

# **M4 junctions 3 to 12 smart motorway**

**Hydrological Risk Assessment  
for Groundwater Source  
Protection Zones**

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## Hydrological Risk Assessment for Groundwater Source Protection Zones

Document No: 514451-MUH-00-ZZ-RP-GE-400157

Revision / Status: 1F

January 2016

| REVISION SCHEDULE |          |                    |             |             |             |
|-------------------|----------|--------------------|-------------|-------------|-------------|
| Rev               | Date     | Details            | Prepared by | Reviewed by | Approved by |
| 0                 | Dec 2015 | Review and Comment | CC          | RJK         | ALC/SBF     |
| 1                 | Jan 2016 | Final              | CC          | RJK         | ALC/SBF     |
|                   |          |                    |             |             |             |
|                   |          |                    |             |             |             |
|                   |          |                    |             |             |             |

| Status Code and Description |                    |   |                        |
|-----------------------------|--------------------|---|------------------------|
| I                           | Information        | D | Draft                  |
| R                           | Review and Comment | A | Submitted for Approval |
| F                           | Final              | C | For Construction       |

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# 1 INTRODUCTION

## 1.1 Introduction

1.1.1 This Hydrological Risk Assessment (“HRA”) has been produced to address concerns raised during the Examination of the Development Consent Order (“DCO”) application regarding the potential impact of the Scheme proposals, with particular regard to construction activities, on groundwater Source Protection Zones (“SPZs”) located at Beenhams Heath and Bray.

1.1.2 Further to Highways England’s response to South East Water’s Written Representation, Highways England were able to source and purchase additional private geological information from the British Geological Survey for this study which negated the need for the targeted ground investigation to inform this assessment.

## 1.2 Terms of Reference

1.2.1 A qualitative assessment of the potential impacts of the Scheme in relation to deterioration of groundwater quality over the full spatial extent of the Scheme was addressed within Chapter 10 (Geology and Soils) and Chapter 15 (Road Drainage and the Water Environment) of the Environmental Statement (“ES”) (Application Document Reference 6-1, APP-150).

1.2.2 Flood risk and run-off management within these areas are detailed in Chapter 15 of the ES (Application Document Reference 6-1, APP-155) and are not considered further in this report.

## 1.3 Description of Scheme

1.3.1 The M4 is the main strategic route between London and the west of England, and on to South Wales. The M4 between Junction 3 (Hayes) and Junction 12 (Theale) currently suffers from heavy congestion, which leads to unpredictable journey times. Traffic flows are forecast to further increase, which will result in more severe congestion without road improvements.

1.3.2 Improvement of the M4 to a Smart Motorway will help to relieve congestion by permanently converting the hard shoulder to a running lane and using technology to vary speed limits and manage traffic. Signs and signals will be used to inform drivers of conditions on the highway network, when and where variable speed limits are in place, and when lanes are closed.

1.3.3 The Scheme involves upgrading both carriageways along approximately 32 miles (50km) of motorway to a Smart Motorway between Junction 3 and Junction 12. The Scheme objectives are to:

- i) Reduce congestion, smooth the flow of traffic to improve journey times and make journeys more reliable;
  - ii) Support and enhance the role of the M4 as a major national and inter-urban regional transport artery;
  - iii) Support the economy and facilitate economic growth within the regions, by providing much needed capacity on the motorway; and
  - iv) Continue to deliver a high level of safety performance of the network using Smart Motorway techniques.
- 1.3.4 The Scheme, approximately 32 miles (50km) in length, will convert the hard shoulder of the M4 to a permanent running lane providing four lane all lane running (“ALR”) with five lane carriageways proposed eastbound from Sutton Lane overbridge (just east of junction 5) to junction 4 and westbound between junctions 4 and 4b. This will be achieved within the existing motorway boundary where possible. Some widening may be required at junctions to accommodate slip roads and in areas where no hard shoulder exists. Necessary signing and technology to manage traffic using variable mandatory speed limits will also be provided.
- 1.3.5 Emergency Refuge Areas (“ERAs”), similar to laybys, will be constructed to provide a safe area for vehicles to stop in an emergency without interrupting the flow of traffic. The current design is for 33 ERAs no more than 2.5km apart.
- 1.3.6 The Scheme will also include the demolition and replacement of 11 overbridges, and the extension of underbridges and culverts where carriageway widening is required.
- 1.3.7 The existing central reserve drainage system will be replaced with surface water channels or linear drains, and some sections of verge drainage will be replaced with new linear drains.
- 1.3.8 Environmental barriers, in the form of fencing to mitigate noise and visual impacts, will be included where the Scheme identifies this form of environmental mitigation is required. Vegetation lost to construction activities will be replanted where possible with locally appropriate species. Environmental enhancement will also be applied in appropriate circumstances.

## 1.4 Site Description

- 1.4.1 This HRA focuses on the potential impact of the Scheme proposals on groundwater SPZs located at two sites along the Scheme, namely Beenhams Heath and Bray.
- (1) The Beenhams Heath SPZ is located between junctions 8/9 and 10 of the M4 and is present beneath the motorway between Scheme Chainage (Ch) Ch36850 and Ch43500

(ref Drawing Nos 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-ZZ-DR-GE-400199 included in Chapter 7 below).

(2) The Bray Gravels SPZ is located between Junctions 7 and 8/9 of the M4 and is present beneath the motorway between Ch29900 and Ch33500 (ref Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 to 514451-MUH-00-ZZ-DR-GE-400201 included in Chapter 7 below).

1.4.2 The site setting at each of the SPZs is discussed within Chapter 2 of this report and the construction elements proposed within these areas is described within Chapter 3.



## 2 SITE SETTING

### 2.1 Geological Setting

- 2.1.1 The 1:50,000 British Geological Survey (BGS) Map Sheets 270 ‘*South London*’ (ref BGS, 1981), 269 ‘*Windsor*’ (ref BGS, 1999) and 268 ‘*Reading*’ (ref BGS, 2000) and the accompanying sheet memoirs (ref Ellison, R.A. & Williamson, I.T., 1999 and Mathers, S.J. & Smith, N.J., 2000) indicate that the M4 between junctions 3 and 12 traverses geological deposits that range from Cretaceous to Quaternary in geological age.
- 2.1.2 The majority of the Scheme is underlain by bedrock strata belonging to the London Clay Formation which is of Palaeogene geological age. Palaeogene clays and sands of the Lambeth Group (formerly the Reading beds) are present to the east of junction 12 and in the vicinity of junctions 6 to 8/9. Strata belonging to the Cretaceous age Upper Chalk Group is limited to the immediate area of junction 12.
- 2.1.3 The Quaternary age superficial (drift) deposits that are present between junctions 3 and 12 comprise extensive river terrace deposits and alluvium deposits associated with the River Thames, its tributaries and associated palaeo-channels. These deposits extend from junctions 3 to 9, to the west of junction 10 and between junctions 11 and 12.
- 2.1.4 Isolated and discontinuous deposits of Brickearth (loess) are expected to occur close to ground level alongside and beneath the Scheme between junctions 3 and 5, junctions 5 and 8 and between junctions 11 and 12.
- 2.1.5 Detailed descriptions of the geological deposits described above along with their extents are provided within the Preliminary Sources Study Report produced for the Scheme (Application Document Reference 6-3, APP-330 to APP-343). Ground conditions specific to the Beenhams Heath and Bray Gravels groundwater SPZ’s are described below.

#### **Beenhams Heath SPZ**

- 2.1.6 The 1:50,000 BGS Map Sheet 269 Windsor (ref BGS, 1999) shows that superficial deposits are generally absent in the Beenhams Heath SPZ. A linear deposit of Older Alluvium associated with Twyford Brook is shown by the geological map to cross the M4 corridor between Ch38800 and Ch39000.
- 2.1.7 An isolated area of Head deposits is recorded between Ch36100 to Ch36300 on the geological map. The geological memoir (ref Ellison and Williamson, 1999) states that Head deposits have formed from periglacial and downwash activity since the Devensian period. The thickness is recorded as being between a few centimetres to over 2m. On lower slopes the Head generally comprises sand and clay with variable amounts of gravel, but in the south of the district the Head comprises a high proportion of gravel and occurs in solifluction lobes. Hight et al (2004) reports that any slopes formed within the Reading Formation of the

Lambeth Group are likely to be mantled by 1-3m of Head deposits, which contain shear surfaces. Where Head deposits overlay clays of the Reading Formation, the clay beneath the Head is likely to be brecciated and softer than the clay at depth.

- 2.1.8 The geological map shows the Beenhams Heath SPZ to be underlain by bedrock strata belonging to the London Clay Formation. The geological memoir (ref Ellison and Williamson, 1999) notes that the London Clay Formation and the Harwich Formation together comprise the Thames Group. The Harwich Formation comprises the sandy beds at the base of the London Clay Formation, which were previously referred to as the “London Clay Basement Bed” (ref Ellison and Williamson, 1999). The London Clay Formation is described as dark grey clay with subordinate silt and fine sand (ref Ellison and Williamson, 1999). The London Clay Formation is shown to rest unconformably on strata belonging to the Lambeth Group, which in turn overlie strata belonging to the Upper Chalk Group.
- 2.1.9 Historical boreholes, the locations of which are shown on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-ZZ-DR-GE-400199, generally describe the bedrock as comprising a silty sand, which suggests that the Harwich Formation is present beneath the Beenhams Heath SPZ. The engineering logs of the historical boreholes are included in Appendix B of the Preliminary Sources Study Report produced for the Scheme (Application Document Reference 6-3, APP-333).

#### **Bray Gravels SPZ**

- 2.1.10 The 1:50,000 BGS Map Sheet 269 Windsor (ref BGS, 1999) shows that the ground conditions within the Bray Gravels SPZ comprise River Terrace Deposits locally overlain by Alluvium. The superficial deposits are in turn underlain by bedrock strata belonging to the Lambeth Group.
- 2.1.11 The River Terrace Deposits belong to the Shepperton Gravel Member and Kempton Park Gravel Formation. The Shepperton Gravel is the first terrace of the post-diversionary Thames River Terrace Deposits and is present between Ch29900 and Ch32500. It predominantly comprises an angular flint gravel (ref Ellison and Williamson, 1999). The Shepperton Gravel Member grades into the Kempton Park Gravel Formation to the west of Ch32500. This is the second post-diversionary river terrace deposit of the River Thames and again it is predominantly recorded to comprise angular flint gravel (ref Ellison and Williamson, 1999). Examination of the available exploratory hole engineering logs suggests that the River Terrace Deposits are present to depths of between 6.0m and 8.0m below existing ground level (“BEGl”). Engineering descriptions on the logs are restricted to ‘sand and gravel’.
- 2.1.12 The geological map shows that Alluvium is generally restricted to the north of the M4 corridor, occurring between Ch32500 and Ch31200 and again between Ch30250 and Ch29900. Alluvial deposits are also coincident with the channels of The Cut Culvert and River Thames. The geological map and the associated memoir (ref Ellison and Williamson,

1999) do not record any details on the composition of the alluvium. Examination of available exploratory hole engineering logs suggests that the Alluvium is up to 2.0m in thickness and typically comprises a silty clay with sand partings and occasional flint gravel clasts. The Alluvium is shown to be underlain by River Terrace Deposits.

- 2.1.13 The 1:50,000 BGS Map Sheet 269 Windsor (ref BGS, 1999) shows that the superficial deposits are underlain by bedrock strata belonging to the Lambeth Group. The Lambeth Group comprises the Upnor Formation and the Reading Formation. The authors of the memoir (ref Ellison and Williamson, 1999) note that in the Windsor district these deposits are usually undifferentiated on borehole logs, with the strata being colloquially referred to as “Reading Beds”. The Lambeth Group is noted to be typically between 22m and 28m thick in the area covered by the map sheet, but may reduce in thickness to the west.
- 2.1.14 The Upnor Formation, formerly known as the “Reading Formation Bottom Bed”, predominantly comprises medium grained, variably pebble, glauconitic sand and is up to 6m thick (Ellison and Williamson, 1999). The deposit contains variable amounts of glauconite grains and sporadic beds of flint pebbles (ref Hight et al, 2004). The Reading Formation predominantly comprises colour mottled clays with subordinate silt and fine to medium grained sand (ref Ellison and Williamson, 1999). The colour of the material is variable and includes pale brown, pale grey-blue, dark brown, pale green, red-brown and crimson depending on the oxidation state of the material (ref Hight et al, 2004). The clay contains numerous fissures resulting in a blocky texture and thinly laminated beds of brown silt and sand are also present, which may constitute up to 50% of the formation (ref Hight et al, 2004). Within the study area thin, black, carbonaceous clays are recorded locally in the middle of the Reading Formation sequence (ref Hight et al, 2004).
- 2.1.15 Descriptions of the Lambeth Group strata included on the available exploratory hole engineering logs are restricted to ‘sand/gravel’, ‘sandy clays’ or ‘clayey sandy gravel’. The locations of exploratory holes consulted are shown Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 and 514451-MUH-00-ZZ-DR-GE-400201 (see Chapter 7 in this report) and the written records are included in Appendix B of the Preliminary Sources Study Report produced for the Scheme.

## 2.2 Hydrological Setting

### Beenhams Heath SPZ

- 2.2.1 Two main rivers (as defined by the Environment Agency (“EA”)) are present within the Beenhams Heath SPZ: Twyford Brook and The Cut. Twyford Brook flows in a south easterly direction and crosses beneath the M4 corridor at Ch38850. Twyford Brook is cut off approximately 80m to the south east of the M4 where it enters The Cut. The Cut is located between 80m and 500m to the south east of the M4 corridor and flows in a north easterly direction.

2.2.2 Billingbear Brook, a small watercourse, flows in a southerly direction and is culverted beneath the M4 at Ch38850. The locations of the watercourses occurring within the Beenhams Heath SPZ are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-ZZ-DR-GE-400199 (Chapter 7).

### **Bray Gravels SPZ**

2.2.3 Four main rivers are located within the Bray Gravels SPZ: The Cut, River Thames, Jubilee River and Roundmoor Ditch. The rivers flow in a south easterly direction across the SPZ and cross the M4 corridor at the following Scheme chainages:

- i) The Cut at Ch32070;
- ii) River Thames at Ch31250;
- iii) Jubilee River at Ch30300; and
- iv) Roundmoor Ditch at Ch30000.

2.2.4 The Bray Gravels SPZ falls within the Thames River Basin District and drainage is subsequently dominated by the River Thames. The Cut, Jubilee River and Roundmoor Ditch converge with the River Thames to the south east of the Bray Gravels SPZ.

2.2.5 Bray Lake and two additional un-named ponds are located some 70m to the south of the M4 corridor between Ch31650 and Ch32400. It is understood that these are possibly old gravel pits, which have subsequently been flooded.

2.2.6 Inspection of recent and historical aerial photographs shows that at some point between 2008 and 2010, gravel extraction commenced to the north of the M4 corridor. The latest available aerial photograph (dated September 2014) shows that the gravel extraction is complete and the remaining gravel pit is now flooded. The new pond is located some 30m north of the M4 corridor between Ch32150 and Ch32500.

2.2.7 The locations of the watercourses and surface water bodies occurring within the Bray Gravels SPZ are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 and 514451-MUH-00-ZZ-DR-GE-400201 (Chapter 7 below).

## **2.3 Hydrogeology**

2.3.1 SPZs are used to identify those areas close to drinking water sources where the risk associated with groundwater contamination is greatest. The EA divides SPZs into three zones, which are divided as follows:

- i) Inner Zone (Zone 1) - Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50m;

- ii) Outer Zone (Zone 2) - Defined by a 400 day travel time from a point below the water table. This zone has a minimum radius of 250 or 500m around the source, depending on the size of the abstraction; and
- iii) Total Catchment (Zone 3) - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source.

### **Beenhams Heath SPZ**

- 2.3.2 The M4 corridor only crosses over the Total Catchment Zone of the Beenhams Heath SPZ, which extends between Scheme Ch36850 and Ch43500. The Inner Zone of the Beenhams Heath SPZ lies between 40m and 100m to the north-west of the M4 corridor. The Outer Zone of the SPZ only extends to the north-west of the Inner Zone and in doing so moves away from the M4 alignment. The extent of the Inner, Outer and Total Catchment Zones associated with the Beenhams Heath SPZ are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-ZZ-DR-GE-400199 (Chapter 7 below).
- 2.3.3 The EA's aquifer designation maps have been made available to view on the EA's 'What's in your back yard?' website (<http://www.environment-agency.gov.uk/wiyby>). The Alluvium and Head deposits are both classified as Secondary A Aquifers by the EA aquifer designation maps. Secondary A Aquifers are permeable strata capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
- 2.3.4 The EA aquifer designation maps classify the London Clay Formation strata that underlie the Beenhams Heath SPZ as unproductive strata. These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
- 2.3.5 The Beenhams Heath SPZ was designated in order to protect the groundwater source within the Principal Aquifer of the Upper Chalk which underlies the London Clay Formation and Lambeth Group strata. Groundwater is abstracted from the Upper Chalk and is used to supply public drinking water.
- 2.3.6 Two groundwater wells (Beenhams Heath No. 1 Well and Beenhams Heath No. 2 Well) were sunk at Beenhams Heath Pumping Station during 1934 (ref Drawing No 514451-MUH-00-ZZ-DR-GE-400198 (Chapter 7)). The record of boring and other ancillary information associated with these wells was purchased from the BGS, the records of which are included within Annex A of this Report for information. The data obtained from the BGS shows that the Upper Chalk was encountered at a depth of 403 feet below ground level, i.e. 123m below ground level.

**Bray Gravels SPZ**

- 2.3.7 The M4 corridor crosses over the Inner, Outer Zone and Total Catchment Zones of the Bray Gravels SPZ. The Inner Zone of the SPZ is present beneath the M4 between Ch32000 and Ch31090. The Outer Zone radiates out from the Inner Zone and is present to the west of the Inner Zone between Ch32580 and Ch32000 and to the east of the Inner Zone between Ch31090 and Ch30100. The Total Catchment (Zone 3) surrounds the Outer Zone and is present beneath the M4 between Ch33500 and Ch32580 and again between Ch30100 and Ch29900. The extent of the Inner, Outer and Total Catchment Zones associated with the Bray Gravels SPZ are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 and 514451-MUH-00-ZZ-DR-GE-400201 (Chapter 7 below).
- 2.3.8 The EA aquifer designation maps show that the Shepperton Gravel Member and Kempton Park Gravel Formation are Principal Aquifers which are layers of drift deposits that have high intergranular permeability meaning they usually provide a high level of water storage.
- 2.3.9 The Alluvium and Lambeth Group strata are both classified as Secondary A Aquifers, which are permeable strata capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
- 2.3.10 The Bray Gravels SPZ has been designated in order to protect the groundwater source within the Principal Aquifer of the Shepperton Gravel Member. Groundwater is abstracted from the Bray Gravels SPZ and is used to supply public drinking water.
- 2.3.11 The records of all groundwater boreholes located within 1km of the Scheme were purchased from the BGS, the records of which are included within Annex B. The location of the twelve groundwater boreholes are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 and 514451-MUH-00-ZZ-DR-GE-400201 (Chapter 7 below).

**2.4 Licensed and Unlicensed Abstractions****Beenhams Heath SPZ**

- 2.4.1 The Beenhams Heath SPZ was designated in order to protect the groundwater source within the Principal Aquifer of the Upper Chalk. Groundwater is abstracted from the Upper Chalk and is used to supply public drinking water.
- 2.4.2 Details of licensed abstraction points within 1km of the Scheme were obtained via a Landmark Information Group Envirocheck Report (ref Landmark Information Group, 2015a). The distance of 1km was selected on the basis that it is considered very unlikely that the construction of the Scheme would have an impact on groundwater at distances beyond this limit. The licensed abstraction points are detailed in Table 1 below and are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-ZZ-DR-GE-400199 (Chapter 7 below).

- 2.4.5 The Beenhams Heath SPZ covers land located in the following local authorities:
- i) Royal Borough of Windsor and Maidenhead; and
  - ii) Wokingham Borough Council.
- 2.4.6 Enquires have been made to both local authorities asking them if they hold any records with respect to unlicensed abstractors located within 1km of the Scheme. As noted above, the distance of 1km was selected on the basis that it is considered very unlikely that the construction of the scheme would have an impact on groundwater at distances beyond this limit.
- 2.4.7 Wokingham Borough Council responded that, within their local authority area, there are four known private water supply boreholes located within 1km of the M4. All four private water supply boreholes are located over 3km away from the Total Catchment (Zone 3) of the Beenhams Heath SPZ. The Total Catchment Zone is the area around a source (i.e. abstraction point) within which all groundwater recharge is presumed to be discharged at the source (ref para 2.3.1). The groundwater located within the immediate vicinity of these unlicensed abstraction points therefore does not recharge groundwater within the Beenhams Heath SPZ and thus is not considered further within this report.
- 2.4.8 A response from The Royal Borough of Windsor and Maidenhead had not been received at the date of issue of this report.

Table 1: Licensed Abstractors within the Beenhams Heath SPZ

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400197 to 400199 | Licence No.   | Operator  | Source        | Type of Abstraction                            | Use  | Importance* | Easting | Northing | Comment   |
|--|---------------|---|---------------|--|--|-------------|---------|----------|---|
| ABS-BH1  | 28/39/24/0109 | South East Water Limited  | Groundwater   | Single point (Beenham's Heath Pumping Station) | Public water supply  | Very high   | 485080  | 175080   | Approx. 130m to the north west of the M4 corridor. Located within Inner Zone of Beenhams Heath SPZ      |
| ABS-BH2  | 28/39/24/0247 | Abudienca Co. Limited/<br>Billingbear Property Management Limited/Mr R Carlsson | Groundwater   | Single point (borehole)                        | Sports grounds/facilities: animal watering, general use (non-agricultural) and spray irrigation. | Medium      | 483280  | 172640   | Approx. 640m to the south of the M4 corridor. Located in Total Catchment Zone of Beenhams Heath SPZ.    |
| ABS-BH3  | 28/39/24/0225 | Indrapura Limited   | Groundwater   | Single point (borehole)                        | Sports grounds/facilities: spray irrigation.   | Medium      | 483280  | 172640   | Approx. 640m to the south of the M4 corridor. Located in Total Catchment Zone of Beenhams Heath SPZ.    |
| ABS-BH4  | 28/39/26/0100 | P G Watts   | Surface Water | Single point (The Cut watercourse)             | General agriculture: spray irrigation/storage.   | Medium      | 486300  | 175700   | Approx. 590m to the east of the M4 corridor. Located within Total Catchment Zone of Beenhams Heath SPZ. |

\* Refer to Table 7 within Section 4 in regards to the assessment of importance



**Bray Gravels SPZ**

- 2.4.9 The Bray Gravels SPZ has been designated in order to protect the groundwater source within the Principal Aquifer of the Shepperton Gravel Member. Groundwater is abstracted from the Bray Gravels SPZ and is used to supply public drinking water.
- 2.4.10 Details of licensed abstraction points within 1km of the Scheme were obtained via a Landmark Information Group Envirocheck Report (ref Landmark Information Group, 2015b). The licensed abstraction points are detailed in Table 2 below and are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 and 514451-MUH-00-ZZ-DR-GE-400201 (Chapter 7 below).
- 2.4.11 The Bray Gravels SPZ covers land located in the following local authorities:
- i) Royal Borough of Windsor and Maidenhead;
  - ii) Buckinghamshire County Council; and
  - iii) South Bucks District Council.
- 2.4.12 Enquires have been made to each of the local authorities asking them if they hold any records with respect to unlicensed abstractors located within 1km of the Scheme. At the time of writing responses had not been received from any of the local authorities listed above.

Table 2: Licensed Abstractors within the Bray Gravels SPZ

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.   | Operator                   | Source      | Type of Abstraction   | Use                 | Importance* | Easting | Northing | Comment   |
|--|---------------|----------------------------|-------------|---|---------------------|-------------|---------|----------|---|
| ABS-BG1  | 28/39/26/0087 | South East Water Limited   | Groundwater | Single point (Bray Gravels Pumping Station 'W1')                | Public water supply | Very high   | 491130  | 179410   | Approx. 43m north of the M4 corridor. Located within Inner Zone of Bray Gravels SPZ.  |
| ABS-BG2  | 28/39/26/0087 | South East Water Limited   | Groundwater | Single point (Bray Gravels Pumping Station 'W2')                | Public water supply | Very high   | 491180  | 179240   | Approx. 112m south of the M4 corridor. Located within Inner Zone of Bray Gravels.     |
| ABS-BG3  | 28/39/26/0087 | South East Water Limited   | Groundwater | Single point (Bray Gravels Pumping Station 'W5')                | Public water supply | Very high   | 491070  | 179460   | Approx. 119m north of the M4 corridor. Located within Inner Zone of Bray Gravels SPZ. |
| ABS-BG4  | 28/39/26/0087 | South East Water Limited   | Groundwater | Single point (Bray Gravels Pumping Station 'A', 'B', 'C' & 'D') | Public water supply | Very high   | 491400  | 178700   | Approx. 670m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ.     |
| ABS-BG5  | 28/39/27/0097 | Thames Water Utilities Ltd | Groundwater | Single point (Dorney Reach Pumping Station 'J')                 | Public water supply | Very high   | 491600  | 178830   | Approx. 695m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ.     |
| ABS-BG6  | 28/29/27/0097 | Thames Water Utilities Ltd | Groundwater | Single point (Dorney Reach Pumping Station 'H')                 | Public water supply | Very high   | 492160  | 179090   | Approx. 731m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ.     |

HIGHWAYS ENGLAND – M4 JUNCTIONS 3 TO 12 SMART MOTORWAY

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.   | Operator                   | Source        | Type of Abstraction                                | Use                 | Importance* | Easting | Northing | Comment   |
|--|---------------|----------------------------|---------------|--|---------------------|-------------|---------|----------|---|
| ABS-BG7  | 28/29/27/0097 | Thames Water Utilities Ltd | Groundwater   | Single point (Dorney Reach Pumping Station 'D')    | Public water supply | Very high   | 491740  | 178860   | Approx. 759m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ. |
| ABS-BG8  | 28/39/26/0114 | South East Water Limited   | Surface water | Single point (Bray [River Thames] Pumping Station) | Public water supply | Very high   | 491550  | 178700   | Approx. 764m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ. |
| ABS-BG9  | 28/39/27/0097 | Thames Water Utilities Ltd | Groundwater   | Single point (Dorney Reach Pumping Station 'A')    | Public water supply | Very high   | 491640  | 178770   | Approx. 766m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ. |
| ABS-BG10   | 28/39/27/0097 | Thames Water Utilities Ltd | Groundwater   | Single point (Dorney Reach Pumping Station 'B')    | Public water supply | Very high   | 491680  | 178790   | Approx. 776m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ. |
| ABS-BG11   | 28/39/27/0097 | Thames Water Utilities Ltd | Groundwater   | Single point (Dorney Reach Pumping Station 'E')    | Public water supply | Very high   | 491810  | 178890   | Approx. 779m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ. |
| ABS-BG12   | 28/39/27/0097 | Thames Water Utilities Ltd | Groundwater   | Single point (Dorney Reach Pumping Station 'F')    | Public water supply | Very high   | 491900  | 178950   | Approx. 786m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ. |

HIGHWAYS ENGLAND – M4 JUNCTIONS 3 TO 12 SMART MOTORWAY

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.     | Operator                   | Source      | Type of Abstraction                             | Use  | Importance* | Easting | Northing | Comment  |
|--|-----------------|----------------------------|-------------|---|--|-------------|---------|----------|--|
| ABS-BG13   | 28/39/27/0097   | Thames Water Utilities Ltd | Groundwater | Single point (Dorney Reach Pumping Station 'G') | Public water supply  | Very high   | 491990  | 178980   | Approx. 795m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ.                |
| ABS-BG14   | 28/39/27/0097   | Thames Water Utilities Ltd | Groundwater | Single point (Dorney Reach Pumping Station 'C') | Public water supply  | Very high   | 491710  | 178660   | Approx. 896m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ.                |
| ABS-BG15   | 28/39/27/0097   | Thames Water Utilities Ltd | Groundwater | Single point (Dorney Reach Pumping Station 'K') | Public water supply  | Very high   | 491820  | 178700   | Approx. 934m south of M4 corridor. Located within Inner Zone of Bray Gravels SPZ.                |
| ABS-BG16   | Th/039/0026/018 | Emmett Brothers            | Groundwater | Single point (borehole 'A' at Bray)             | General agriculture: spray irrigation                              | Very high   | 490800  | 179193   | Approx. 80m to the north of the M4 corridor. Located within Inner Zone of Bray Gravels SPZ       |
| ABS-BG17   | 28/39/27/0136   | Emmett Brothers            | Groundwater | Single point (West Town Farm, Taplow BH 'J')    | General farming and domestic/general agriculture: spray irrigation | High        | 492260  | 179841   | Approx. 26m to the south of the M4 corridor. Located within Outer Zone of Bray Gravels SPZ       |
| ABS-BG18   | 28/39/26/0085   | W Emmett and Son           | Groundwater | Single point (Bray gravel pit point 'B')        | General agriculture: spray irrigation                              | High        | 490900  | 178700   | Approx. 358m to the south east of the M4 corridor. Located within Outer Zone of Bray Gravels SPZ |
| ABS-BG19   | Th/039/0026/018 | Emmett Brothers            | Groundwater | Single point (borehole 'B' at Bray)             | General agriculture: spray irrigation                              | High        | 490717  | 178455   | Approx. 451m to the south east of the M4 corridor. Located within Outer Zone of Bray Gravels SPZ |

HIGHWAYS ENGLAND – M4 JUNCTIONS 3 TO 12 SMART MOTORWAY

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.   | Operator  | Source      | Type of Abstraction                            | Use  | Importance* | Easting | Northing | Comment   |
|--|---------------|---|-------------|--|--|-------------|---------|----------|---|
| ABS-BG20   | 28/39/27/0136 | Emmett Brothers   | Groundwater | Single point (West Town Farm, Taplow Bh 'H')   | General farming and domestic/general agriculture: spray irrigation | High        | 492572  | 179213   | Approx. 711m south of M4 corridor. Located within Outer Zone of Bray Gravels SPZ.           |
| ABS-BG21   | 28/39/26/0133 | Cemex Uk Materials Limited/Rmc Materials Limited/Rmc Readymix Home Counties Ltd | Groundwater | Single point (Bray Gravel Pit Point 'A')       | Mineral products: general use                                      | High        | 491200  | 178350   | Approx. 819m south of M4 corridor. Located within Outer Zone of Bray Gravels SPZ.           |
| ABS-BG22   | 28/39/27/0120 | J M Palmer, J R Adams & W D M Buckley   | Groundwater | Single point (Dorney Court, Windsor Well 'A')  | Horticulture and nurseries: spray irrigation                       | High        | 492700  | 179100   | Approx. 852m south of M4 corridor. Located within Outer Zone of Bray Gravels SPZ.           |
| ABS-BG23   | 28/39/26/0133 | Ready Mixed Concrete (Transite) Ltd   | Groundwater | Single point (Bray Gravel Pit Point 'A')       | Mineral products: general use                                      | High        | 491200  | 178200   | Approx. 936m south of M4 corridor. Located within Outer Zone of Bray Gravels SPZ.           |
| ABS-BG24   | 28/39/26/0071 | Summerlease Limited   | Groundwater | Single point (Monkey Island Lane Point 'A')    | Mineral products: mineral washing                                  | High        | 491200  | 178200   | Approx. 936m south of M4 corridor. Located within Outer Zone of Bray Gravels SPZ.           |
| ABS-BG25   | 28/39/27/0136 | Emmett Brothers   | Groundwater | Single point (West Town Farm, Taplow Well 'E') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492487  | 180190   | Approx. 248m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ. |

HIGHWAYS ENGLAND – M4 JUNCTIONS 3 TO 12 SMART MOTORWAY

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.   | Operator                               | Source      | Type of Abstraction                            | Use  | Importance* | Easting | Northing | Comment   |
|--|---------------|--|-------------|--|--|-------------|---------|----------|---|
| ABS-BG26   | 28/39/27/0076 | W Emmett & Son                         | Groundwater | Single point (West Town Farm, Taplow Well 'E') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492500  | 180200   | Approx. 254m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ. |
| ABS-BG27   | 28/39/27/0136 | Emmett Brothers                        | Groundwater | Single point (West Town Farm, Taplow Well 'E') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492620  | 180230   | Approx. 256m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ. |
| ABS-BG28   | 28/39/27/0136 | Emmett Brothers                        | Groundwater | Single point (West Town Farm, Taplow Well 'D') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492286  | 180416   | Approx. 516m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ. |
| ABS-BG29   | 28/39/27/0076 | W Emmett & Son/Philpot Enterprises Ltd | Groundwater | Single point (West Town Farm, Taplow Well 'D') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492200  | 180400   | Approx. 522m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ. |
| ABS-BG30   | 28/39/27/0076 | W Emmett & Son                         | Groundwater | Single point (West Town Farm, Taplow - Well)   | General farming and domestic/general agriculture: spray irrigation | Medium      | 492190  | 180400   | Approx. 524m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ. |
| ABS-BG31   | 28/39/27/0076 | W Emmett & Son                         | Groundwater | Single point (West Town Farm, Taplow Well 'F') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492000  | 180400   | Approx. 571m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ. |

HIGHWAYS ENGLAND – M4 JUNCTIONS 3 TO 12 SMART MOTORWAY

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.   | Operator                | Source      | Type of Abstraction                            | Use  | Importance* | Easting | Northing | Comment   |
|--|---------------|-------------------------|-------------|--|--|-------------|---------|----------|---|
| ABS-BG32   | 28/39/27/0136 | Emmett Brothers         | Groundwater | Single point (West Town Farm, Taplow Well 'F') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492032  | 180421   | Approx. 584m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ.           |
| ABS-BG33   | 28/39/27/0076 | W Emmett & Son          | Groundwater | Single point (West Town Farm, Taplow - Well)   | General farming and domestic/general agriculture: spray irrigation | Medium      | 492020  | 180420   | Approx. 586m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ.           |
| ABS-BG34   | 28/39/27/0076 | Philpot Enterprises Ltd | Groundwater | Single point (West Town Farm, Taplow Well 'F') | General farming and domestic/general agriculture: spray irrigation | Medium      | 492020  | 180420   | Approx. 586m north of M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ.           |
| ABS-BG35   | 28/39/26/0148 | Mr C Wheeler            | Groundwater | Single point (Lillibrooke Farm point 'A')      | General agriculture: spray irrigation                              | Medium      | 488610  | 178170   | Approx. 750m to the south of the M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ |
| ABS-BG36   | 28/39/26/0129 | Mr C Wheeler            | Groundwater | Single point (Lillibrooke Farm point 'A')      | General agriculture: spray irrigation                              | Medium      | 488610  | 178170   | Approx. 750m to the south of the M4 corridor. Located within Total Catchment Zone of Bray Gravels SPZ |
| ABS-BG37   | 28/39/27/0136 | Emmett Brothers         | Groundwater | Single point (West Town Farm, Taplow Bh 'C')   | General farming and domestic/general agriculture: spray irrigation | Low         | 493270  | 179820   | Located outside of Bray Gravels SPZ   |

| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.   | Operator        | Source      | Type of Abstraction                          | Use  | Importance* | Easting | Northing | Comment                             |
|--|---------------|-----------------|-------------|--|--|-------------|---------|----------|-------------------------------------|
| ABS-BG38   | 28/39/27/0136 | Emmett Brothers | Groundwater | Single point (West Town Farm, Taplow Bh 'B') | General farming and domestic/general agriculture: spray irrigation | Low         | 493200  | 180300   | Located outside of Bray Gravels SPZ |
| ABS-BG39   | 28/39/27/0076 | W Emmett & Son  | Groundwater | Single point (West Town Farm, Taplow Bh 'B') | General farming and domestic/general agriculture: spray irrigation | Low         | 493200  | 180300   | Located outside of Bray Gravels SPZ |
| ABS-BG40   | 28/39/27/0136 | Emmett Brothers | Groundwater | Single point (West Town Farm, Taplow Bh 'C') | General farming and domestic/general agriculture: spray irrigation | Low         | 493284  | 179846   | Located outside of Bray Gravels SPZ |
| ABS-BG41   | 28/39/27/0136 | Emmett Brothers | Groundwater | Single point (West Town Farm, Taplow Bh 'B') | General farming and domestic/general agriculture: spray irrigation | Low         | 493209  | 180300   | Located outside of Bray Gravels SPZ |
| ABS-BG42   | 28/39/27/0076 | W Emmett & Son  | Groundwater | Single point (West Town Farm, Taplow Bh 'C') | General farming and domestic/general agriculture: spray irrigation | Low         | 493300  | 179800   | Located outside of Bray Gravels SPZ |
| ABS-BG43   | 28/39/27/0136 | Emmett Brothers | Groundwater | Single point (West Town Farm, Taplow Bh 'A') | General farming and domestic/general agriculture: spray irrigation | Low         | 492540  | 180740   | Located outside of Bray Gravels SPZ |



| Location on Drawing Nos. 514451-MUH-00-ZZ-DR-GE-400200 to 400201 | Licence No.   | Operator                              | Source      | Type of Abstraction                               | Use  | Importance* | Easting | Northing | Comment                             |
|--|---------------|---------------------------------------|-------------|---|--|-------------|---------|----------|-------------------------------------|
| ABS-BG44   | 28/39/27/0136 | Emmett Brothers                       | Groundwater | Single point (West Town Farm, Taplow Bh 'A')      | General farming and domestic/general agriculture: spray irrigation | Low         | 492557  | 180765   | Located outside of Bray Gravels SPZ |
| ABS-BG45   | 28/39/27/0076 | W Emmett & Son                        | Groundwater | Single point (West Town Farm, Taplow Bh 'A')      | General farming and domestic/general agriculture: spray irrigation | Low         | 492500  | 180800   | Located outside of Bray Gravels SPZ |
| ABS-BG46   | 28/39/27/0113 | J M Palmer, J R Adams & W D M Buckley | Groundwater | Single point (Park Fruit Farm, Windsor Point 'B') | General farming and domestic/general agriculture: spray irrigation | Low         | 492800  | 179100   | Located outside of Bray Gravels SPZ |
| ABS-BG47   | 28/39/27/0113 | J M Palmer, J R Adams & W D M Buckley | Groundwater | Single point (Park Fruit Farm, Windsor Point 'A') | General farming and domestic/general agriculture: spray irrigation | Low         | 492700  | 179000   | Located outside of Bray Gravels SPZ |

\* Refer to Table 7 within Chapter 4 in regards to the assessment of importance

## **2.5 Landfill Sites**

### **Beenhams Heath SPZ**

- 2.5.1 As part of the Preliminary Sources Study Report produced for the Scheme, historical landfill records were collated as part of a review of the EA's 'What's in your back yard?' website (<http://www.environment-agency.gov.uk/wiyby>) and the available HA GDMS records. A number of historical landfill sites were found to lie adjacent to the Scheme. However, none of the recorded landfill sites were located within the Beenhams Heath SPZ.

### **Bray Gravels SPZ**

- 2.5.2 The review of historical landfill sites undertaken as part of the Preliminary Sources Study Report identified three historical landfill sites lying adjacent to the Scheme within the Bray Gravels SPZ. These are comprised largely of former gravel extraction sites that have been infilled over time by a variety of domestic and industrial wastes. The historical landfill sites located within the Bray Gravels SPZ are detailed in Table 3 below and are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 and 514451-MUH-00-ZZ-DR-GE-400201 (ref Chapter 7 below).
- 2.5.3 There is no evidence of landfill material being present beneath the existing M4 corridor within the Bray Gravels SPZ. None of the proposed construction elements (ref Chapter 3 below) will interact with the landfill sites.

Table 3: Summary of landfill sites present within the Bray Gravels SPZ

| Chainage       | Site Name     | Location                          | Landfill Type     | Type of waste received – Sourced from EA website  | Information contained within HA GMS reports  |
|----------------|---------------|-----------------------------------|-------------------|---|--|
| 31850 to 31950 | Weirbank      | South of the M4 in between Scheme | Historic landfill | <b>Inert:</b><br>Waste which remains largely unaltered once buried such as glass, concrete, bricks, tiles, soil and stones.   | No information available   |
| 32900 to 33300 | Priors Way    | North of the M4 in between Scheme | Historic landfill | <b>Inert:</b><br>Waste which remains largely unaltered once buried such as glass, concrete, bricks, tiles, soil and stones.<br><b>Industrial:</b><br>Waste from a factory or industrial process. It excludes waste from mines, quarries and agricultural wastes.<br><b>Commercial:</b><br>Waste from premises used wholly or mainly for trade, business, sport, recreation or entertainment. Excludes household and industrial waste. | According to HA GDMS report 12715 this site is understood to have been landscaped after gravel extraction, with the only landfill being near the centre of the site to a depth of approximately 10m. The landfill is understood to be inert.   |
| 32700 to 33300 | Aysgarth Park | South of the M4 in between Scheme | Historic landfill | <b>Inert:</b><br>Waste which remains largely unaltered once buried such as glass, concrete, bricks, tiles, soil and stones.<br><b>Industrial:</b><br>Waste from a factory or industrial process. It excludes waste from mines, quarries and agricultural wastes.<br><b>Commercial:</b><br>Waste from premises used wholly or mainly for trade, business, sport, recreation or entertainment. Excludes household and industrial waste. | HA GDMS report 12715 states that a Public Consultation revealed this site being an old gravel pit infilled with paper wastes from a printing works, which may have been impregnated with printing dyes containing phenols and polyaromatic hydrocarbons. Mercury is also used in the printing process and if the paper is of 'Kraft' origin hydrogen sulphide may be produced. |

## 3 PROPOSED CONSTRUCTION

### 3.1 General

- 3.1.1 As discussed in Chapter 1, the conversion of the M4 between junctions 3 and 12 to a smart motorway involves permanently converting the hard shoulder to a running lane and using technology to vary speed limits and manage traffic. This will be achieved within the existing motorway boundary where possible. Some widening is required at junctions to accommodate slip roads and in areas where no hard shoulder exists. ERAs will be constructed to provide a safe area for vehicles to stop in an emergency without interrupting the flow of traffic. The Scheme will also include the demolition and replacement of 11 overbridges, and the extension of underbridges and culverts where carriageway widening is required. Necessary signing and technology to manage traffic using variable mandatory speed limits will also be provided.
- 3.1.2 Gantry structures are required to support overhead signs, signals, CCTV, vehicle detection and speed limit enforcement equipment, which will be used to inform drivers of conditions on the highway network, when and where variable speed limits are in place, and when lanes are closed. Existing gantries will be retained where possible but five types of new gantries are proposed within the Scheme:
- i) MS3 cantilever gantry;
  - ii) MS4 (hockey stick) gantry;
  - iii) ADS cantilever gantry;
  - iv) Super cantilever gantry; and
  - v) Superspan gantry.
- 3.1.3 Draft Approval in Principle (“AIP”) reports have been produced for each of the proposed gantry types which are listed in Table 4 below. These reports record the agreement between the Designer and Highways England of the basis and criteria for the detailed design and/or assessment of a highway structure and were produced in the summer of 2015 and do not form part of the DCO application.
- 3.1.4 These reports outline the proposed design of the gantries and in each case it is proposed that the foundations will comprise in-situ reinforced concrete bored piles with a reinforced concrete pile cap. Two layout options have been proposed for the gantry foundations (three for the super cantilever gantries), which are dependent on carriageway constraints. The proposed foundation layout drawings relevant to each gantry type are listed in Table 4 and are included in Chapter 7 of this report for reference.

3.1.5 The construction elements that are proposed within the Beenhams Heath and Bray Gravels SPZ are discussed in further detail below.

Table 4: Summary of gantry types proposed along the Scheme

| Gantry Type               | Approval in Principal Document No.        | Drawing No.  |
|---------------------------|---|--|
| MS4 (hockey stick) gantry | Document No. 537806-URS-ST-S3-AI-GN-50001 | <b>Option 1</b><br>Drawing No. 537806-MUH-ST-S3-AI-GN-500011<br><b>Option 2</b><br>Drawing No. 537806-MUH-ST-S3-AI-GN-500011 |
| MS3 cantilever gantry     | Document No. 537806-URS-ST-S3-AI-GN-50002 | Drawing No. 537806-MUH-ST-S3-AI-GN-500021  |
| Super cantilever gantry   | Document No. 537806-URS-ST-S3-AI-GN-50003 | Drawing No. 537806-MUH-ST-S3-AI-GN-500031  |
| Superspan portal gantry   | Document No. 537806-URS-ST-S3-AI-GN-50004 | Drawing No. 537806-MUH-ST-S3-AI-GN-500041  |
| ADS cantilever gantry     | Document No. 537806-URS-ST-S3-AI-GN-50005 | Drawing No. 537806-MUH-ST-S3-AI-GN-500051  |

## 3.2 Beenhams Heath SPZ

3.2.1 The following construction elements are proposed within the Beenhams Heath SPZ:

- i) 1 No. MS3 cantilever gantry;
- ii) 7 No. MS4 (hockey stick) gantries;
- iii) 3 No. Super cantilever gantries;
- iv) 1 No. Superspan gantry; and
- v) 6 No. ERAs.

3.2.2 The hard shoulder of both the eastbound and westbound carriageways of the M4 is continuous within the Beenhams Heath SPZ and as such widening, the demolition and replacement of bridges and/or extension of underbridges/culverts is not required to convert the hard shoulder into a running lane.

3.2.3 The proposed gantries and ERAs within the Beenhams Heath SPZ are detailed in Table 5 and are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-

ZZ-DR-GE-400199 (Chapter 7 below). All the proposed gantries and ERAs are located within the Total Catchment Zone of the Beenhams Heath SPZ.

Table 5: Proposed construction elements within the Beenhams Heath SPZ

| Name  | Structure | Structure type   | Scheme chainage | Carriageway | Earthworks Construction                             | Total length affected by new construction(m) | SPZ designation at location |
|-------|-----------|------------------|-----------------|-------------|---|--|-----------------------------|
| G7-09 | Gantry    | MS4              | 36,915          | WB          | Unreinforced cutting                                | 39   | Catchment Zone (Zone 3)     |
| G7-11 | Gantry    | MS4              | 37,100          | EB          | Minor granular fill wedge                           | 39   | Catchment Zone (Zone 3)     |
| G7-12 | Gantry    | MS4              | 37,530          | WB          | Unreinforced cutting                                | 39   | Catchment Zone (Zone 3)     |
| G7-13 | Gantry    | MS3 Cantilever   | 37,634          | EB          | Unreinforced cutting                                | 39   | Catchment Zone (Zone 3)     |
| E7-A2 | ERA       | -                | -               | WB          | #N/A  | 160  | Catchment Zone (Zone 3)     |
| G7-15 | Gantry    | Superspan        | 38,400          | EB & WB     | #N/A  | 37   | Catchment Zone (Zone 3)     |
| E7-B2 | ERA       | -                | -               | EB          | Granular fill wedge & geogrid reinforced embankment | 160  | Catchment Zone (Zone 3)     |
| G7-17 | Gantry    | MS4              | 39,260          | EB          | Minor granular fill wedge                           | 39   | Catchment Zone (Zone 3)     |
| G7-18 | Gantry    | MS4              | 40,000          | EB          | Minor granular fill wedge                           | 39   | Catchment Zone (Zone 3)     |
| E7-A3 | ERA       | -                | -               | WB          | Granular fill wedge                                 | 160  | Catchment Zone (Zone 3)     |
| G7-20 | Gantry    | MS4              | 40,700          | EB          | #N/A  | 39   | Catchment Zone (Zone 3)     |
| G7-21 | Gantry    | Super cantilever | 41,080          | WB          | #N/A  | 24   | Catchment Zone (Zone 3)     |
| E7-B3 | ERA       | -                | -               | EB          | Granular fill wedge                                 | 160  | Catchment Zone (Zone 3)     |
| G7-23 | Gantry    | Super cantilever | 41,742          | EB          | Unreinforced cutting                                | 41   | Catchment Zone (Zone 3)     |
| G7-25 | Gantry    | MS4              | 42,400          | WB          | Unreinforced cutting                                | 39   | Catchment Zone (Zone 3)     |
| G7-26 | Gantry    | Super cantilever | 42,948          | WB          | Minor granular fill wedge                           | 41   | Catchment Zone (Zone 3)     |

| Name  | Structure | Structure type | Scheme chainage | Carriageway | Earthworks Construction                            | Total length affected by new construction(m) | SPZ designation at location |
|-------|-----------|----------------|-----------------|-------------|--|--|-----------------------------|
| E7-A4 | ERA       | -              | -               | WB          | #N/A   | 160  | Catchment Zone (Zone 3)     |
| E7-B4 | ERA       | -              | -               | EB          | Minor granular fill wedge/<br>unreinforced cutting | 160  | Catchment Zone (Zone 3)     |



### 3.3 Bray Gravels SPZ

3.3.1 The following construction elements are proposed within the Bray Gravels SPZ:

- i) 2 No. MS3 cantilever gantries;
- ii) 7 No. MS4 (hockey stick) gantries;
- iii) 2 No. ADS cantilever gantries;
- iv) 3 No. Super cantilever gantries;
- v) 3 No. ERAs;
- vi) 5 No. areas of widening requiring retained earthworks solutions (hereafter referred to as retained solution);
- vii) Demolition and re-construction of Ascot Road Overbridge, Monkey Island Lane Overbridge and Marsh Lane Overbridge; and
- viii) Extension of Thames Bray Underbridge.

3.3.2 The proposed construction elements within the Bray Gravels SPZ are shown on Drawing Nos 514451-MUH-00-ZZ-DR-GE-400200 and 514451-MUH-00-ZZ-DR-GE-400201 (Chapter 7 below). These drawings show that the proposed construction elements are located variably within the Inner, Outer and Total Catchment Zones of the Bray Gravels SPZ.

3.3.3 The proposed gantries and ERA's are detailed in Table 6, whereas the 5 No. areas of widening requiring retained earthworks solutions and the proposed works to the 3 No. overbridges and 1 No. underbridge are discussed in further detail below.

Table 6: Proposed construction elements within the Bray Gravels SPZ

| Name  | Type of structure                    | Gantry type      | Scheme chainage | Carriageway | Earthworks Construction                           | Total length affected by new construction (m) | SPZ designation at location                 |
|-------|--------------------------------------|------------------|-----------------|-------------|---|---|---|
| G6-04 | Gantry                               | Super cantilever | 29,958          | WB          | Minor granular fill wedge/unreinforced cutting    | 40  | Catchment Zone (Zone 3)                     |
| G6-05 | Gantry                               | ADS Cantilever   | 30,182          | EB          | Minor granular fill wedge/unreinforced cutting    | 40  | Outer Zone (Zone 2)                         |
| E6-B1 | ERA                                  | -                | 30,450          | EB          | Minor granular fill wedge/unreinforced cutting    | 160   | Outer Zone (Zone 2)                         |
| R28   | Area of widening (retained solution) | -                | 30,540          | WB          | Geogrid reinforced embankment retained solution   | 330   | Outer Zone (Zone 2)                         |
| R29   | Area of Widening (retained solution) | -                | 30,580          | EB          | Geogrid reinforced embankment                     | 1200  | Inner Zone (Zone 1) and Outer Zone (Zone 2) |
| G6-06 | Gantry                               | MS4              | 30,587          | WB          | Minor granular fill wedge/unreinforced cutting    | 40  | Outer Zone (Zone 2)                         |
| G6-07 | Gantry                               | MS4              | 30,737          | EB          | Minor granular fill wedge/granular fill wedge     | 40  | Outer Zone (Zone 2)                         |
| G6-09 | Gantry                               | MS3 Cantilever   | 30,832          | WB          | Minor granular fill wedge/granular fill wedge     | 40  | Outer Zone (Zone 2)                         |
| G6-08 | Gantry                               | ADS Cantilever   | 31,050          | EB          | Granular fill wedge/Geogrid reinforced embankment | 40  | Outer Zone (Zone 2)                         |
| G6-10 | Gantry                               | MS4              | 31,350          | WB          | Granular fill wedge/Geogrid reinforced embankment | 40  | Inner Zone (Zone 1)                         |
| E6-A1 | ERA                                  | -                | 31,425          | WB          | Granular fill wedge/Geogrid reinforced embankment | 160   | Inner Zone (Zone 1)                         |
| R30   | Area of Widening (retained solution) | -                | 31,540          | WB          | Minor granular fill wedge/unreinforced cutting    | 90  | Inner Zone (Zone 1)                         |
| G6-12 | Gantry                               | MS4              | 31,624          | EB          | Minor granular fill wedge/unreinforced cutting    | 40  | Inner Zone (Zone 1)                         |
| G6-13 | Gantry                               | MS3 Cantilever   | 31,807          | WB          | Minor granular fill wedge/unreinforced cutting    | 40  | Inner Zone (Zone 1)                         |
| E6-B2 | ERA                                  | -                | 31,800          | EB          | Minor granular fill wedge/unreinforced cutting    | 40  | Inner Zone (Zone 1)                         |

| Name  | Type of structure                    | Gantry type      | Scheme chainage | Carriageway | Earthworks Construction                           | Total length affected by new construction (m) | SPZ designation at location |
|-------|--------------------------------------|------------------|-----------------|-------------|---|---|-----------------------------|
| G6-14 | Gantry                               | MS4              | 32,159          | WB          | Granular fill wedge/Geogrid reinforced embankment | 40  | Outer Zone (Zone 2)         |
| G6-15 | Gantry                               | MS4              | 32,266          | EB          | Granular fill wedge/Geogrid reinforced embankment | 40  | Outer Zone (Zone 2)         |
| G6-18 | Gantry                               | Super cantilever | 32,866          | EB          | Granular fill wedge/Geogrid reinforced embankment | 40  | Catchment Zone (Zone 3)     |
| G6-17 | Gantry                               | MS4              | 32,963          | WB          | Granular fill wedge/Geogrid reinforced embankment | 40  | Catchment Zone (Zone 3)     |
| G6-19 | Gantry                               | Super cantilever | 33,197          | WB          | Minor granular fill wedge/unreinforced cutting    | 40  | Catchment Zone (Zone 3)     |
| R31   | Area of Widening (retained solution) | -                | 33,080          | EB          | Minor granular fill wedge/unreinforced cutting    | 820   | Catchment Zone (Zone 3)     |
| R32   | Area of Widening (retained solution) | -                | 33,200          | WB          | Minor granular fill wedge/unreinforced cutting    | 700   | Catchment Zone (Zone 3)     |

### Proposed Structures and Widening

- 3.3.4 The structures on the M4 from junctions 4 to 8/9 were mostly built during the 1960s to accommodate a dual two lane motorway. In the 1970s the motorway was widened to dual three lanes, but the structures were generally not modified. This has resulted in the hard shoulder being discontinuous at some overbridges and underbridges. These constraints need to be removed so that the hard shoulder can function as a continuous running lane.
- 3.3.5 In the Bray Gravels SPZ, it is proposed to demolish and re-construct Ascot Road overbridge, Monkey Island Lane overbridge and Marsh Lane overbridge and extend the Thames Bray Underbridge to accommodate the Scheme. The hard shoulder is discontinuous in the approaches to these structures and as such it is also necessary to widen the existing carriageway either side of these structures.
- 3.3.6 The proposals for each of these structures and associated widening are discussed in turn below.

### Ascot Road Overbridge

- 3.3.7 The existing structure carries the A330 Ascot Road, and all-purpose suburban single carriageway, over the M4 and in conjunction with the A308(M) connects junctions 8/9 of the M4 with the villages and towns to the south of the M4. The proposed structure will carry the re-aligned Ascot Road immediately east of the existing structure.
- 3.3.8 A longer span replacement bridge is required at Ascot Road overbridge due to the discontinuous hard shoulder of the M4. The proposed structure will be constructed adjacent to the existing bridge, i.e. offline. This will allow pedestrians and road traffic to continue to use the existing bridge while the new bridge is being constructed. On completion of the new bridge, traffic will be diverted onto it and the old bridge will be demolished.
- 3.3.9 An AIP document has been produced for the design and replacement of Ascot Road Overbridge which outlines the proposals for the bridge (ref Alliance Document No. 514451-MUH-ST-ZZ-RP-OB-300278). This report describes that the proposed structure is a single-span, steel-concrete composite bridge with full-height integral abutments founded on single rows of piles. The overall square deck width is approximately 13.3m, comprising a single 7.3m carriageway with a 3.0m footway to the west, a 2.0m footway to the east and 0.5m parapet upstands.
- 3.3.10 The proposed substructure consists of partially-buried full-height reinforced concrete abutments at the back of the north and south verges of the M4 motorway. The deck superstructure will be made fully-integral with the abutment walls. Reinforced concrete wingwalls will be provided parallel to the route over the structure, and are intended to be structurally isolated from the main abutment walls.

- 3.3.11 The abutment walls will be integral with the foundations and comprise a single row of reinforced concrete piles, which will be structurally continuous with the abutment wall above. It is proposed to adopt pad foundations for the structurally isolated reinforced concrete wingwalls.
- 3.3.12 The general arrangement of the Ascot Road overbridge replacement is shown on Drawing Nos 514451-MUH-ST-ZZ-RP-OB-300278-001 and 514451-MUH-ST-ZZ-RP-OB-300278-002 (Chapter 7 below), which is provided with this report.
- 3.3.13 The proposed structure will be approximately 1.4m higher than the existing overbridge and as such the re-aligned Ascot Road to both the north and south of the M4 corridor will be held on an embankment. To the north of the M4, a 170m long retaining wall is required to prevent the embankment for the re-aligned Ascot Road encroaching onto adjacent land that is currently part of the Priors Way Industrial Park (Ref Drawing No. 514451-MUH-SR-986-HW-GA-301001 (Chapter 7 below)). The design of this retaining wall is structurally isolated from the proposed replacement overbridge. It is proposed that this retaining wall will be of reinforced soil construction.
- 3.3.14 The M4 carriageway on both the eastbound and westbound approaches to Ascot Road Overbridge requires widening. Retained solution R31 is proposed to widen the eastbound carriageway between Ch33080 and Ch33900 whilst retained solution R32 is proposed to widen the westbound carriageway between Ch33200 and Ch33900. Both of these retained solutions will comprise a minor (<1.0m) granular fill wedge/unreinforced cutting.
- 3.3.15 Ascot Road overbridge and retained solutions R31 and R32 are located within the Total Catchment Zone of the Bray Gravels SPZ.

#### **Monkey Island Lane Overbridge**

- 3.3.16 The existing structure carries Monkey Island Lane, a local unclassified road, over the M4 connecting the village of Bray with a number of dwellings and several hotels and other businesses. Monkey Island Lane is currently a no through-road to vehicular traffic to the south with the road continuing as a bridleway. The proposed structure will carry the re-aligned Monkey Island Lane, immediately to the west of the existing structure.
- 3.3.17 A longer span replacement bridge is required at Monkey Island Lane overbridge due to the discontinuous hard shoulder of the M4. The proposed structure will be constructed adjacent to the existing bridge, i.e. offline. This will allow the bridge to remain in use until the new bridge is constructed.
- 3.3.18 An AIP has been produced for the design and replacement of Monkey Island Lane overbridge, which outlines the proposals for the bridge (ref Alliance Document No. 514451-MUH-ST-ZZ-RP-OB-300277). The AIP describes that the proposed structure is a single-span steel-concrete composite bridge with full-height integral abutments founded on single

rows of piles. The overall square deck width is approximately 11.5m, comprising a single 5.5 m carriageway with a 2.0 m footway to the west, a 3.0 m footway to the east and 0.5 m parapet upstands.

- 3.3.19 The proposed substructure consists of partially-buried full-height reinforced concrete abutments at the back of the north and south verges of the M4 motorway. The deck superstructure will be made fully integral with the abutment walls. Reinforced concrete wingwalls will be provided parallel to the route over the structure, and are intended to be structurally isolated from the main abutment walls.
- 3.3.20 The general arrangement of the Monkey Island Lane overbridge replacement is shown on Drawing Nos 514451-MUH-ST-ZZ-RP-OB-300277-001 and 514451-MUH-ST-ZZ-RP-OB-300277-002.
- 3.3.21 The proposed structure will be approximately 1.4m higher than the existing overbridge and as such the re-aligned Monkey Island Lane to both the north and south of the M4 corridor will be held on an embankment (Ref Drawing No. 514451-MUH-SR-979-HW-GA-301002).
- 3.3.22 The M4 carriageway at both the eastbound and westbound approaches to Monkey Island Lane Overbridge requires widening. Retained solution R30 is proposed to widen the westbound carriageway between Ch31540 and Ch31630. This retained solution will comprise a minor (<1.0m high) granular fill wedge/unreinforced cutting.
- 3.3.23 Retained solution R29 is proposed to widen the eastbound carriageway continuously between Ch30580 and Ch31780. Retained solution R29 begins west of Monkey Island Lane Overbridge and ends to the east of Marsh Lane Overbridge. In doing so, it widens the eastbound approaches to Monkey Island Lane Overbridge, Thames Bray Underbridge and Marsh Lane Overbridge. It is proposed that retained solution R29 will comprise a reinforced soil embankment which ranges in height between 2.0m and 7.0m.
- 3.3.24 Monkey Island Lane Overbridge and retained solution R30 are located entirely within the Inner Zone of the Bray Gravels SPZ. Retained solution R29 is 1.2km long and as such will be constructed within both the Inner and Outer Zone of the SPZ. R29 will be located within the Inner Zone between Ch30580 and Ch31090 and within the Outer Zone between Ch31090 and Ch31780.

#### **Marsh Lane Overbridge**

- 3.3.25 The existing structure carries Marsh lane, a local unclassified road, over the M4 connecting the A4 from the north to the village of Dorney to the south of the M4. The proposed structure will be constructed on-line of the existing Marsh Lane Overbridge.

- 3.3.26 A longer span replacement bridge is required at Marsh Lane Overbridge due to the discontinuous hard shoulder of the M4. Marsh Lane will be temporally closed for the duration of construction.
- 3.3.27 An AIP has been produced for the design and replacement of Marsh Lane Overbridge which outlines the proposals for the bridge (ref Alliance Document No. 514451-MUH-ST-ZZ-RP-OB-300276). The AIP describes that the proposed structure is a single-span steel-concrete composite semi-integral bridge spanning between full-height abutments at the back of the north and south verges. The overall square deck width is approximately 13.8 m, comprising a single 6.75 m carriageway with a 3.0 m footway to both east and west, with 0.5 m parapet upstands.
- 3.3.28 The proposed substructure consists of partially-buried full-height reinforced concrete abutments at the back of the north and south verges of the M4 motorway. The deck superstructure will be made fully integral with the abutment walls. Reinforced concrete wingwalls will be provided parallel to the route over the structure, and are intended to be structurally isolated from the main abutment walls.
- 3.3.29 The general arrangement of the Marsh Lane overbridge replacement is shown on Drawing Nos 514451-MUH-ST-ZZ-RP-OB-300276-001 and 514451-MUH-ST-ZZ-RP-OB-300276-002 in Chapter 7 below.
- 3.3.30 The proposed structure will be approximately 1.2m higher than the existing overbridge and as such re-aligned Marsh Lane to both the north and south of the M4 corridor will be held on an embankment (Ref Drawing No. 514451-MUH-SR-977-HW-GA-301003 (Chapter 7 below)). The embankments are to comprise reinforced soil embankments so that the footprint of the earthwork remains within the highway boundary.
- 3.3.31 As described above, it is proposed that retained solution R29 will widen the eastbound approach to Marsh Lane. Retained solution R28 is proposed to widen the westbound approach to Marsh Lane between Ch30540 and Ch30870. It is proposed that retained solution R28 will comprise a reinforced soil embankment which ranges in height between 2.0m and 7.0m.
- 3.3.32 Marsh Lane Overbridge and retained solution R28 are located within the Outer Zone of the Bray Gravels SPZ.

#### **Thames Bray Underbridge**

- 3.3.33 The Thames Bray underbridge carries the M4 over the River Thames with a central span of over 80m. The M4 hard shoulders are discontinuous over the underbridge, which therefore requires widening by 7.8m. This will be achieved by asymmetrical widening to the north of the M4. To accommodate this, the central alignment of the M4 motorway over the bridge will be moved to the north by up to 4.0m.

- 3.3.34 An AIP has been produced for widening of Thames Bray underbridge which outlines the proposals for the bridge (ref Alliance Document No. 514451-MUH-ST-78-RP-UB-300002). The AIP describes that the current structure comprises three continuous square spans of 8 No. haunched fabricated steel beams with a composite reinforced concrete deck slab. Holding down anchorages, located within the abutment walls, sustain the uplift forces at the beam ends. The abutment pile cap also supports the 8 No. tapered columns, which form the pier supports. The wing walls are aligned parallel with the carriageway above. The substructure was constructed in 1939. However, the bridge deck was not constructed until 1960 due to the intervening war. The bridge has undergone a series of maintenance and strengthening schemes during its history, the most recent of which being undertaken in 2006.
- 3.3.35 The widening proposals are to extend the bridge on the north side by approximately 7.8m with the addition of 2 No. haunched steel girders and composite deck slab closely matching the profile and appearance of the existing bridge.
- 3.3.36 The substructure comprises of cantilever hollow 'T' abutment wall construction on piled foundations. The two intermediate supports each consist of eight concrete tapered columns, founded on the same pile cap as the abutment walls. The foundation pile caps at each end of the structure are supported by vertical and raking piles. The widened substructure will comprise a cantilever 'T' abutment wall independent and similar to the existing abutments on piled foundations. Galleries will be provided within the abutment walls for inspection and maintenance of the new girder holding down assemblies. The new intermediate pier supports will match the shape and level of existing concrete tapered columns.
- 3.3.37 The general arrangement of the Thames Bray underbridge widening are shown on Drawing Nos 514451-MUH-ST-S2-DR-UB-397801-2A and 514451-MUH-ST-S2-DR-UB-397802-2A (Chapter 7 below).
- 3.3.38 The Thames Bray underbridge is located within the Inner Zone of the Bray Gravels SPZ.



## 4 POTENTIAL IMPACTS TO CONTROLLED WATERS

### 4.1 Introduction

4.1.1 This chapter assesses the impacts of the Scheme on groundwater and surface water bodies located within the Beenhams Heath and Bray Gravels SPZs during the construction and operational phases of the Scheme.

4.1.2 The approach to assessing the impacts of the construction on the water environment involves an assessment of the relative significance of the impacts. The methodology assesses the likely impacts of the Scheme on the water environment; identifies the need for mitigation through improved design and environmental management during construction and operation; and assesses the residual effects of the mitigated Scheme. The methodology for this approach is listed below:

- i) Assessment of baseline environmental importance - an assessment of baseline importance has been undertaken by drawing together and reviewing available data. Drawing Nos 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-ZZ-DR-GE-400201 (Chapter 7 below) present the baseline conditions with respect to the water environment. Flood risk and run-off management are detailed in Chapter 15 (Road Drainage and the Water Environment) of the ES;
- ii) Assessment of impact magnitude - the magnitude of impact is described with reference to the Scheme-specific effect descriptors presented in Table 8. The Scheme has been assessed to ensure that all effects on road drainage and the water environment are identified and that any environmental issues associated with the underlying groundwater are also considered;
- iii) Assessment of impact significance - the significance of an environmental effect is typically a function of the value or importance of the receptor and the magnitude or scale of the impact. Combining the environmental value of the resource or receptor with the magnitude of impact produces a significance of effect category; and
- iv) Assessment of residual effects after mitigation - effects that remain after mitigation are referred to as "residual effects". The key outcome of the assessment is the significance of the residual effects after mitigation or enhancement.

### 4.2 Assessment of Baseline Conditions

4.2.1 The baseline conditions were established as part of the preparation of the ES, which included the review of existing data, specific enquiries to the BGS and additional consultation with the Local Authorities that flank the Scheme. The baseline conditions of the

Beenhams Heath SPZ and Bray Gravels SPZ have been further refined in Chapter 2 and 3 of this report.

- 4.2.2 As detailed within Chapter 15 (Road Drainage and the Water Environment) of the ES, the drainage and water receptors have been assigned a value/importance based upon criteria derived from DMRB Volume 11, Section 3, Part 10 (HD 45/09) (ref Department for Transport, 2009). The value/importance assigned to the drainage and water receptors are present in Table 7.

Table 7: Receptor Value/Importance

| Value/importance | Typical descriptors  | Typical example |   |
|------------------|--|-----------------|---|
| Very High        | Attribute has a high quality and rarity on a regional or national scale. | Surface waters  | EC Designated Salmonid/Cyprinid fishery<br>River Quality Objective (“RQO”) River Ecosystem Class RE1*<br>Site protected under EU or UK wildlife legislation (SAC, SPA, SSSI, Ramsar site) |
|                  |  | Groundwater     | Major aquifer providing a regionally important resource or supporting site protected under wildlife legislation;<br>Inner Zone (Zone 1) of SPZ  |
| High             | Attribute has a high quality and rarity on a local scale.                | Surface Waters  | RQO River Ecosystem Class RE2*<br>Major Cyprinid Fishery<br>Species protected under EU or UK wildlife legislation   |
|                  |  | Groundwater     | Major aquifer providing locally important resourced or supporting river ecosystem;<br>Outer Zone (Zone 2) of SPZ  |
| Medium           | Attribute has a medium quality and rarity on a local scale.              | Surface waters  | RQO River Ecosystem Class RE3 or RE4*   |
|                  |  | Groundwater     | Aquifer providing water for agricultural or industrial use with limited connection to surface water SPZ<br>Total Catchment (Zone 3) of SPZ  |
| Low              | Attribute has a low quality and rarity on a local scale.                 | Surface waters  | RQO River Ecosystem Class RE5*  |
|                  |  | Groundwater     | Non-aquifer   |

Source: (DMRB Volume 11 Section 3 Part 10 (HD 45/09))

### 4.3 Assessment of Impact Magnitude

- 4.3.1 The magnitude of impacts of the Scheme on receptors is assessed considering the scale, extent of change, nature and duration of the impact as described in Chapter 5

(Environmental Impact Assessment Methodology) of the ES (Application Document Reference 6-1, APP-145). The magnitude of the impact may be major, moderate or minor, adverse or beneficial, or negligible in accordance with DMRB Volume 11, Section 3, Part 10 (HD 45/09) (ref Department for Transport, 2009). These terms are defined in Table 8.

Table 8: Definitions of magnitude of impact

| Magnitude of Impact   | Typical Criteria Descriptors  |
|-----------------------|---|
| Major adverse         | Total loss or large scale damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic conspicuous features and elements.<br><b>Surface Water:</b> Failure of both soluble and sediment-bound pollutants in Highways Agency Water Risk Assessment Tool ("HAWRAT") and compliance failure with Environmental Quality Standard ("EQS") values.<br><b>Groundwater:</b> Loss of, or extensive change to, an aquifer. Potential high risk of pollution to groundwater from routine runoff. |
| Moderate adverse      | Partial loss or noticeable damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic noticeable features and elements.<br><b>Surface Water:</b> Failure of both soluble and sediment-bound pollutants in HAWRAT but compliance with EQS values.<br><b>Groundwater:</b> Partial loss or change to an aquifer. Potential medium risk of pollution to groundwater from routine runoff.  |
| Minor adverse         | Slight loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.<br><b>Surface Water:</b> Failure of either soluble or sediment-bound pollutants in HAWRAT. Calculated risk of pollution from spillages >0.5% annually and <1% annually.<br><b>Groundwater:</b> Potential low risk of pollution to groundwater from routine runoff.   |
| Negligible adverse    | Barely noticeable loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.<br><b>Surface Water:</b> No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants).<br><b>Groundwater:</b> No measurable impact upon an aquifer and risk of pollution from spillages.  |
| No change             | No noticeable loss, damage or alteration to character or features or elements.  |
| Negligible beneficial | Barely noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.<br><b>Surface Water:</b> No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants).<br><b>Groundwater:</b> No measurable impact upon an aquifer and risk of pollution from spillages.  |
| Minor beneficial      | Slight improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.<br><b>Surface Water:</b> HAWRAT assessment of either soluble or sediment-bound pollutants indicates "Pass" from an existing site where the baseline was a "Fail" condition.<br><b>Groundwater:</b> Calculated reduction in existing spillage risk by 50% or more to an aquifer.  |

| Magnitude of Impact | Typical Criteria Descriptors  |
|---------------------|---|
| Moderate beneficial | Partial or noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic and noticeable features and elements, or by the addition of new characteristic features.<br><b>Surface Water:</b> HAWRAT assessment of both soluble and sediment-bound pollutants indicates “Pass” from an existing site where the baseline was a “Fail” condition.<br><b>Groundwater:</b> Calculated reduction in existing spillage risk by 50% or more.                               |
| Major beneficial    | Large scale improvement of character by the restoration of features and elements, and/or the removal of uncharacteristic and conspicuous features and elements, or by the addition of new distinctive features.<br><b>Surface Water:</b> Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse.<br><b>Groundwater:</b> Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of an aquifer. |

## 4.4 Assessment of Impact Significance

4.4.1 The significance of the effects of the Scheme on receptors is based on a combination of the value of the resource and the magnitude of the impact, as shown in Table 9. This matrix table is derived from Chapter 5 (Environmental Impact Assessment Methodology) of the ES and follows the criteria set out in DMRB Volume 11, Section 3, Part 10 (HD 45/09) (ref Department for Transport, 2009). Professional judgement has been used when selecting the significance of effect where there is a choice, e.g. slight/moderate.

Table 9: Significance matrix table

| Value/importance of receptor | Magnitude of impact |                 |                  |                  |
|------------------------------|---------------------|-----------------|------------------|------------------|
|                              | Negligible          | Minor           | Moderate         | Major            |
| Very high                    | Neutral             | Moderate/large  | Large/very large | Very large       |
| High                         | Neutral             | Slight/moderate | Moderate/large   | Large/very large |
| Medium                       | Neutral             | Slight          | Moderate         | Large            |
| Low                          | Neutral             | Neutral         | Slight           | Slight/moderate  |

Source: (DMRB Volume 11 Section 3 Part 10 (HD 45/09))

4.4.2 The smart motorway construction will be largely on the existing alignment of the motorway. As such, construction impact will be largely localised with respect to Controlled Waters. Table 10 details the magnitude of impact in relation to the value/importance of the receptor for the key areas that lie within the Beenhams Heath SPZ, whilst Table 11 details the Bray Gravels SPZ.

Table 10: Significance of construction within the Beenhams Heath SPZ

| Construction  | Description  | Value/ importance of receptor | Magnitude of impact | Significance |
|---|--|-------------------------------|---------------------|--------------|
| <b>Gantries:</b><br>G7-09, G7-11, G7-12, G7-13, G7-15, G7-17, G7-18, G7-20, G7-21, G7-23, G7-25 & G7-26 | Shallow in-situ reinforced concrete bored piles located at isolated areas within <b>Total Catchment Zone (Zone 3) of SPZ</b> .<br>Chalk aquifer from which groundwater is abstracted is located at a depth of 123m below existing ground level. Overlying strata (London Clay Formation and Lambeth Group) act as an aquitard.           | Medium                        | Negligible          | Neutral      |
| <b>ERA's:</b><br>E7-A2, E7-B2, E7-A3, E7-B3, E7-A4 & E7-B4  | Localised areas of earthworks widening within the existing highway boundary and within the <b>Total Catchment Zone (Zone 3) of SPZ</b> .<br>Chalk aquifer from which groundwater is abstracted is located at a depth of 123m below existing ground level. Overlying strata (London Clay Formation and Lambeth Group) act as an aquitard. | Medium                        | Negligible          | Neutral      |

Table 11: Significance of construction within the Bray Gravels SPZ

| Location                                 | Description   | Value/ importance of receptor | Magnitude of impact | Significance    |
|--|---|-------------------------------|---------------------|-----------------|
| <b>Gantries:</b><br>G6-10, G6-12 & G6-13 | In-situ reinforced concrete bored piles located at isolated areas within <b>Inner Zone (Zone 1) of SPZ</b> .<br>Gantry foundations will be contained within Made Ground (associated with highway embankment construction) or River Terrace Deposits.  | Very high                     | Minor               | Moderate/ large |
| <b>ERA's:</b><br>E6-A1 & E6-B2           | Localised areas of earthworks widening within the existing highway boundary within <b>Inner Zone (Zone 1) of SPZ</b> .<br>The construction of the ERA's will take place at or above existing ground level. Local areas of minor cutting may be required but this is not likely to exceed 1m in depth. | Very high                     | Negligible          | Neutral         |

| Location   | Description   | Value/ importance of receptor | Magnitude of impact | Significance     |
|--|---|-------------------------------|---------------------|------------------|
| Areas of widening: R29 (Ch30580 to Ch31090 only) & R30     | Reinforced soil embankment / minor (<1.0m) granular fill wedge/unreinforced cutting within <b>Inner Zone (Zone 1) of SPZ</b> .<br>The areas of widening will take place at or above existing ground level. Local areas of minor cutting may be required but this is not likely to exceed 1m in depth. | Very high                     | Negligible          | Neutral          |
| Monkey Island Overbridge                                   | Construction of new bridge off-line. Bridge abutments will be sitting on concrete piles. Shallow founded wing walls. Re-aligned Monkey Island Lane will be held on unreinforced embankments. Controlled demolition of old bridge. <b>Located within Inner Zone (Zone 1) of SPZ</b>                    | Very high                     | Moderate            | Large/very large |
| Thames Bray Underbridge                                    | Extension of existing underbridge. Underbridge abutments will be sitting on concrete piles. <b>Located within Inner Zone (Zone 1) of SPZ.</b>   | Very high                     | Moderate            | Large/very large |
| Gantries: G6-05, G6-06, G6-07, G6-08, G6-09, G6-14 & G6-15 | In-situ reinforced concrete bored piles located at isolated areas within <b>Outer Zone (Zone 2) of SPZ</b> .<br>Gantry foundations will be contained within Made Ground (associated with highway embankment construction) or River Terrace Deposits.  | High                          | Minor               | Slight/ moderate |
| ERA's: E6-B1   | Localised areas of widening within <b>Outer Zone (Zone 2) of SPZ</b> .<br>The construction of the ERA's will take place at or above existing ground level. Local areas of minor cutting may be required but this is not likely to exceed 1m in depth.   | High                          | Negligible          | Neutral          |
| Areas of widening: R28 & R29 (Ch31090 to Ch31780 only)     | Reinforced soil embankment within <b>Outer Zone (Zone 2) of SPZ</b> .<br>The areas of widening will take place at or above existing ground level. Local areas of minor cutting may be required but this is not likely to exceed 1m in depth.  | High                          | Negligible          | Neutral          |
| Marsh Lane Overbridge                                      | Controlled demolition of old bridge. Construction of new bridge on-line. Bridge abutments will be sitting on concrete piles. Shallow founded wing walls. Re-aligned Marsh Lane will be held on reinforced soil embankments. <b>Located within Outer Zone (Zone 2) of SPZ</b>                          | High                          | Moderate            | Moderate/ large  |

| Location  | Description   | Value/ importance of receptor | Magnitude of impact | Significance |
|---|---|-------------------------------|---------------------|--------------|
| <b>Gantries:</b><br>G6-04, G6-17, G6-18 & G6-19 | In-situ reinforced concrete bored piles located at isolated areas within <b>Total Catchment Zone (Zone 3) of SPZ</b> . Gantry foundations will be contained within Made Ground (associated with highway embankment construction) or River Terrace Deposits.   | Medium                        | Minor               | Slight       |
| <b>Areas of widening:</b><br>R31 & R32          | Minor (<1.0m) granular fill wedge/unreinforced cutting within <b>Total Catchment Zone (Zone 3) of SPZ</b> . The areas of widening will take place at or above existing ground level. Local areas of minor cutting may be required but this is not likely to exceed 1m in depth.                           | Medium                        | Negligible          | Neutral      |
| <b>Ascot Road Overbridge</b>                    | Construction of new bridge off-line. Bridge abutments will be sitting on concrete piles. Shallow founded wing walls. Re-aligned Ascot Road will be held on un-reinforced and reinforced soil embankments. Controlled demolition of old bridge. <b>Located within Total Catchment Zone (Zone 3) of SPZ</b> | Medium                        | Moderate            | Moderate     |

## 4.5 Design and Mitigation

- 4.5.1 The Beenhams Heath and Bray Gravels SPZs are underlain by Principal Aquifers from which groundwater abstraction for public water supplies is currently taking place. Certain construction activities, such as piling, excavation of soft ground beneath proposed sections of embankment widening and excavation below the water table, have the potential to cause migration of contaminants (such as suspended solids), which may affect groundwater quality, and in particular affect public water drinking supplies.
- 4.5.2 The construction of the ERAs, the areas of widening (retained solutions R28 to R32) and the re-aligned side roads associated with Ascot Road, Monkey Island Lane and Marsh Lane overbridges will take place at or above existing ground level. Local areas of minor cutting may be required, but this is not likely to exceed 1m in depth. Excavations will be designed to be as shallow as possible, and above the groundwater table, in order to mitigate the risk of disturbing the ground and increasing turbidity within the groundwater. Careful management of construction site drainage (e.g. sediment traps, settling lagoons, siltbusters, etc.) will also mitigate the attendant risks.
- 4.5.3 It is proposed that the gantries will be founded on in-situ bored concrete piles, which are expected to vary in length dependent on the ground conditions at each element to be constructed. Within the Beenhams Heath SPZ, it is anticipated that the gantries will be founded within Made Ground (associated with highway construction) or strata belonging to the London Clay Formation. Within the Bray Gravels SPZ, it is anticipated that the gantry foundations will be contained within the Made Ground (associated with highway embankment construction) or founded within the River Terrace Deposits to achieve the required end bearing support.
- 4.5.4 Due to the nature of the construction, ground conditions and the high groundwater levels within the Bray Gravels SPZ, it is proposed that the bridge abutments associated with the construction of Ascot Road overbridge, Monkey Island Lane overbridge and Marsh Lane overbridge and the extension of the Thames Bray underbridge will sit on reinforced concrete piles.
- 4.5.5 Piled foundations will cause least disturbance to the ground below the bridges and gantries and will negate the need for dewatering. Appropriate measures such as the use of full permanent casings during piling works will reduce/mitigate likely effects on the groundwater environment. Careful management of construction site drainage (e.g. sediment traps settling lagoons, siltbusters, etc.) will also mitigate against the attendant risks.
- 4.5.6 Further ground investigation is to be undertaken within the Order limits as shown edged red in Drawing Nos 514451-MUH-00-ZZ-DR-GE-400197 to 514451-MUH-00-ZZ-DR-GE-400201 (Chapter 7 below) during the detailed design phase of the Scheme. Boreholes are also planned within the Bray Gravels SPZ, in order to aid the design process and allow further detailed hydrogeological risk assessments to be undertaken to verify the potential impacts



from migration of suspended solids/contaminants, which will then be mitigated via the measures discussed above in paragraphs 4.5.1 to 4.5.5.

- 4.5.7 To ensure the quality of the groundwater environment does not deteriorate during construction, mitigation measures will be employed as detailed in Chapter 9 (Geology and Soils) of the Outline Construction Environmental Management Plan ("CEMP") in Appendix 4.2A of the Environmental Statement (Application Document Reference 6-3, APP-293). These measures include a pollution control plan, standard best practices and relevant Pollution Prevention Guidelines ("PPGs"). The final CEMP is required, to be approved before construction of the Scheme commences pursuant to requirement 8 in the Development Consent Order ("DCO").
- 4.5.8 The contractor is required under requirement 8 in the DCO to comply with the requirements of the CEMP and prepare appropriate method statements and management plans detailing the approach to construction. These will include the control of site activities and the prevention of pollution by introducing measures such as:
- i) Providing a suitable construction site drainage system including cut-off ditches or drains with suitably sized treatment facilities such as settlement or detention basins;
  - ii) Ensuring that flow attenuation ponds, pollution control ponds, swales and oil interceptors required for the permanent works will be completed before the start of earthwork operations. Obtaining the necessary consents for any soakaway or filtration systems or to enable discharge of surface water runoff from the construction site to watercourses or foul sewers or disposal offsite;
  - iii) Putting in place appropriate measures such as use of bunds of non-erodible material or silt or sediment fences adjacent to watercourses;
  - iv) Implementing a surface water or groundwater monitoring plan, particularly in relation to works that could affect aquifers or drilling works; and
  - v) Adopting measures to comply with relevant PPGs: temporary construction methods and CIRIA publications (including 'Control of water pollution from construction sites. Guidance for consultants and contractors' (C532), 'Control of water pollution from linear construction projects. Technical guidance' (C648), 'Control of water pollution from linear construction projects. Site guide' (C649).
- 4.5.9 The contractor will comply with BS 6031 'Code of Practice for earthworks' regarding the general control of site drainage including, for example, all washings, dewatering, abstractions and surface water runoff, unless otherwise agreed by the employer's representative.

- 4.5.10 If any water abstraction is required as part of the construction process, the EA will be contacted and the appropriate licenses will be obtained. Any abstraction practices will be in accordance with the guidelines and requirements of these licences.
- 4.5.11 The contractor shall comply with The Control of Pollution (Oil Storage) (England) Regulations 2001 that apply in relation to storage of any oil-based materials including petrol, diesel, waste and vegetable and plant oil, but excluding uncut bitumen. Above ground fuel and oil storage tanks will also comply with PPG2 which sets out requirements including those relating to positioning, specification, capacity, secondary containment and ancillary equipment for storage tanks. Stationary plant used by the contractor will be fitted with measures such as drip trays to retain potential leakage of oil or fuel. The contractor will be required to empty trays at regular intervals to prevent overflow.
- 4.5.12 Specific method statements for works in sensitive locations, such as over or adjacent to watercourses, will also be produced. These will include details of the environmental protection measures to be implemented.
- 4.5.13 The CEMP will include an emergency preparedness and response plan. This will provide a full list of protocols and communication channels with the EA in the event of a pollution incident.
- 4.5.14 Any contractor will be required to demonstrate that all site managers, supervisors, foremen and operatives, together with security staff, will be provided with the relevant environmental training and awareness of site procedures and best construction practice.

## **4.6 Assessment of Residual Effects after Mitigation**

- 4.6.1 The implementation of the mitigation measures as detailed above and as appropriate to each area of the site will ensure that the potential impacts of the Scheme on the groundwater environment are minimised if not neutralised. The following table summarises the significance of the residual effects on the Bray Gravels SPZ only, given that the significance of effects on the Beenhams Heath SPZ were assessed to be neutral during construction of the Scheme.

Table 12: Significance of impacts following mitigation within the Bray Gravels SPZ

| Location   | Description   | Significance of Impact as derived in Table 11 | Mitigation  | Significance of Residual Effect |
|--|---|---|---|---------------------------------|
| <b>Gantries:</b><br>G6-10, G6-12 & G6-13                             | In-situ reinforced concrete bored piles located at isolated areas within <b>Inner Zone (Zone 1) of SPZ</b> .<br>Gantry foundations will be contained within Made Ground (associated with highway embankment construction) or River Terrace Deposits.                                | Moderate/ large                               | Minimisation of pile length and use of full permanent pile casings will minimise effects on groundwater.  | Neutral                         |
| <b>Monkey Island Overbridge</b>                                      | Construction of new bridge off-line. Bridge abutments will be sitting on concrete piles. Shallow founded wing walls. Re-aligned Monkey Island Lane will be held on un-reinforced embankments. Controlled demolition of old bridge. <b>Located within Inner Zone (Zone 1) of SPZ</b> | Large/very large                              | Careful management of construction site drainage (e.g. use of sediment traps etc.) will mitigate against the attendant risks.<br>Use of full permanent pile casings where piled structures are required will minimise effects on groundwater. | Neutral to Slight Adverse       |
| <b>Thames Bray Underbridge</b>                                       | Extension of existing underbridge. Underbridge abutments will be sitting on concrete piles. <b>Located within Inner Zone (Zone 1) of SPZ</b> .  | Large/very large                              | Careful management of construction site drainage (e.g. use of sediment traps etc.) will mitigate against the attendant risks.<br>Use of full permanent pile casings where piled structures are required will minimise effects on groundwater. | Neutral to Slight Adverse       |
| <b>Gantries:</b><br>G6-05, G6-06, G6-07, G6-08, G6-09, G6-14 & G6-15 | In-situ reinforced concrete bored piles located at isolated areas within <b>Outer Zone (Zone 2) of SPZ</b> .<br>Gantry foundations will be contained within Made Ground (associated with highway embankment construction) or River Terrace Deposits.                                | Slight/ moderate                              | Minimisation of pile length and use of full permanent pile casings will minimise effects on groundwater.  | Neutral                         |
| <b>Marsh Lane Overbridge</b>   | Controlled demolition of old bridge. Construction of new bridge on-line. Bridge abutments will be sitting on concrete piles. Shallow founded wing walls. Re-aligned Marsh Lane will be held on reinforced soil embankments. <b>Located within Outer Zone (Zone 2) of SPZ</b>        | Moderate/ large                               | Careful management of construction site drainage (e.g. use of sediment traps etc.) will mitigate against the attendant risks.<br>Use of full permanent pile casings where piled structures are required will minimise effects on groundwater. | Neutral to Slight Adverse       |

| Location   | Description   | Significance of Impact as derived in Table 11 | Mitigation  | Significance of Residual Effect |
|--|---|---|---|---------------------------------|
| <b>Gantries:</b><br>G6-04, G6-17,<br>G6-18 & G6-19   | In-situ reinforced concrete bored piles located at isolated areas within <b>Total Catchment Zone (Zone 3) of SPZ</b> .<br>Gantry foundations will be contained within Made Ground (associated with highway embankment construction) or River Terrace Deposits.  | Slight  | Minimisation of pile length and use of full permanent pile casings will minimise effects on groundwater.  | Neutral                         |
| <b>Ascot Road Overbridge</b>   | Construction of new bridge off-line. Bridge abutments will be sitting on concrete piles. Shallow founded wing walls. Re-aligned Ascot Road will be held on un-reinforced and reinforced soil embankments. Controlled demolition of old bridge. <b>Located within Total Catchment Zone (Zone 3) of SPZ</b> | Moderate                                      | Careful management of construction site drainage (e.g. use of sediment traps etc.) will mitigate against the attendant risks.<br>Use of full permanent pile casings where piled structures are required will minimise effects on groundwater. | Neutral to Slight Adverse       |
| <b>Note:</b> ERAs and Areas of Widening as detailed in Table 11 have not been included in this table as they were assessed in Table 11 as having a negligible impact and a neutral significance. |   |   |   |                                 |

- 4.6.2 The residual effects that could arise from construction of the Scheme have been set out in Table 12 above. On the whole, the overall significance of the effects can be seen to be neutral, although some slight adverse effects may occur. Any effects are expected to be temporary during the construction of the Scheme and will be further mitigated by the preparation and implementation of a surface and groundwater monitoring plan in and around the bridge sites where the greatest disturbance of the ground is likely, as required under the CEMP. This monitoring plan will be further enhanced by the instigation of an emergency preparedness and response plan. This will be required to provide a full list of protocols and communication channels with the Environment Agency and South East Water in the event of a pollution incident.
- 4.6.3 Following completion of the construction of the Scheme it is concluded that the residual effect on the SPZs during operation of the scheme will be neutral.

## 5 CONCLUSIONS

- 5.0.1 A hydrological risk assessment has been undertaken to ascertain the potential construction impacts of the Scheme on the Beenhams Heath SPZ and Brays Gravels SPZ. This has included a review of existing background data, borehole information and specific enquiries to local authorities flanking the Scheme with respect to Unlicensed Abstractors.
- 5.0.2 The assessment has determined that the construction proposals within the Beenhams Heath SPZ are likely to have a neutral significance impact. Within the Bray Gravels SPZ, the significance impact is likely to range between slight and large/very large.
- 5.0.3 The mitigation proposals put forward to manage the construction impacts within the Bray Gravels SPZ will significantly reduce these potential impacts to groundwater and surface waters (Table 12). Although the residual significance of the effect is assessed to be neutral to slight adverse during the temporary construction phase, the resulting permanent impact of the Scheme has been assessed as neutral.
- 5.0.4 Further ground investigations will be conducted within the Order limits to provide additional data for design purposes and to facilitate further verification impact assessments as the detailed design of the Scheme develops. The information obtained will be used to plan and design further appropriate mitigation measures.

## 6 REFERENCES

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Alliance 2015b. M4 Junctions 3 to 12 smart motorway. Approval in Principle: Design of replacement overbridge Monkey Island Lane (Structure Key: 979). Document No. 514451-MUH-ST-ZZ-RP-OB-300277.

Alliance 2015c. M4 Junctions 3 to 12 smart motorway. Approval in Principle: Design of replacement overbridge Marsh Lane (Structure Key: 977). Document No. 514451-MUH-ST-ZZ-RP-OB-300276.

Alliance 2015d. M4 Junctions 3 to 12 smart motorway. Approval in Principle: Assessment of Thames Bray Underbridge Widening (Structure Key: 978). Document No. 514451-MUH-ST-78-RP-UB-300002.



## 7 DRAWINGS

### Hydrological Risk Assessment Drawings

Drawing No. 514451-MUH-00-ZZ-DR-GE-400197 - Hydrological Risk Assessment – Beenhams Heath SPZ (Sheet 1 of 3)

Drawing No. 514451-MUH-00-ZZ-DR-GE-400198 - Hydrological Risk Assessment – Beenhams Heath SPZ (Sheet 2 of 3)

Drawing No. 514451-MUH-00-ZZ-DR-GE-400199 - Hydrological Risk Assessment – Beenhams Heath SPZ (Sheet 3 of 3)

Drawing No. 514451-MUH-00-ZZ-DR-GE-400200 - Hydrological Risk Assessment – Bray Gravels SPZ (Sheet 1 of 2)

Drawing No. 514451-MUH-00-ZZ-DR-GE-400201 - Hydrological Risk Assessment – Bray Gravels SPZ (Sheet 2 of 2)

### Gantry Drawings

Drawing No. 537806-MUH-ST-S3-AI-GN-500011 – MS4 Typical Verge and Layout Plan and Cross Section Option 1

Drawing No. 537806-MUH-ST-S3-AI-GN-500011 – MS4 Typical Verge and Layout Plan and Cross Section Option 2

Drawing No. 537806-MUH-ST-S3-AI-GN-500021 – MS3 Cantilever Gantry Typical Verge Layout Plan and Cross Section

Drawing No. 537806-MUH-ST-S3-AI-GN-500031 – Super Cantilever Gantry Typical Verge Layout Plan and Cross Section

Drawing No. 537806-MUH-ST-S3-AI-GN-500041 – Superspan Portal Gantry Typical Verge Layout Plan and Cross Section

Drawing No. 537806-MUH-ST-S3-AI-GN-500051 – ADS Cantilever Gantry Typical Verge Layout Plan and Cross Section

### Overbridge and Underbridge Drawings

Drawing No. 514451-MUH-ST-ZZ-RP-OB-300278-001 – Ascot Road Bridge Replacement Structure Key 986 General Arrangement Sheet 1 of 2

Drawing No. 514451-MUH-ST-ZZ-RP-OB-300278-002 – Ascot Road Bridge Replacement Structure Key 986 General Arrangement Sheet 2 of 2

Drawing No. 514451-MUH-SR-986-HW-GA-301001 – Side Road Alignment Ascot Road Proposed Off-line Option

Drawing No. 514451-MUH-ST-ZZ-RP-OB-300277-001 – Monkey Island Lane Bridge Replacement Structure Key 979 General Arrangement Sheet 1 of 2

Drawing No. 514451-MUH-ST-ZZ-RP-OB-300277-002 – Monkey Island Lane Bridge Replacement Structure Key 979 General Arrangement Sheet 2 of 2

Drawing No. 514451-MUH-SR-979-HW-GA-301002 – Side Road Alignment Monkey Island Lane Proposed Off-line Option

Drawing No. 514451-MUH-ST-ZZ-RP-OB-300276-001 – Marsh Lane Bridge Replacement Structure Key 977 General Arrangement Sheet 1 of 2

Drawing No. 514451-MUH-ST-ZZ-RP-OB-300276-002 – Marsh Lane Bridge Replacement Structure Key 977 General Arrangement Sheet 2 of 2

Drawing No. 514451-MUH-SR-977-HW-GA-301003 – Side Road Alignment Marsh Lane Proposed On-line Option

Drawing No. 514451-MUH-ST-S2-DR-UB-397801-2A – Thames Bray Underbridge Widening General Arrangement

Drawing No. 514451-MUH-ST-S2-DR-UB-397802-2A – Thames Bray Underbridge Widening Details

## **Annex A: Beenhams Heath SPZ Groundwater Boreholes**

**Borehole records and other ancillary information associated with the following wells:**

- **Beenhams Heath No. 1 Well; and**
- **Beenhams Heath No. 2 Well**

## **Annex B: Bray Gravels SPZ Groundwater Boreholes**

**Borehole records and other ancillary information associated with the following wells:**

- **Bray Gravels No. 1 Borehole,**
- **Bray Gravels No. 2 Borehole,**
- **Bray Gravels No. 3 Borehole,**
- **Bray Gravels No. 4 Borehole,**
- **Bray Gravels W1 (Bray North Site 1) Borehole,**
- **Bray Gravels W2 (Bray North Site 2) Borehole,**
- **Bray Gravels W3 (Bray North Site 3) Borehole,**
- **Bray Gravels W4 (Bray North Site 4) Borehole,**
- **Bray Gravels W5 (Bray North Site 5) Borehole,**
- **Bray Gravels W6 (Bray North Site 6) Borehole,**
- **Bray Gravels K (Bray North Site OBH K) Borehole; and**
- **Bray Gravels L (Bray North Site OBH L) Borehole**