Lower Thames Crossing

Post-Consultation Scheme Assessment Report

Volume 2: Introduction and Existing Conditions

Section 13: Appendices

Volume 2

Contents

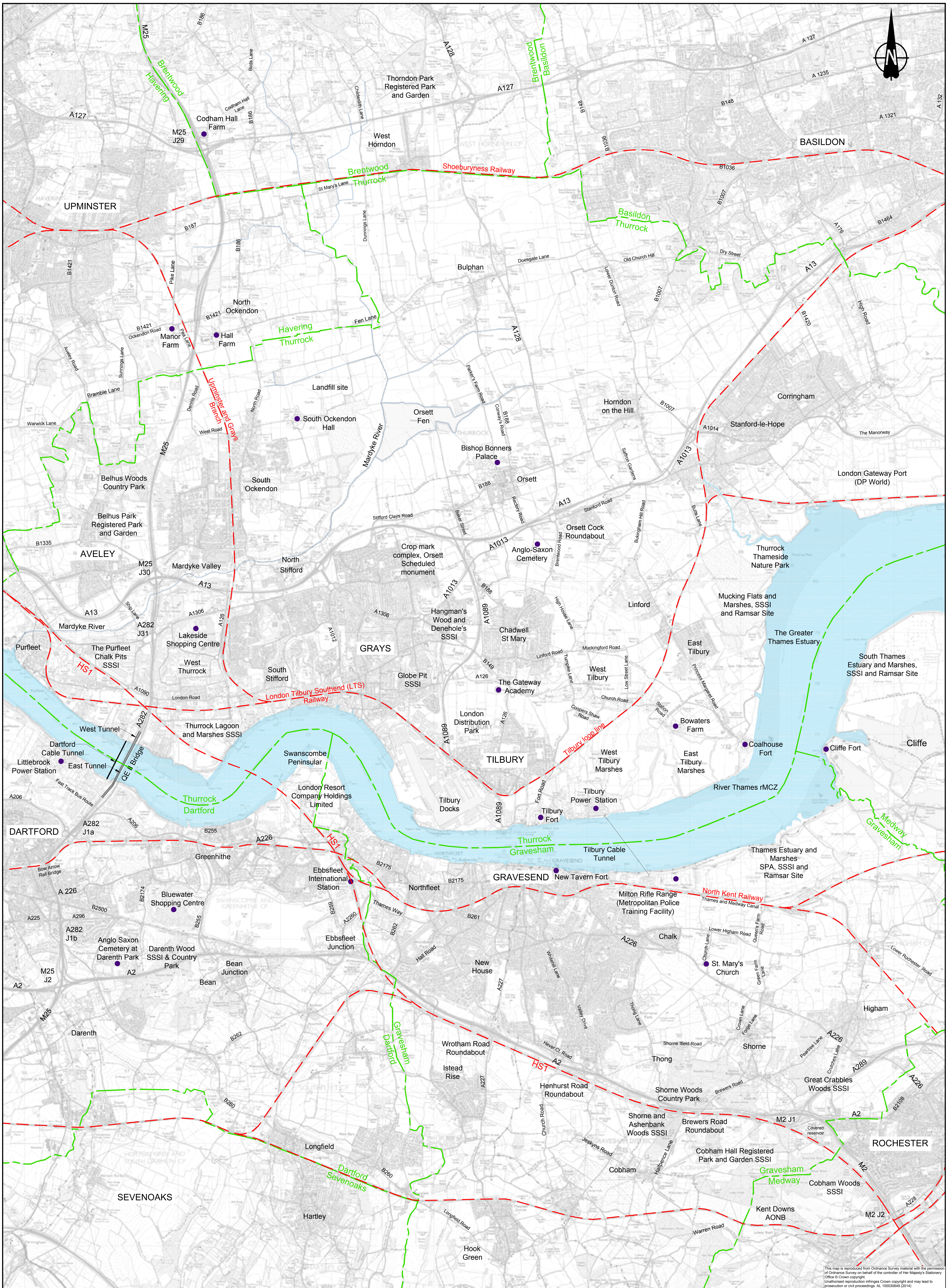
Appendix 2.1
Previous Studies References

Previous Studies References

Title	Date	Client	Author(s)
Assessment of Lower Thames Crossing Capacity	November 2008	Essex County Council and Kent County Council	Gifford, MVA Consultancy and Capita
Dartford River Crossing Study into Capacity Requirement	January 2009	Department for Transport/ Highways Agency	Parsons Brinckerhoff
Lower Thames Capacity Study: Option A	March 2010	Department for Transport/ Highways Agency	Halcrow Hyder Joint Venture (HHJV)
Dartford Crossing Review of Financing Options	March 2010	Department for Transport	PricewaterhouseCoopers
Delivering a Sustainable Transport System London to Dover/ Channel Tunnel Final Report	May 2010	Kent County Council	Jacobs
The Lower Thames Crossing (KPMG Regeneration and Funding Report)	August 2010	Kent County Council	KPMG
Third Thames Crossing Regeneration Impact Assessment	May 2012	Kent County Council, Essex County Council and Thurrock Council	URS
Review of Lower Thames Crossing Options: Final Review Report	April 2013	Department for Transport	AECOM
Review of Lower Thames Crossing Options: Output 2 Design & Costing Report	April 2013	Department for Transport	AECOM
Options for a New Lower Thames Crossing; Consultation Document	May 2013	Department for Transport	Department for Transport
Options for a New Lower Thames Crossing; Consultation Response Summary	December 2013	Department for Transport	Department for Transport
Module 1: Lower Thames Crossing Study: Comparative Air Quality Assessment of Options	May 2014	Department for Transport	Jacobs
Module 2: Scoping the cost of potential environmental mitigation of Option C	May 2014	Department for Transport	Jacobs/ AECOM
Module 3: Potential Additional Network investment at M25 Junction 30 and on the A13	May 2014	Department for Transport	Jacobs/ AECOM
Module 4: Integration of Option A with the M25 and A282	May 2014	Department for Transport	Jacobs/ AECOM
Module 5: Review of Potential Employment and Housing Growth	May 2014	Department for Transport	Jacobs
Technical Note Overall Cost Information for Options A+ and C2	May 2014	Department for Transport	Jacobs/ AECOM
Government Response to Consultation: Options for a New Lower Thames Crossing	July 2014	Department for Transport	Department for Transport

Appendix 2.2
Key Plan

Key Plan



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P03	S5	13-03-17	Minor Amendments	MRG	MR	GH
P02	S5	28-06-16	Post consultation SAR changes	MRG	ABE	GH
P01	S5	18-01-16	SAR ISSUE	MRG	MR	GH

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Project

LOWER THAMES CROSSING

Drawing title

Key Plan

Status	S5	Revision	P03
Scale	NTS	Date - 13-01-16	
Drawn By	M Rojas-Gómez		
Checked By	M Robinson		
Approved By	G Hodge		
Project No.	HA PIN HA540039	Originator HHJ	Original Size A1
Drawing number	HML-ZZZZZZZZZZ-DR-RD-1002		

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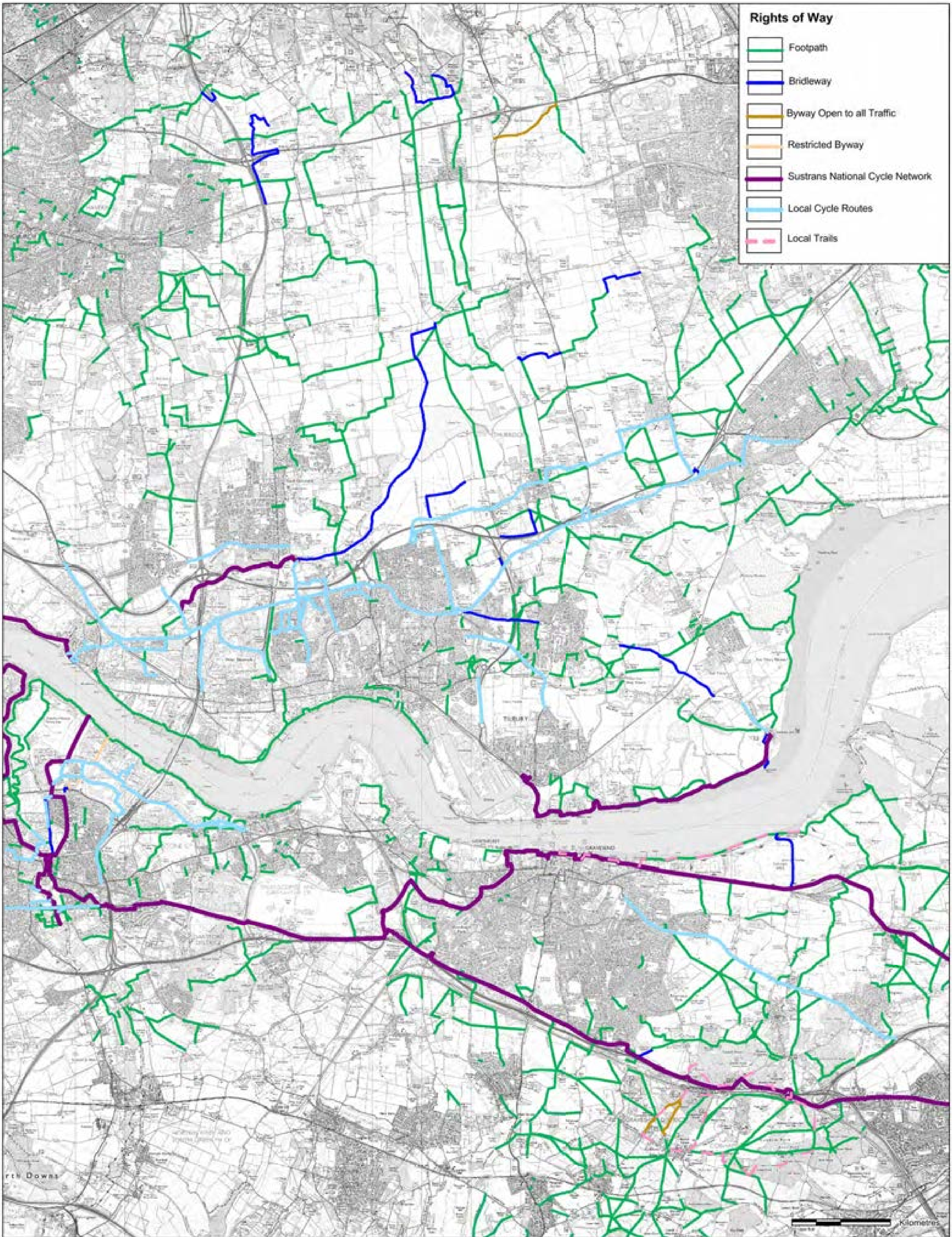
Appendix 2.3
Public Rights of Way and Cycle Routes

Public Rights of Way and Cycle Routes



Rev	Status	Rev Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P01	S5	18-01-16	SAR Issue	MM	SR	AS

The design shown on these drawings is illustrative and may be subject to change in later stages of the scheme development.

Client: highways england

Halcrow Hyder Joint Venture

Halcrow Hyder

Project: LOWER THAMES CROSSING

Drawing Title: Public Rights of Way and Cycle Routes

Status	S5
Revision	P01
Scale	1:70,000
Date	18/01/2016
Drawn By	M.MUTALE
Checked By	S.RIMELL
Approved By	A.SAUNDERS
Project No.	HA540039
Originator	HHJ
Original Size	A3
Drawing Number	HHJ-EGN-ZZZZZZZZEG-MP-EN-0013

Appendix 2.4
Existing Geology and Mining

Existing Geology and Mining

Existing Geology and Mining

A2.4.1. Existing Geology

A2.4.1.1 The generalised geological succession of the study area is summarised in **Table 1**. For Geological plans refer to the Post-Consultation SAR Volume 4 Appendix 4.2.

TABLE 1 - GENERALISED GEOLOGICAL SUCCESSION

System / Period	Series	Group	Formation	General Description	Stratigraphical Thickness
Quaternary	Holocene		Alluvium	Marine and Estuarine Alluvium Silt and clay with lenses and beds of peat, and seams of sand and gravel.	1 - 20m
Quaternary	Pleistocene		Head Deposits Terrace Gravels (Taplow Gravel) (Lynch Hill Gravel) (Boyn Hill Gravel) (Black Park Gravel)	Undifferentiated, pebbly sandy clay; some gravel. River Terrace Deposits - Gravel, sandy and clayey in part.	Not identified
Palaeogene	Eocene	Thames Group	London Clay Formation Harwich Formation	Dark bluish to brownish grey clay, containing variable amounts of fine-grained sand and silt. Cross-bedded shelly sand (the Oldhaven Beds) with a basal pebble bed.	Up to 150m 0 - 12m
Palaeogene	Palaeocene	Lambeth Group No Group	Woolwich Formation Upnor Formation Thanet Sand Formation	The upper beds are clay with shells, ferruginous sand, lignitic sand and lignite. The lower beds are coarse sand with pale grey clay partings and coarse gravel of black flint. Greenish to brownish grey silty, fine-grained sand, clayey and more silty in lower part, with a conglomerate of flint pebbles and nodular flints at the base.	5-20m Up to 32m
Cretaceous	Upper Cretaceous	Upper Chalk Group	Undivided, mainly Seaford Chalk Lewes Chalk	Fossilferous nodular chalk with bands of nodular flints, hardgrounds and marl seams.	Up to 70m 20 – 40m

System / Period	Series	Group	Formation	General Description	Stratigraphical Thickness
				White chalk with hard nodular beds.	

Notes: Excludes stratigraphical units that are absent from the study area. Stratagraphical thicknesses have been taken from Geological Maps.

A2.4.1.2 The study areas for Locations A and C are situated on the southern limb of the London Basin syncline, which include the strata up to the Thames Group. The strata dips very gently to the northwest at generally less than 2 degrees. Unconformably overlying the Upper Chalk in the central part of the London Basin are Palaeogene deposits, which are mainly comprised of the Thanet Sand Formation and Lambeth Group, these are dominated by sands and clays. The Thames Group (mainly the London Clay Formation) is also present, although mainly in the area north of the A13.

A2.4.1.3 The Palaeogene and Late Cretaceous deposits are overlain in places by Quaternary deposits mainly of Alluvium (with peat lenses and beds), River Terrace and Head Deposits. The Alluvium deposits are most evident along the River Thames channel and subsidiary river channels, such as the Mardyke and the River Darent. The River Terrace Deposits are also present in places below the Alluvium to varying thicknesses. River Terrace Deposits dominate the hill tops and higher ground, especially to the north and also to the south of the River Thames valley.

A2.4.1.4 In the north, generally north of the Mardyke channel, around Ockendon but also continuing eastwards to Orsett, the London Clay Formation is present below the River Terrace and Head Deposits. It is shown in outcrop in many places where there have been old quarries and pits. However, most of these areas are shown on the geological maps as Worked Ground (described as mainly chalk, sand and gravel pits with little or no fill), and as Worked Ground and Made Ground (described as wholly or partly backfilled pits). The natural London Clay outcrops begin to appear intermittently around North Ockendon and become more regular in the far north of the study are near Little Warley along the A127 and to the east of the A128.

A2.4.1.5 South of the Mardyke Valley and north of the West Thurrock and Tilbury Marshes, the higher ground and hill tops consist of River Terrace Deposits overlying the Lambeth Group and Thanet Sand Formation; these in turn unconformably overlie the Upper Chalk Formation. In the West Thurrock area, where the land slopes gently towards the West Thurrock Marshes, the Upper Chalk is shown in outcrop. Although most of the area is shown as Worked Ground, which is described as mainly chalk, sand and gravel pits with little or no fill on the geological maps and Worked Ground and Made Ground, which is described as wholly or partly backfilled pits. Similarly on the south side of the River Thames Valley the Upper Chalk outcrops on the lower sides of the hills, although in the western area from Swanscombe to Dartford it is shown with hatching identifying Worked Ground and Worked Ground and Made Ground.

A2.4.2. Mining

A2.4.2.1 Quarrying of sand and gravel for building materials and the excavation of chalk and clay for the manufacturing of cement was extensive either side of the River Thames, the majority of which has now ceased. The chalk quarries, of which there are many between the A13 in the north and the A2 in the south, were 25m deep or more. Since the end of manufacture of cement the quarries have either been backfilled with waste, left as water- filled lakes or been redeveloped for industrial, retail and residential development.

A2.4.2.2 Chalk extraction in the area has not just been limited to open quarries. Numerous deneholes and even underground mines (beneath Dartford) are present throughout the area from the A13 south to the A2. Deneholes comprise a small shaft excavated down to the chalk off which small adits were driven. The chalk mining in this way was undertaken in medieval times and was used for liming agricultural fields. Some deneholes are known to have been constructed in pre-Roman times. The location of deneholes is very difficult to predict and several of these were encountered during the construction of HS1.

A2.4.2.3 North of Junction 30 (M25), gravel, sand and clay extraction was extensive. In many locations the underlying deposits of London Clay have been excavated for cement production, in particular north of South Ockendon. The mining that occurred around Ockendon reached its zenith post 1920. At one point 1.5 million tonnes were extracted per annum from a quarry. The clay was mixed with water to turn it to slurry, allowing it to be pumped to a cement plant in Grays initially, and later to a plant in Northfleet for addition to the raw cement mix. This involved an 11km pipeline beneath the Thames. As aforementioned the remains of these pits are depicted as outcropped London Clay or worked ground due to the majority being backfilled with landfill material. Information provided by the current landfill operator during previous studies suggests the backfilled pit known as Area 3 at Ockendon was licensed to accept hazardous waste within the last 40 years in the form of asbestos and liquid toxic for a period of time after changes in legislation. Area 3 is still operational and is planned to be extended to the east, although it does not accept hazardous waste anymore. It is unknown when this ceased and the amount of waste accepted.

A2.4.2.4 Other areas of chalk, sand and gravel extraction have occurred near the A2 at Shorne, the surrounding land between East Tilbury and Chadwell St Mary and around Junction 30 of the M25 and along the A13. The majority of these have been backfilled with landfill material.

Appendix 2.5
Existing Utilities

Existing Utilities

Existing Utilities

A2.5.1.1 Existing utility information has been obtained from utility companies for Locations A and C. This process has identified the location and type of significant utility infrastructure within the Study Area. The key utilities are described below.

Location A

A2.5.1.2 On the south side of the River Thames there is a sub-surface medium pressure gas pipeline crossing beneath existing A282 on the approximate line of Bow Arrow Lane south footway.

A2.5.1.3 On the south side of the River Thames there is one or more sub-surface oil pipeline(s) at Junction 1a crossing the A282 roughly perpendicular to the carriageways. The depth of the oil pipeline(s) is currently unknown.

A2.5.1.4 On the south side of the River Thames is an existing high voltage overhead electricity line that originates from Littlebrook Power Station. The electricity line crosses over Junction 1a in the east-west direction and again at a skew in the north-west direction around the fast track bus route.

A2.5.1.5 On the north side of the River Thames there are overhead electricity lines that cross existing A282 between Junction 31 and Junction 30.

A2.5.1.6 There is a National Grid underground power cable tunnel (Dartford Cable Tunnel) crossing the river and running parallel approximately 120m to the west of the existing Dartford west tunnel. It is understood to carry National Grid high voltage cables and underground cables (including those associated with the existing tunnel ventilation buildings) and drainage.

A2.5.1.7 On the north side there are various sub surface national grid conductors and high voltage cables.

A2.5.1.8 Other utility infrastructure within Location A includes low voltage cables, fibre optic cables, telephone lines, drainage pipes, technology and lighting cabling and infrastructure.

Location C

A2.5.1.9 On the south side of the River Thames are overhead electricity lines and a major gas pipeline. Adjacent to the A2 near Cobham London Road services there is a large electricity pylon and associated overhead cables. These overhead cables go north over the A2, approximately 1km to the east of Chalk and then over the Thames and Medway Canal west of the railway sidings.

A2.5.1.10 There are overhead cables from the east which generally run parallel with the Thames and Medway Canal and these cables connect into a large pylon on the south bank of the River Thames to the east of the Metropolitan Police Specialist Training Centre. At this point the cables go beneath the river in a cable tunnel in a north westerly direction towards Tilbury power station.

A2.5.1.11 On a similar alignment to the overhead cables there is a National Grid gas pipeline that runs under the A2 and north east towards the river where it crosses the river via a tunnel towards Coalhouse Fort.

A2.5.1.12 On the north side of the river there are a large number of overhead cables that originate at Tilbury power station and run north.

A2.5.1.13 The gas pipeline from south of the river runs between West Tilbury and and East Tilbury and then north, eventually crossing the A127 to the east of the A127/ A128 grade separated junction.

A2.5.1.14 Within Location C there is a significant amount of other utility infrastructure, this includes low voltage cables, fibre optic cables, telephone lines and sewer pipes.

Appendix 2.6
Highway and River Operation and Maintenance

Highway and River Operation and Maintenance

Highway and River Operations and Maintenance

A2.6.1 Highway Operations and Maintenance

A2.6.1.1 LTC would interface with and affect strategic roads in two Highways England maintenance areas, Area 4 and Area 5 as shown in **Figure 1**.

A2.6.1.2 Area 4 is maintained by A-one+ Integrated Highway Services (Colas/ Costain/ CH2MHill) on behalf of Highways England.

A2.6.1.3 Area 5 is maintained by Connect Plus under the M25 DBFO Contract, a 30 year concession contract which commenced in 2009. This includes the operation and maintenance of the Dartford Crossing and its approaches.

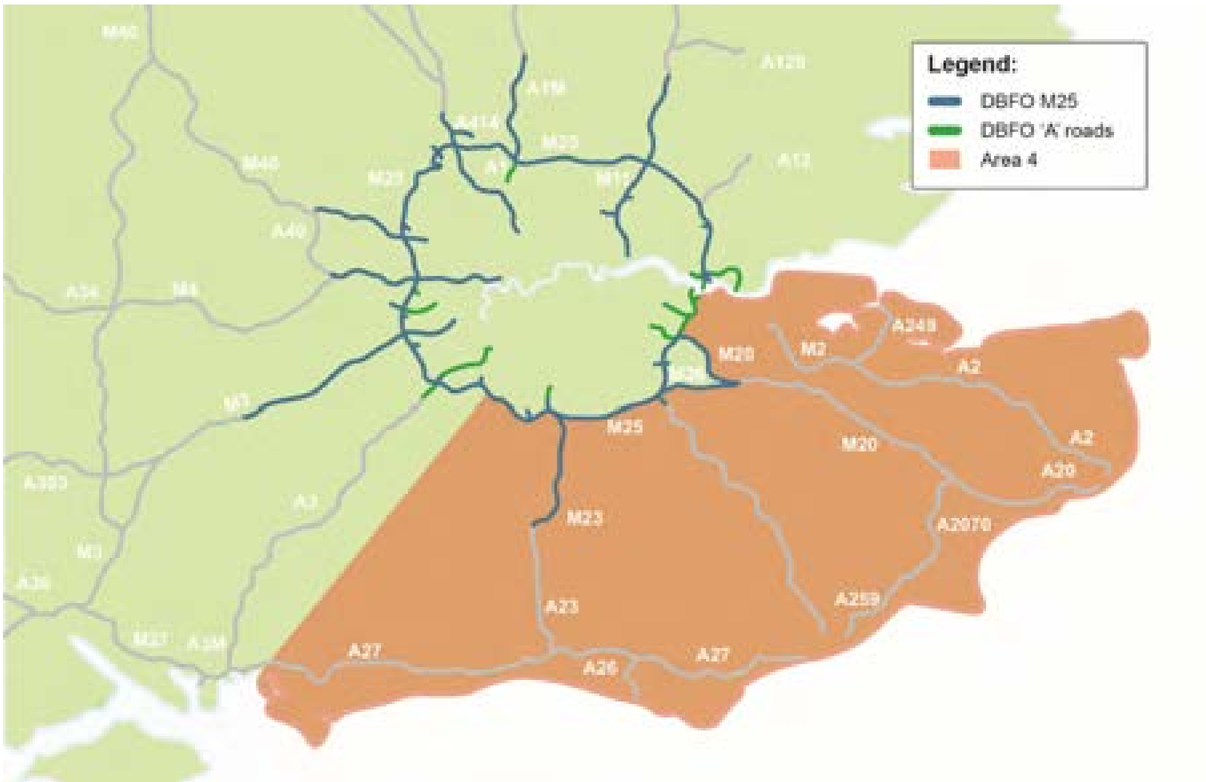


FIGURE 1 - EXTENT OF M25 DBFO AND AREA 4 CONTRACTS

A.2.6.1.4 At present, the motorway network is accessed via short/medium term stops on the hard shoulder or under traffic management following the road space booking procedure. Off network access is also used in some locations.

A.2.6.1.5 At the Dartford Tunnels, maintenance is undertaken during planned closures. On the QEII Bridge, maintenance is carried out during lane closures or full bridge closures.

A.2.6.1.6 The existing tunnel system includes fire detection and suppression systems, public address (PA) system, lane control signs, Communications/SCADA (Supervisory Control and Data Acquisiton), emergency services radio/telephone re-broadcast system, tunnel specific CCTV, drainage & pumping systems, ventilation and road lighting and emergency lighting. This is operated from the Dartford River Crossing Control Centre (DRCC) which is located adjacent to the southern end of the crossing. There are two compounds where

Highways England Traffic Officers and Traffic Management (TM) crews are located to provide immediate assistance for incidents on the crossings. Additionally there are twelve observation points at the extents of the crossing which Highways England Traffic Officers can use to gain access to the crossing to assist road users. There is currently a northbound and a southbound depot which have a TM crew and Traffic Officers on site to enable small incidents to be dealt with quickly on site. Communication with the Highways England Traffic Officers and TM crews is managed by Connect Plus via the DRCC.

A2.6.2 River Operations

A2.6.2.1 The River Thames is Britain's busiest inland waterway, handling some 50m tonnes of cargo each year and contributing over £3bn to the economy annually. Each year 230,000 commercial and leisure vessels pass within the Port of London's 95 miles of river and estuary between Teddington and the North Sea. Of these, 10,000 larger vessels are guided by Thames pilots annually.

A2.6.2.2 Marine traffic information produced by the Port of London Authority (PLA) consisting of shipping data from May 2011 to January 2015 has been analysed for each of the locations being considered.

Location A

A2.6.2.3 The number of vessel movements along the River Thames at Location

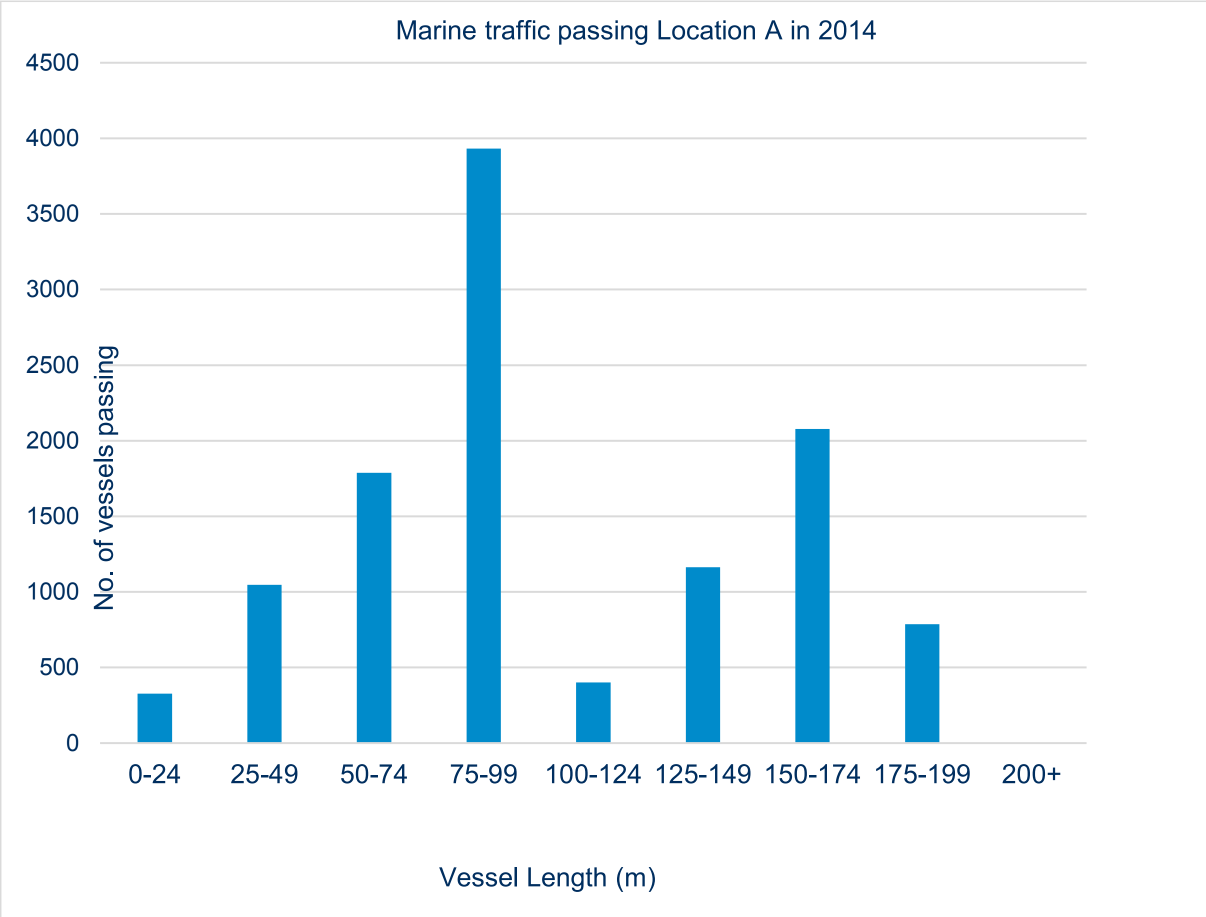


FIGURE 2 - MARINE TRAFFIC LOCATION A

Location C

A2.6.2.4 The number of vessel movements along the River Thames at Location C are summarised in Figure 3

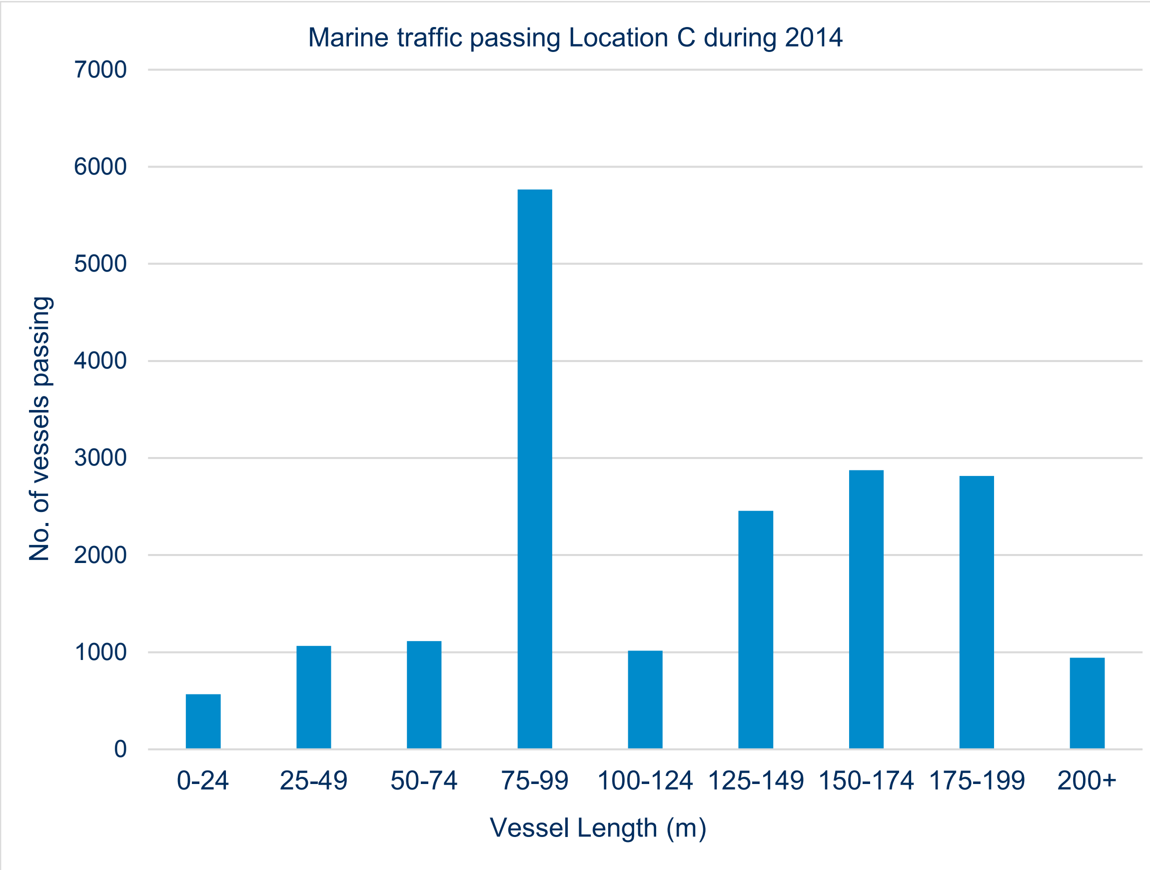


FIGURE 3 - MARINE TRAFFIC LOCATION C

A2.6.3 Future Marine Traffic

A2.6.3.1 At present limited information is available on the future development anticipated in:

- The ports and berths along the River Thames.
- The volume of marine traffic navigating the locations.
- The size of the vessels navigating the locations.

A2.6.3.2 This information is in the process of being requested from relevant stakeholders under the stakeholder engagement process. In the absence of this information, a functional assessment of the river channel, constraints and physical limitations has been undertaken to determine the initial design vessels that can traverse the river and use the terminals.

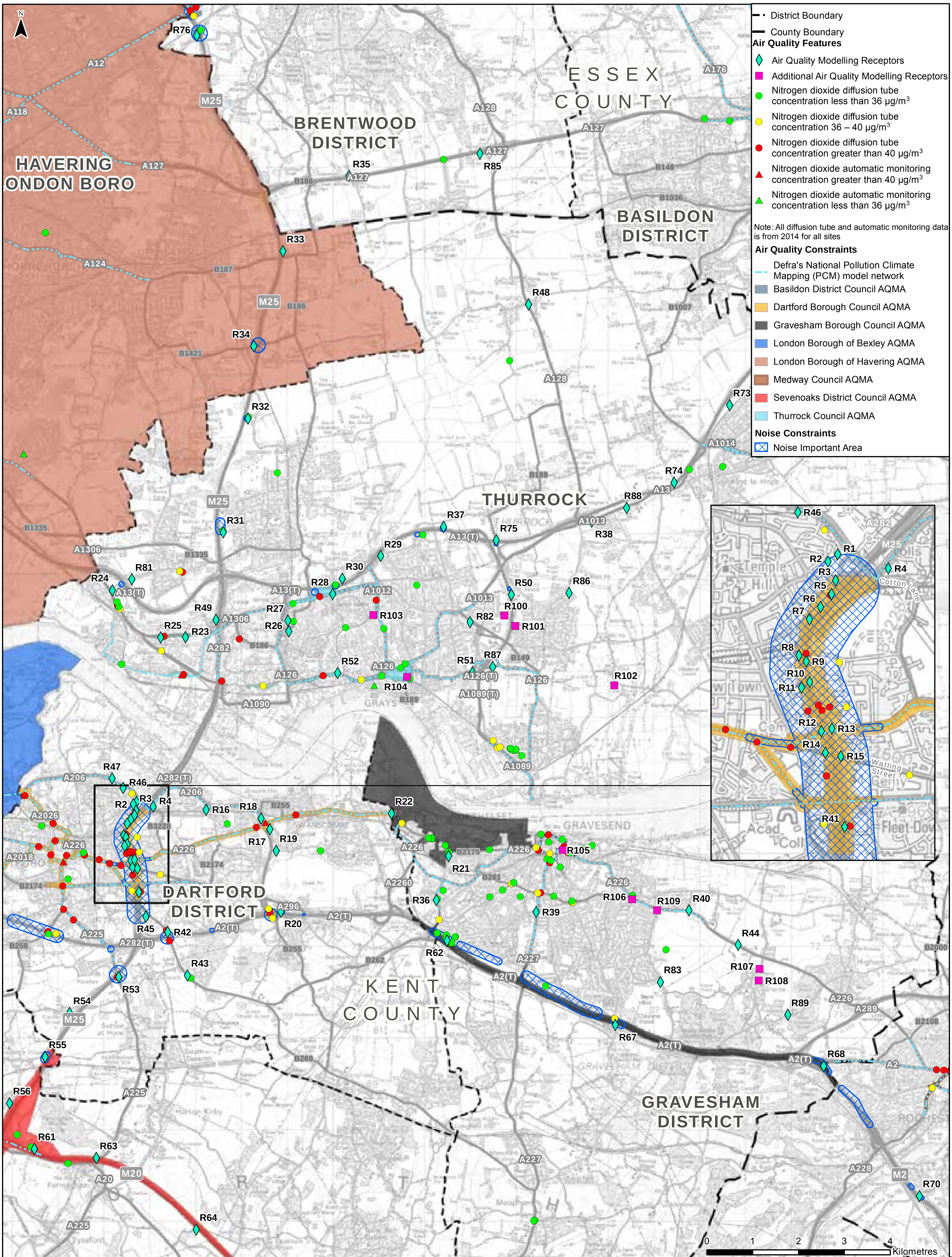
A2.6.3.3 Based on the information currently available, the minimum air draft clearance for shipping at Location A is 57.5m AOD over a clear width of 100m and 50m AOD over an additional 205m. Bridge pylon foundations would likely require to be designed for similar levels of accidental ship collision as the existing crossing (accidental head on impact of a 65,000 Dead Weight Tonnage (DWT) vessel fully laden or foundations would likely require to be designed for similar levels of accidental ship collision as the existing crossing (accidental head on impact of a 65,000 Dead Weight Tonnage (DWT) vessel fully laden or in ballast approaching at 10 knots).

A2.6.3.4 Based on the information currently available, the minimum air draft clearance for shipping at Location C is assumed as 75.19m AOD over a clear width of 305m. Bridge pylon foundations located in the river would require to be designed to resist the accidental ship collision loads. For a structure spanning approximately 800m at Location C, the likely design vessel is assessed as a 120,000 DWT vessel fully laden or in ballast approaching at 10 knots. If the span is reduced and the main pylon foundations moved to deeper water then the likely design vessel is assessed as increasing to 145,000 DWT vessel fully laden and in ballast.

A2.6.3.5 The final design vessels would be determined from a risk analysis which would be undertaken if a bridge solution is selected.

Appendix 2.7
Air and Noise Constraints and Air Quality Modelling Receptor Locations

Air and Noise Constraints and Air Quality Modelling
Receptor Locations



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P02	S5	08/08/16	Post Consultation SAR Issue	LH	SR	AS
P01	S5	18/01/16	SAR ISSUE	LH	SR	AS

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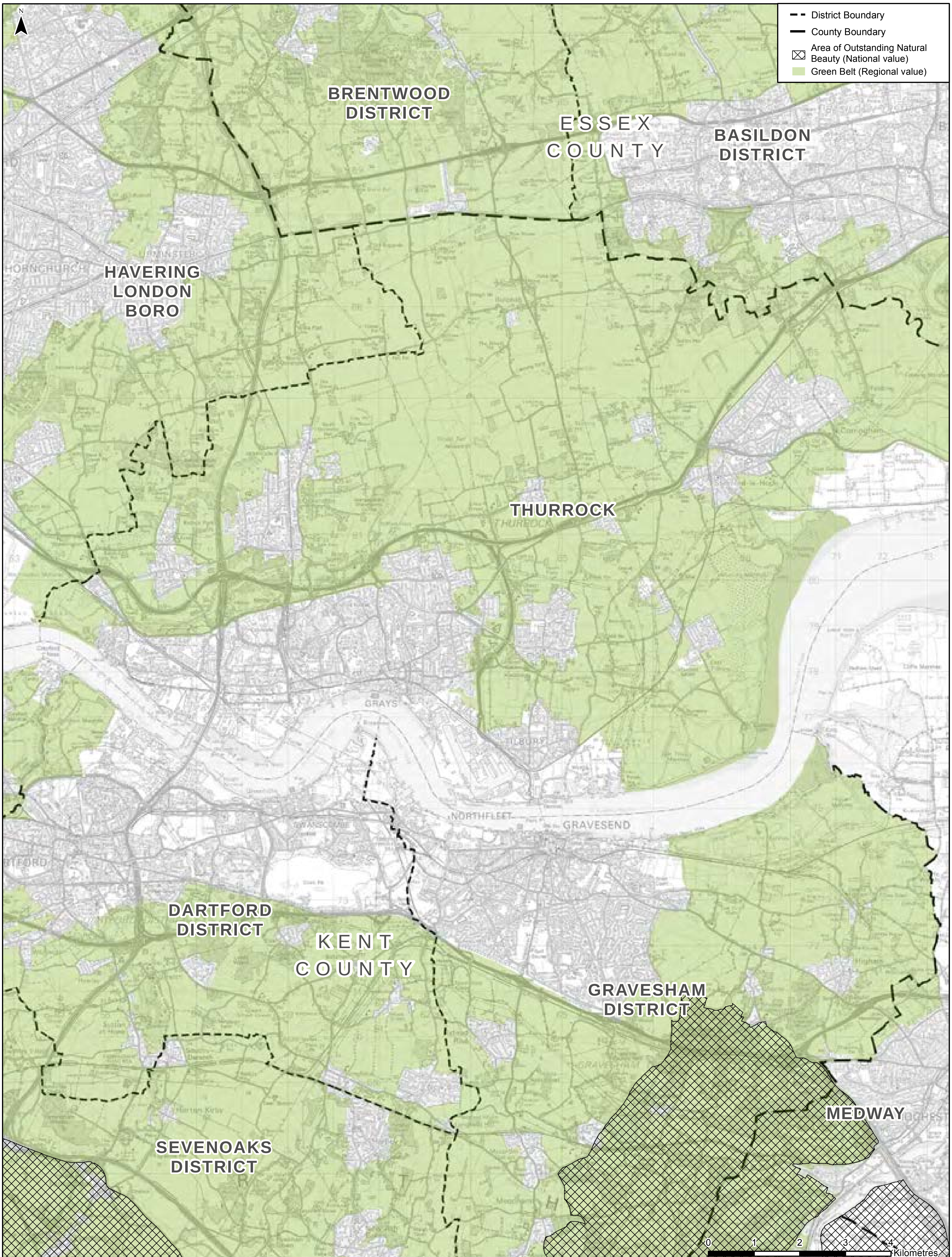
Project: LOWER THAMES CROSSING

Drawing Title: Air and Noise Constraints and Air Quality Modelling Receptor Locations

Status	S5
Revision	P02
Scale	1:75,000
Date	08/08/16
Drawn By	L.HULME
Checked By	S.RIMELL
Approved By	A.SAUNDERS
Project No. (HA PIN / Originator)	HA540039 / HHJ
Original Size	A3
Drawing Number	HHJ –EGN –ZZZZZZZEG-MP-EN-007

Appendix 2.8
Landscape/ Townscape Constraints

Landscape/ Townscape Constraints



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P01	S5	18/01/16	SAR ISSUE	LH	SR	AS

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Project
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Drawing Title
Landscape / Townscape Constraints

Status	S5	Revision	P02
Scale	1:75,000	Date	08/08/16
Drawn By	L.HULME		
Checked By	S.RIMELL		
Approved By	A.SAUNDERS		
Project No. HA PIN	HA540039	Originator	HHJ
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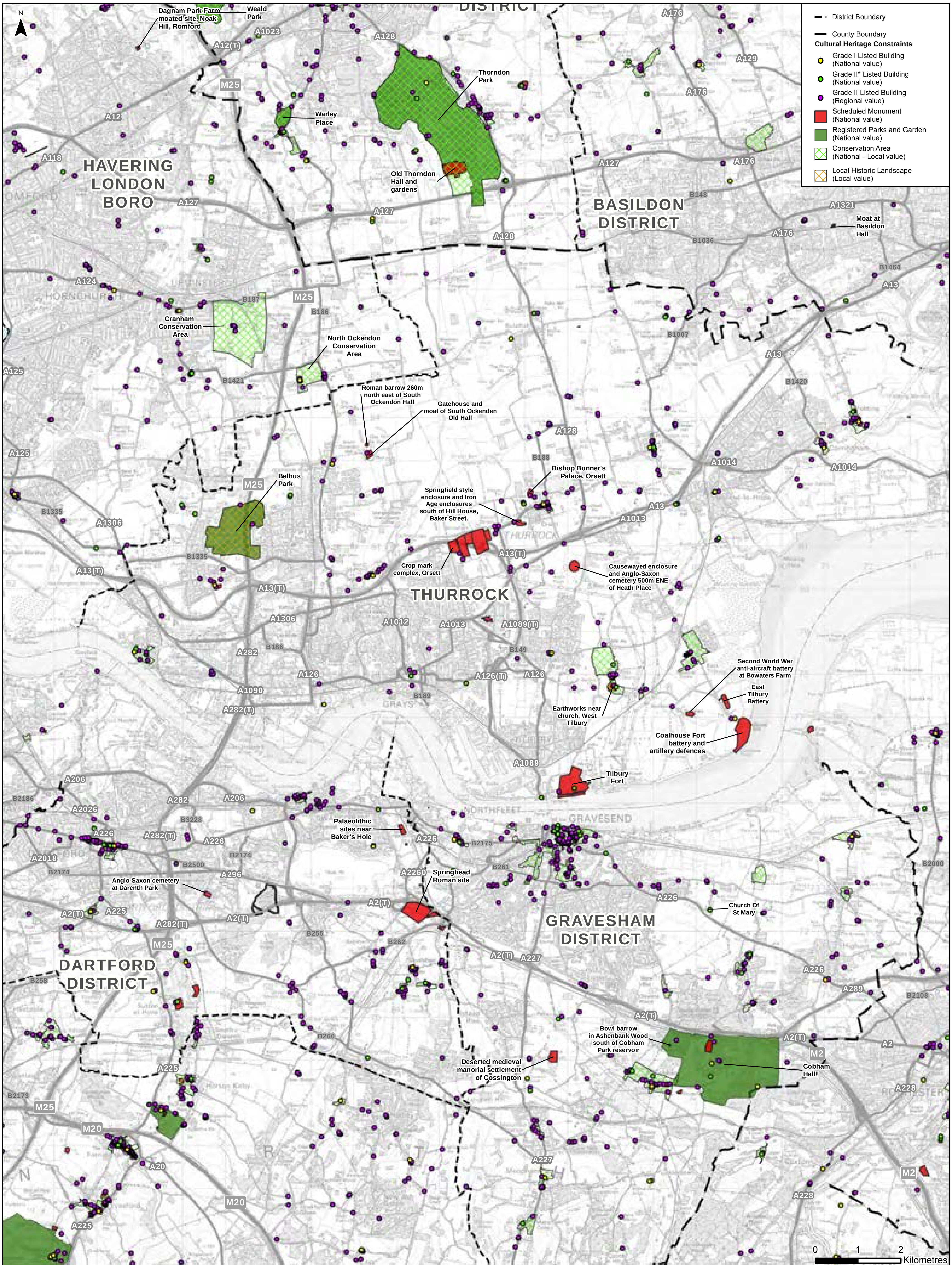
Appendix 2.9
Historic Environment Constraints

Historic Environment Constraints



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Project: LOWER THAMES CROSSING

Drawing Title: Historic Environment Constraints

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P02	S5	08/08/16	Post Consultation SAR Issue	LH	SR	AS
P01	S5	18/01/16	SAR ISSUE	LH	SR	AS

Status	S5
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Date	08/08/2016
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Checked By	S.RIMELL
Approved By	A.SAUNDERS
Project No. (HA PIN / Originator)	HA540039 / HHJ
Original Size	A3
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Appendix 2.10
Biodiversity Constraints

Biodiversity Constraints

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P01	S5	18/01/16	SAR ISSUE	LH / SR / AS
Rev	Status	Rev. Date	Purpose of revision	Drawn / Chck'd / Apprv'd

Client: highways england

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Drawing Title: Biodiversity Constraints

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Revision	P02
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Date	08/08/16
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Checked By	S.RIMELL
Approved By	A.SAUNDERS
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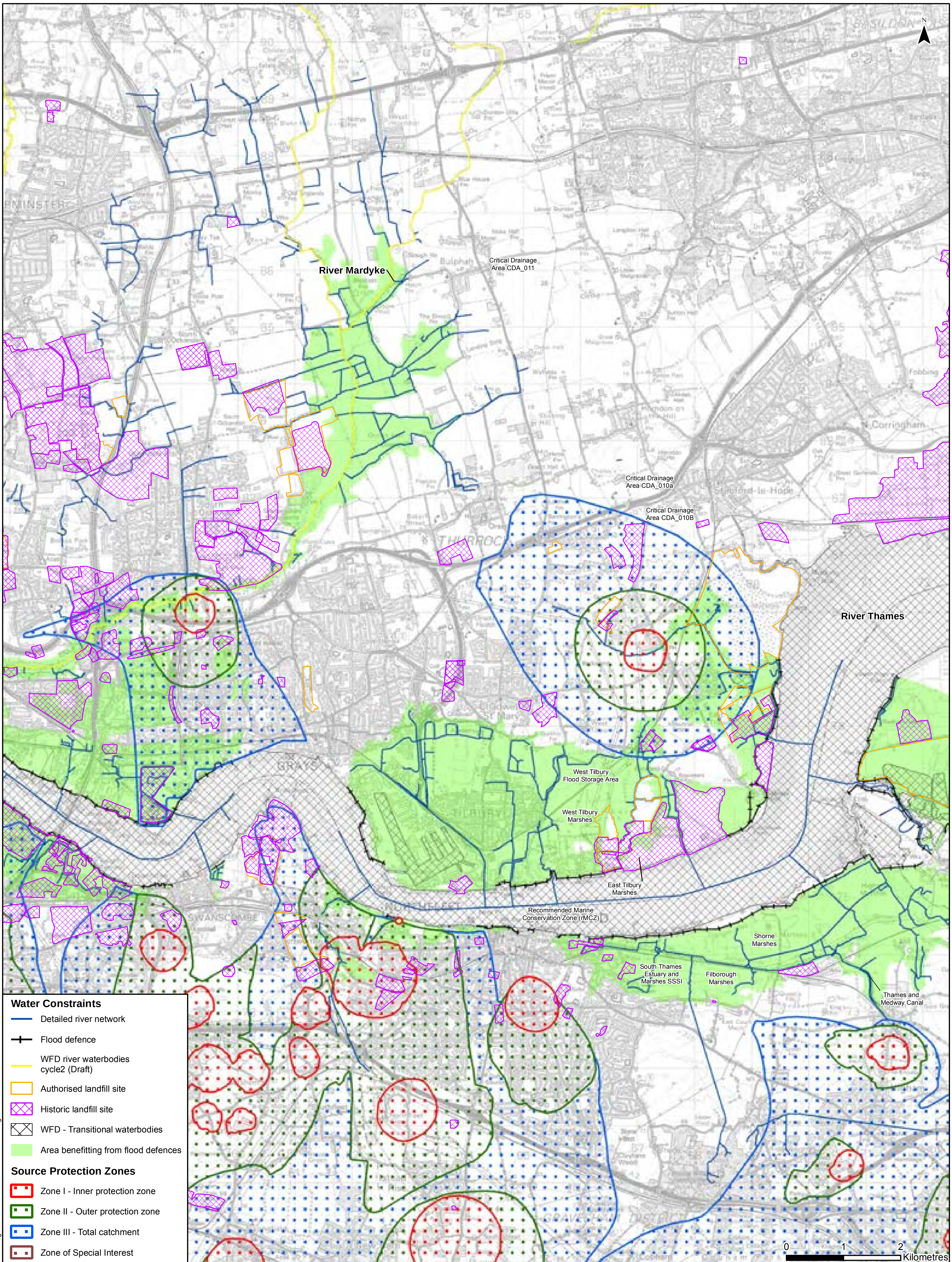
Appendix 2.11
Water Constraints

Water Constraints



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P01	S5	18/01/16	SAR ISSUE	LH	SR	AS

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Project: LOWER THAMES CROSSING

Drawing Title: Water Constraints

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Drawn By	L.HULME		
Checked By	S.RIMELL		
Approved By	A.SAUNDERS		
Project No. HA PIN	HA540039	Originator	HHJ
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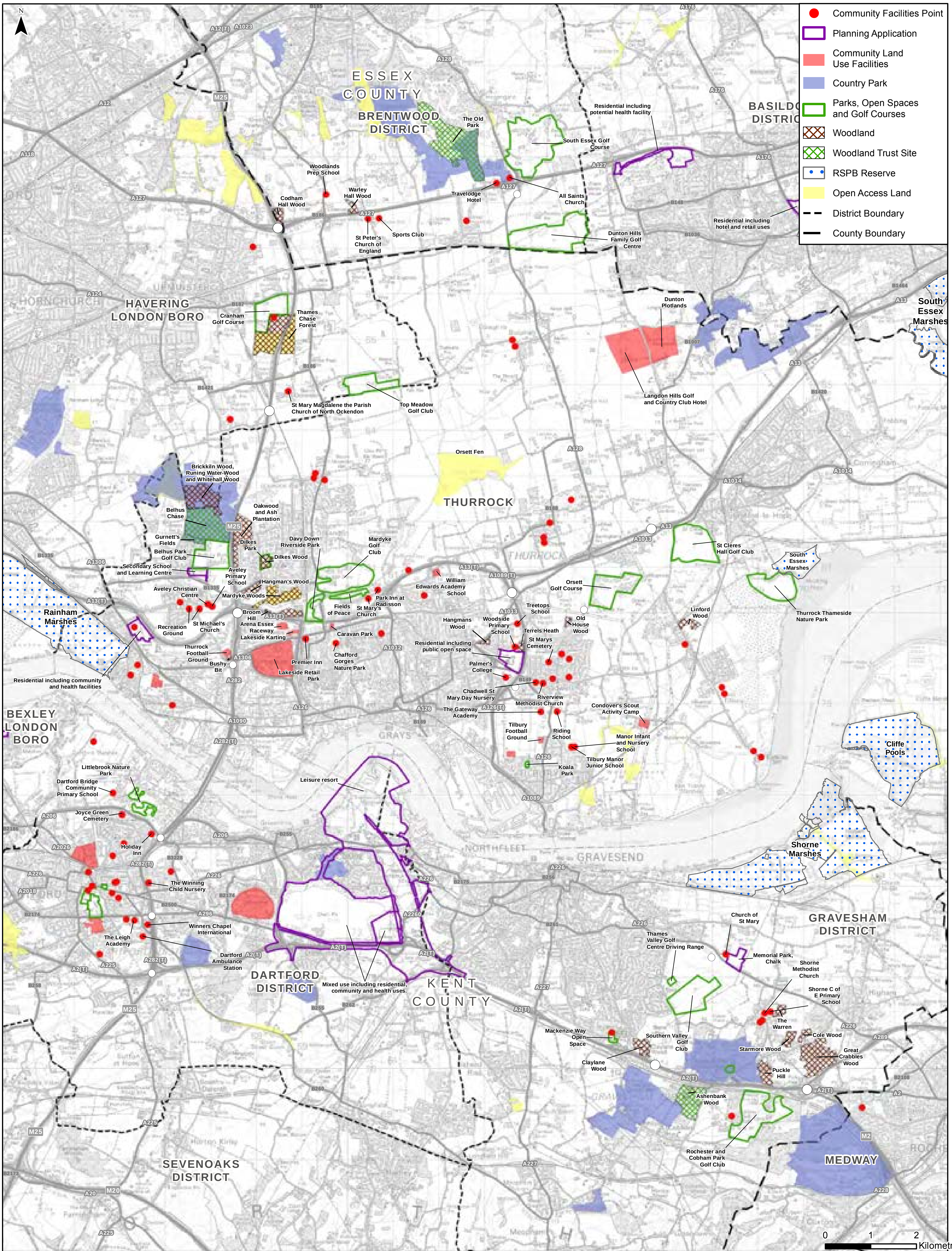
Appendix 2.12
Community Land Use Constraints

Community Land Use Constraints



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Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P02	S5	08/08/16	Post Consultation SAR Issue	LH	SR	AS
P01	S5	18/01/16	SAR ISSUE	LH	SR	AS

ILLUSTRATIVE DESIGN

The design shown on these drawings is illustrative and may be subject to change in later stages of the scheme development.

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Project
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Drawing Title
Community Land Use Constraints

Status	S5
Revision	P02
Scale	1:75,000
Date	08/08/16
Drawn By	L.HULME
Checked By	S.RIMELL
Approved By	A.SAUNDERS
Project No. HA PIN	HA540039
Originator	HHJ
Original Size	A3
Drawing Number	HHJ-EGN-ZZZZZZZZEG-MP-EN-0012

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Highways England creative job number S160683

Report No HA540039-HHJ-ZZZ-REP-ZZZ-012