WWII air raid shelter visible as an earthwork and structure on 1940s aerial photographs. Its small size and location within a garden suggest that it was a private shelter. The site has since been built over and the shelter probably levelled.	HER	Modern (WWII)	Low
98	MNF49691 (NHER)	TG 5232 0570	Air Raid Shelter	A WWI air raid shelter is visible as an earthwork on 1940s aerial photographs, It lay within what appears to have been an industrial site and its size suggests that it was an industrial shelter. The site has since been levelled and built over.	HER	Modern (WWII)	Low
99	MNF49598 (NHER)	TG 5196 0561	Bomb Crater	A probable WWII bomb crater is visible on an earthwork and disturbed ground on 1940s aerial photographs. Recent aerial photographs show that the site may still survive as a slight earthwork.	HER	Modern (WWII)	Low
100	MNF19084 & MNF19949 (NHER)	TG 5207 0537	Pillbox, Anti-Aircraft Battery	A WWII Light Anti-Aircraft Battery is visible as a group of earthworks, structures ad buildings on aerial photographs and has also been partially recorded on the ground, It comprised a	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
				Bofors gun emplacement, a Type 22 pillbox, a possible earthwork gun emplacement and a variety of ancillary structures and huts. Many of the structures were removed at the end of the war, the pillbox was demolished in 1991 during the construction of the A12 (T) on top of the former railway embankment.			
101	MNF49686 (NHER)	TG 5234 0564	Air Raid Shelter	A probable WWII air raid shelter visible as an earthwork on 1940s aerial photographs. There is no evidence to suggest that anything survives above ground today.	HER	Modern (WWII)	Low
102	MNF49688 (NHER)	TG 5239 0564	Air Raid Shelter	A probable WWII air raid shelter visible as an earthwork on 1940s aerial photographs. There is no evidence to suggest that anything survives above ground today.	HER	Modern (WWII)	Low
103	MNF49687 (NHER)	TG 5241 0561	Blast Wall, Air Raid Shelter	A probable surface level air raid shelter is visible as an extant building on 1940s aerial photographs. It has since been levelled and built over.	HER	Modern (WWII)	Low
104	MNF49578 (NHER)	TG 5227 0558	Air Raid Shelter	Two possible WWI air raid shelters visible as earthworks on 1940s aerial photographs. The area has since been levelled.	HER	Modern (WWII)	Low
105	MNF49689 (NHER)	TG 5218 0548	Air Raid Shelter	A large WWI air raid shelter is visible as an earthwork and associated structures on 1940s aerial photographs. This was probably a public shelter. The site has since been levelled and built over.	HER	Modern (WWII)	Low
106	MNF49561 (NHER)	TG 5219 0543	Air Raid Shelter	Twelve probably WWII air raid shelters visible as earthworks and structures. The site has since been levelled.	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
107	MNF48435 (NHER)	TG 5223 0544	Bomb Site, Water Tank	A static emergency water supply tank, dating to WWII, is visible as an extant structure on 1940s aerial photographs taken in 1944. It is one of several such tanks positioned around Great Yarmouth for use by fire fighters after bombing raids. It was located on what was probably a bomb site but had been removed by 1945.	HER	Modern (WWII)	Low
108	MNF49514 (NHER)	TG 5228 0545	Air Raid Shelter	A probable WWII air raid shelter visible as an earthwork on 1940s aerial photographs. There is no evidence that anything remains above ground today.	HER	Modern (WWII)	Low
109	MNF49567 (NHER)	TG 5233 0550	Air Raid Shelter	Two probable WWII air photographs visible on aerial photographs. The site has since been levelled.	HER	Modern (WWII)	Low
110	MNF15149 (NHER)	TG 525 055	Prison, Maltings	A post medieval maltings, dating from the early 19th century. The maltings were said to have been used as a prison during the Napoleonic War. The buildings were demolished in the 1980s after being damaged by fire.	HER	Post medieval	Low
111	MNF48433 (NHER)	TG 5252 0550	Fire Station, Air Raid Shelter, Broadcasting Transmitter	Structures and buildings visible on 1940s aerial photographs. These may have represented WWII civil defence buildings. No traces of these structures are visible today.	HER	Modern (WWII)	Low
112	NHLE ref 1246973 MNF47922 (NHER)	TG 52570 05433	House	Providence Villa, built in 1843. It is built of red brick with a gault brick façade. There is a date plaque on the house which reads *Providence Villa I & S L, 1843*.	Listed (Grade II), & HER	Post medieval	Medium
113	NHLE ref 1246972 MNF47923	TG 52575 05424	House	96 High Road was built around 1830s. It is mainly constructed of red brick but has a gault brick façade.	Listed (Grade II), & HER	Post medieval	Medium

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
	(NHER)						
114	NHLE ref 1246971 MNF48137 (NHER)	TG 52579 05414	Terraced House	95 High Road was once two early 19th century terraced houses, but is now one house. It is constructed of gault brick and is of two storeys with a black glazed pantile roof.	Listed (Grade II), & HER	Post medieval	Medium
115	NHLE ref 1246970 MNF48136 (NHER)	TG 52610 05354	House	Ahoy and Manby House (86 and 87 High Road) are a pair of red brick houses built in the 1840s. Most of the structures are colourwashed. On no 86 there is an inscriptions stating that Captain G W Manby F.R.S, the inventor of life saving apparatus) lived in the house and dies there is 1854.	Listed (Grade II), & HER	Post medieval	Medium
116	MNF66695, MNF10562 (NHER)	TG 5250 0530	Church, Priory, Leper Hospital	This is the site of a large Augustinian Friary and church. The friary was founded in the 13th century and was dissolved in 1538. Human skeletons have been found here since the 18th century and excavations have revealed the presence of structures on the site. Remains of the friary buildings have also been incorporated into buildings to the north and south of Burnt Lane.	HER	Medieval	Medium
117	MNF49505 (NHER)	TG 5249 0537	Air Raid Shelter	Two probable WWII air raid shelters are visible as earthworks and structures on 1940s aerial photographs. There is no evidence to suggest that any part of the shelters now survives above ground.	HER	Modern (WWII)	Low
118	NHLE ref 1096790 MNF47939 (NHER)	TG 52411 05346	Methodist Chapel	Southtown and Gorleston Methodist Church is a late 19th century red brick Methodist church which was extended in 1901. It has a gault brick façade under a slate roof and is of a single storey.	Listed (Grade II), & HER	Post medieval	Medium

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
119	MNF49503 (NHER)	TG 5245 0533	Air Raid Shelter	Two probable WWII air raid shelters visible as earthworks on 1940s aerial photographs. There is no evidence to suggest anything survives above ground today.	HER	Modern (WWII)	Low
120	MNF49506 (NHER)	TG 5250 0531	Air Raid Shelter	Possible WWII air raid shelter visible as an earthwork on 1940s aerial photographs. The site has since been built over.	HER	Modern (WWII)	Low
121	NHLE ref 1096804	TG 52417 05260	Friary	Remains of the house of the Austin Friary. This building dates to the 15th century, but the Friary was founded in 1311. It is of flint and brick. The surviving remains consist of a short stretch of wall with part of a 15th century chafered 4 centred brick arch.	Listed (Grade II)	Medieval	Medium
122	MNF49502 (NHER)	TG 5244 0528	Air Raid Shelter	Five probable WWII air raid shelters visible as earthworks and structures on 1940s aerial photographs. There is no evidence to suggest that anything survives above ground today.	HER	Modern (WWII)	Low
123	MNF66634 (NHER)	TG 5244 0527	Beam Slot, Timber Framed Building	A watching brief in 2013 revealed beam slots and post holes associated with a late medieval timber-framed building. Finds recovered from these features included late medieval brick, roof tile and wall plaster.	HER	Uncertain	Low
124	MNF49500 (NHER)	TG 5247 0525	Air Raid Shelter	Five probable WWII air raid shelters visible as earthworks and structures on 1940s aerial photographs. There is nothing to suggest that anything remains above ground today.	HER	Modern (WWII)	Low
125	MNF39960 (NHER)	TG 5236 0527	Boundary Post	A cast iron boundary post which is probably dated to 1819. It is inscribed '*The Bounds of Gorleston and Southtown*'.	HER	Post medieval	Low
126	MNF49513 (NHER)	TG 5233 0526	Air Raid Shelter	A probable air raid shelter dating to WWII is visible as a structure on 1940s aerial photographs. The site has since been levelled.	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
127	NMF32655 (NHER)	TG 5264 0535	Gun emplacement	A group of WWII defences, comprising a tower for a light anti-aircraft gun, a spigot mortar emplacement and a possible air raid shelter, are visible as extant structures and earthworks on aerial photographs. The tower was demolished in the post war period and there is no evidence that any trace of the defences now survives at the site.	HER	Modern (WWII)	Low
128	MNF61540 (NHER)	TG 5264 0529	Findspot	An archaeological evaluation in August 2010 revealed an alluvial deposit and a residual sherd of late 18th to late 19th century pottery.	HER	Modern (WWII)	Low
129	NHLE ref 1246974	TG 52608 05230	House	Koolunga House, formerly known as Wishbone. The house has now been split into flats. It is dated 1826 and built of gault brick with slate roof.	Listed (Grade II)	Post medieval	Medium
130	MNF46945, MNF46934 (NHER)	TG 5291 0550	Military training site, weapons pit, pillbox	Evidence of WWII military activity, including anti invasion defences, is visible on 1940s aerial photographs as groups of earthworks, buildings and structures. These extended across a large area of South Denes, from Main Cross Road in the north to an area of open ground (now a caravan park) to the south. They included areas of pit digging, weapons pits, possible pillboxes, a possible air raid shelter, spigot mortar emplacements, barbed wire and anti-tank scaffolding. The majority of these features were removed by 1945.	HER	Modern (WWII)	Low
131	MNF46925 (NHER)	TG 5302 0576	Ambulance station	Two buildings are visible on 1940s aerial photographs. The precise function of the buildings is not clear, but they could have been a WWII ambulance station. One of these buildings may still survive as a garage building.	HER	Modern (WWII)	Low

Site no.	HER/NHLE Ref	Grid ref	Site type	Description	Designation	Period	Value
132	NHLE ref 1246057	TG 52999 05508	Monument	Nelsons Monument, also known as Norfolk Pillar. Constructed in 1817-19 by William Wilkins. It was the first monument in England to Admiral Lord Nelson (Nelson's Column in London was 1840s, but the column in Dublin was of 1808). The monument consists of fluted Greek Doric column on a square pedestal standing on a raised plinth.	Listed (Grade I)	Post medieval	High
133	NHLE ref 1246978	TG 52657 05084	Milepost	Milepost in front of No 245 High Street. It is made of cast iron and dated 1828. It is triangular casting with a broach into a flat top.	Listed (Grade II)	Post medieval	Low
134	NHLE ref 1246977	TG 52665 05022	House	235 High Street is an early 19th century house of rendered and colourwashed brick. It has a slate roof and is of 2 storeys with a dormer attic.	Listed (Grade II)	Post medieval	Medium
135	NHLE ref 1246975	TG 52721 04845	Public House	The Short Blue Public House was built in the early 18th century and altered in the 20th century. It is built of stuccoed brick and colourwashed. It has a pantile roof which is black glazed to the front.	Listed (Grade II)	Post medieval	Medium